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THE MACHINE TOOL INDUSTRY

by

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WHAT IS A MACHINE TOOL?

The Machine Tool Industry is the keystone of modern civilization. Machine tools are the master tools of industry. Machine tools perform the elementary operations necessary in making other machines out of metal. Without machine tools it would be impossible to produce most of our every day necessities and luxuries. These include not only those products on which metal parts are used, but include hundreds of other products, which seem to bear no relation to a machine tool. Automobiles, airplanes, agricultural implements, bicycles, business machines, ships, railroad trains, road building machinery, mining machinery, oil drilling and oil producing machinery, industrial and household electrical equipment, and utensils of many sorts are produced by machine tools, or else by machines which in turn are made on machine tools.

Forests are converted into lumber, paper, and rayon, by machines produced by machine tools. Food products, drugs, toilet articles, sanitary preparations, cigarettes and many other products of all kinds are made, packed and distributed by machinery or equipment which is made on machine tools. The printing press, radio, telephone, telegraph, and all instruments of communication owe their present form and efficiency largely to the machine tool.

Clothing is a product of textile machines and sewing machines, both of which are the products of the machine tool. Shoes, automobile tires, and leather and rubber products in great variety are available because of the machine tool. And finally, a machine tool is the only device which reproduces itself, for machine tools are made on machine tools.

Mass production as we know it today is made possible by the intensive development of the machine tool. Without mass production our standard of living would be that of a century ago.

With the aid of the relatively simple machine tools in use 30 years ago, before the days of mass production in the automobile industry, what was considered then a good automobile could be produced at a cost of about $3500.00. Today, due to the astounding improvements in machine tools, an automobile far better in every respect than the best automobiles of even 10 years ago can be produced and sold profitably at $600.00 or $700.00.

Without mass production, resulting from improved machine tools, typewriters which sell today at about $100.00 would cost a thousand dollars. An ordinary alarm clock would sell at $35.00 or more. Examples could be multiplied indefinitely. It is a

basic fact that mass production resulting from the use of modern machine tools has made hundreds of products available to all at moderate cost, and has thus provided work for millions who would necessarily be unemployed if production methods of half a century ago were still in operation.

The definition that is commonly accepted in this country of a machine tool is "a power-driven complete metal working machine, not portable by hand, having one or more tool or work holding devices, used for progressively removing metal in the form of chips." Lathes, planers and drill presses are common forms of machine tools. Grinding machines, honing and lapping machines are also included in this classification, although the chips removed are so fine they can only be seen under the microscope.

There are many other important metal working machines that are not classed as machine tools, such as punch presses, metal shears, rolling mills, stamping machines, and coining presses, as well as forging machines. None of these machines are considered machine tools because they do not remove metal in the form of chips.

A machine tool will take a bar or a block of metal, or a rough casting and by one of the various processes to be described, will machine the part to the shape required.

There are unlimited varieties and combinations of machine tools being made today. These tools range in size from small bench lathes to enormous machines which weigh up to 50 tons. They all operate on principles, however, that might be classed as the five basic arts of metal working. These five basic arts are the following

1. Milling, consisting of machining a piece of metal by feeding it past a rotating cutter with multiple cutting edges, known as a milling cutter. This process includes the hobbing of gears.

2. Planing, consisting of machining a surface by moving the work back and forth under a stationary cutting tool. This classification includes shaping, in which the tool moves in a straight line over the stationary piece of work, and includes slotting and broaching.

3. Turning, Which consists of shaping a rotating piece by means of a cutting tool, thus generating a cylindrical surface. This process is exemplified by the ordinary engine lathe, as well as by other forms of lathes, such as Turret Lathes, Automatic Lathes, single spindle automatic screw machines, multiple spindle bar machines, and multiple spindle chucking machines.

4. Boring, which consists of cutting a round hole by means of a rotating cutting tool. This process is exemplified by the ordinary drill press. This classification includes multiple spindle drilling machines, horizontal boring machines, and includes reaming and honing. Honing is used extensively in the finishing of automobile cylinder bores wherein the rotating cutting tool is a rotating head which carries abrasive sticks.

5. Grinding, which consists of shaping a piece by bringing it into contact with rotating abrasive wheels. This process may be internal grinding (as in grinding a hole), or external grinding (as in grinding the outside of a shaft), or surface grinding (as in grinding a flat surface). This process also includes polishing, buffing and lapping.

NATURE OF THE MACHINE TOOL INDUSTRY

The machine tool industry, as industries go in our country, is a comparatively small industry. Its importance to our national economy, its importance to our human welfare and its importance to our national defense, is out of all proportion to the dollar volume of its business, or the number of men employed. Compared with the steel industry, or the automobile industry, it is pretty small, as it employs approximately fifty or sixty thousand men under present conditions. The industry embraces about 250 companies. Many of these, however, only make an occasional machine tool. The distinctive machine tool building companies number only about 150. No one company employs more than about 5000 men, while the average company employs about 200 or 250 men.

The demand for machine tools fluctuates widely from year to year, and the capacity of the industry as a whole, of course, varies with the demand. The problems of the industry are severely complicated by this tremendous fluctuation in demand.

Location of Plants.

Most of the machine tool plants in the United States are located in the northwestern industrial section of the country, east of the Mississippi and north of the Ohio River. The industry got its start over a century ago in the industrial section of New England and a large portion of the machines made at that time were used for the purpose of making fire arms. As railroads were built in the east and were later pushed forward to the west, the metal working industries worked westward with them, and later skilled mechanics who had their preliminary training in New England, started plants at various points toward the west. About

the time of the Civil War certain plants started the manufacture of machine tools in Cincinnati, one of the principal machine tool centers. A little later other plants were started in Cleveland, Rochester, Rockford and Milwaukee. Many scattered plants are located in many of our larger cities, such as Philadelphia, Buffalo, Toledo, Detroit, Indianapolis and Chicago. In addition, a good many plants are located quite a ways from the centers of cities, and in small towns where many of the workers enjoy the privilege of owning their own farms.

Personnel.

By its very nature, the machine tool industry required personnel of the finest type. Its engineering staffs are confronted repeatedly with crucial problems which demand a high order of skill and training. There is no industry in which designing genius and the ability to build high performance into machines and equipment is of greater importance. The service rendered by the machine tools of today is ample evidence of the degree to which these machine tool staffs have fulfilled their responsibilities. The first concern of the machine tool industry is accuracy. It is obvious, therefore, that workers whose time is devoted to accurate performance, must be men of a superior type - intelligent, thorough, dependable and orderly. To these attributes must be added skill and training.

Machine tool plant mechanics constitute a group of workers which can hardly be matched in any other industry. The exacting demands for precision and performance of machine tools calls for handicraft of a superior order, the hands and brains of the builders are thus developed to a high degree and pride in work is a major attribute of all of these craftsmen, who have given extended service to the industry.

A large percentage of men in middle age, and men past middle age, with many years of service in machine tool plants, refutes the contention that there is no place in industry for men over 40.

The machine tool worker is not of a roving disposition and the great majority of the good workmen own their own homes. The machine tool builders have always maintained the policy of paying wages comparing very favorably with those paid in any other industry. The cleanliness, sanitation, and the lighting of the plants conform to the highest modern standards, as might be expected in an industry in which accuracy is the first consideration.

Under normal conditions, therefore, the turn-over rate of labor is unusually low.

However, extreme variations in the demand for machine tools creates a very difficult personnel problem. The gradual development of higher cutting speeds used, and refinement in the precision of the work to be done, make it increasingly important to have a large number of highly skilled mechanics available. Under favorable conditions the energies of the industry are directed to this end through intensive training of apprentices and learners.

When business falls off sharply, however, the machine tool builder maintains a nucleus of his older and more experienced, better trained men, if he can possibly afford to do so. It is, however, sometimes impossible for him to retain apprentices and learners who are in the process of training. After a depression, therefore, when business improves, it is very difficult to get back the men who have been released, with the result that training new men is necessary before a plant can be brought up to a high rate of activity again.

The machine tool field has always been an attractive one for young men of ingenuity, ambition and energy to go into. The training that many such men have had in our plants has fitted them admirably for work in many other plants, and many other industries. Many men who served their apprenticeship in our machine tool plants are now leading executives and keymen in automobile plants, refrigerator plants, in the electrical industry and textile industry, and many other industries. Many of the mechanics who have been trained in the machine tool plants have become machine operators and foremen in the plants of the machine tool company's customers using machine tools of the type on which the men were originally trained. In this way this industry does a tremendous service to all other industries in training and preparing men for carrying on the nation's production.

Among the large customers of the industry are the other machine tool builders.

Practically all operations in a machine tool plant are done on machine tools. The big base castings are machined on planers or milling machines, usually made by other machine tool builders. Gears, shafts and spindles are machined from bar stock, or from very high quality steel forgings on engine lathes, turret lathes or automatic lathes purchased from other machine tool builders. The gear teeth in gears have to be cut on other highly specialized machines, and various parts have to be drilled, bored and ground on machines made by still others. Years ago at one time in the industry, each machine tool builder made a great variety of machines, and made a large portion of the machines that he used in his own plant. No one company today however is able to do that. Only by specializing in the design and development and building

of one type of machine tool can the average machine tool builder survive today. Specialization has become highly developed in each individual plant, competition between machine tool builders is very keen, and only by specialization within a small field has any one machine tool builder been able to survive and develop the type of machine that could meet competition.

LIFE OF MACHINE TOOLS.

Like everything else, machine tools wear out. A very fine accurate tool room lathe which has been used for about ten years is no longer able to do fine precision work in spite of occasional overhauling. It might still be acceptable in some other department for rough work, and after a few years more it might be sold in the second hand market to a garage mechanic. A machine becomes less accurate as it grows older in service.

In addition to the loss of accuracy due to wear, machine tools become rapidly obsolete and out of date. New machines are continually being devised, which are so much more accurate and so much more productive than the older machines, that any one using older machines for production can no longer compete. The high wages that are being paid in all of our industries, here and abroad, today make it necessary to give our mechanics better tools to work with. Hardly any given model or design of machine remains fixed. Each machine tool builder is constantly improving the machine he makes. Machines that are over seven years old are quite apt to be obsolete. A good general rule to apply is that any machine that is ten years old should be investigated to see if it should not be replaced with a new one. In most cases, a new machine will pay for itself in the savings it makes over the old one in a very reasonable length of time.

This fact is not well recognized in a good many of our industries. It is found to be very true in our automobile industry, but throughout our other plants, in our Government arsenals and in our Government navy yards there are many machines still in operation that are so old and so obsolete that they can very economically be replaced by those of new and improved design. A study made by the American Machinist in 1935 shows about 65% of the machine tools in this country were more than ten years old. The percentage has not been substantially changed since that time.

DEVELOPMENT AND RESEARCH.

All of our plants building machine tools are constantly engaged in development work and research work, devising new machines that are great improvements over the older ones. The

Machine Tool Builders Association has periodically held a machine tool show at Cleveland, at which time the latest and most up to date machines of the industry have been exhibited in actual operation. Many of you, I hope, have had an opportunity to visit some of these remarkable shows. The last show of this kind was held in 1935, and all plans were made for another show to be held from October 4th to 14th of this year. The outbreak of the European War, with the constant flood of orders for machine tools from England and France, coming as it did at a time when there was a general improvement in domestic business in this country, which again made further demands for new machine tools, made it apparent that nobody could take time out for the machine tool show, so it unfortunately had to be cancelled. This periodic exhibition of machine tools of the industry in the large exhibition hall and annexes at Cleveland, has afforded American industry an excellent opportunity to keep posted on the developments in our industry, and I hope that all of you men will have an opportunity to visit Cleveland during the next show, which probably, however, will not be held until after the present emergency, due to the European War, is over.

Many new developments in the machine tool field have been made necessary in the last few years by the advent of carbide cutting tools. In order to use these tools properly and take the full advantage of them, machines of more rigid construction and capable of higher speeds and greater precision, have become necessary. Other developments have been made to allow all types of machines to do more accurate work in less time. These newer machines have been made more attractive in appearance, easier to operate, and in a good many cases have been made automatic, or semi-automatic, in many of their functions. Higher grade materials, anti-friction bearings, more thorough lubrication, heavier and more rigid elements have been used throughout to obtain better accuracy, combined with long life and greatly increased rates of production. Simplified electric drives, inbuilt electric controls, and the hydraulic operation of many functions have improved the character and efficiency of the machines tremendously. Machines are now capable of manufacturing parts to extremely close limits and at rates of production that were undreamed of a few years ago. The machine tool builder has come to recognize the great importance of the type of research, development and invention that has brought about these great changes, and most of the companies have specialized staffs, who are carrying this type of development work on continually. The great improvement in these machines makes it important for every manufacturer to study intensively the type of machines that are available to solve his problems. All the machine tool builders maintain engineering experts who are always ready to give prospective customers expert advice on the savings that can be accomplished with the latest type of machines they manufacture.

MARKETS.

As pointed out earlier the machine tool industry serves all industries making articles out of metal. Industrial development in the United States exceeds that in any other country. Next in industrial development are Germany and England. These three countries - the United States, Germany and England, are the only countries where any appreciable number of machine tools are made. The industry in the United States is much larger than in either England or Germany and our high production machines excell theirs in performance.

One of the chief reasons for this is the existence here of the largest single market in the world, namely our automobile industry. We make about four million motor cars a year, while England, which is next, has had a peak production of only 400,000. This huge market for automobiles has allowed our machine tool industry to develop high production machines that lead the world. The production problems involved in making this tremendous number of cars has been worked out largely by the American machine tool builder and it is he who largely deserves credit for the high production methods and high production machines made in this country today, which are capable of building automobiles so cheaply they can be sold throughout the world at prices much below those made elsewhere.

Since the start of the depression in 1930, Russia has bought American machine tools for making automobiles, tractors, farm implements and airplanes. The automobile and airplane industries in Japan, England and France have also been customers for this type of American machines. This export business of our industry has been greater in the last two years, chiefly due to the demand for building up airplane factories in England and France, and this demand has increased since the European War broke out.

In spite of this export business, the main interest of the machine tool builder and the largest demand for his product is in the domestic market. All machine tool builders today are giving preference to domestic orders. The industry is now running at a higher level of production than at any time since 1929. All companies I know of are allotting only a portion of their capacity to foreign orders, as they are all determined to reserve sufficient capacity to take care of the domestic demand on reasonable deliveries.

For a great many years this domestic business has been so poor that standard machine tools could be purchased either from stock or on very short notice. When the industry is running as full as it is today, these conditions necessarily are somewhat

changed. Anyone needing machine tools today must, therefore, plan to place orders further in advance than when our plants had very little to do, as in the past ten years.

Up until about a month or two ago, our National Machine Tool Builders Association published monthly reports on new orders in our industry. The new order curve plotted from this data over the past several years is shown by one of our charts. The tremendous fluctuation in demand represented by new orders over a period of years is indicated by this curve.

The Association has felt that this curve has never given a picture of the actual conditions in our industry comparable to the statistics published by other industries, so starting this year they have compiled the operating capacity curve shown by our second chart. This was released to the press the first time this month. The change in the rate of operation of our industry since the first of the year is well portrayed by this curve.

PROBLEMS OF NATIONAL DEFENSE.

I am sure you all recognize the importance of our industry to the problems of national defense. Machine tools have to be used for the production of all mechanized material used in modern warfare, including rifles, guns, tanks, airplanes and all sorts of munitions. Fortunately many of the existing plants outside the Government Arsenals and Navy Yards, can be used in times of National emergency for the production of many of these items with the use of existing machine tools.

In times of peace, machinery for making military and naval supplies represents only a very small portion of the industry's business. In the past, the demand for this type of machine has not arisen until we were in the midst of a conflict, with the result that the industry has been taxed for this vital machinery at the same time that there is a demand for many other types of machines. One of the greatest services the Congress, the Army and the Navy, and you gentlemen, could do our country, would be to keep our arsenals and our navy yards so well equipped in times of peace, that their equipment would be adequate when an emergency arose. Some appropriations have been made for this purpose in the last year or two, but I feel they are very inadequate.

For the last few years our industry has been discussing these problems of national defense with the Procurement Planning Division and other Government officials. This work has been handled by a Committee on Cooperation with Government Departments, and is made up of the last five presidents of our Association. This committee has been effective in bringing about

cooperation between the Association and the Government on many of these problems of National Defense.

One of the most serious problems among the many that face the Procurement Planning Division is the production of shells. Peacetime facilities can build up a moderate reserve and may meet a small part of war needs, but the quantities involved in war are so enormous that serious thoughts have been given to methods of production that can be quickly set up.

To give you some conception of the problem, in one group alone, the 3" group, comprising the 75 m/m and 81 m/m shell, it is estimated that 70,000,000 shells might be needed in one year, or a maximum production of 310,000 per day. The largest source of such shell during the World War produced 25,000 a day with 1400 men. You no doubt are familiar with the Frankford Arsenal's modern shell production line, representing the best shell production equipment which can be built today. Such a line produces shells with one-third the men, or less, used on the equipment utilized during the past war. This means a tremendous saving in man power and a tremendous saving in space, but to produce the quantities mentioned, which might be necessary in a modern war, 250 or 300 lines like the one at Frankford would be needed, running three eight hour shifts.

To meet this need, the Procurement Planning Division has a plan involving several steps.

First, by using the educational order method to develop our productive capacity for shell by encouraging the installation of modern shell machinery, like the Frankford line, in different plants, which would be available for immediate use if war emergency should arise, and by placing contracts under the appropriation now available for munitions to build up a reserve stock by the use of this equipment.

Second, in the event of an emergency, to improvise, adapt and rebuild existing equipment so as to step up production to the greatest possible extent in plants making oil field tools, pumps, railroad equipment and other items, not critically essential in time of war.

Third, by having a definite understanding with machine tool builders that on the outbreak of the emergency they will immediately undertake the greatest possible production of machines with the assurance that all they can possibly build will be taken as fast as they can produce them. Among these will be the highly production shell machines such as are being used at Frankford.

Fourth, by having sources outside of the machine tool industry produce large quantities of simple single-purpose shell machines suitable for belt or motor drive, for operation by women, which can be quickly installed. Such a machine as we have in mind would have one feed and one speed, with no refinements of design, possibly with a cast iron spindle, mounted in babbitt bearings.

The same need led to the development of such machines after we got into the last war, but it is far better that designs and patterns and sample machines be prepared and tested with the experience we have had since the World War before the emergency is on us.

The National Machine Tool Builders Association has just completed arrangements with the War Department to undertake the design of these single purpose machines, and has actually assigned men for this work. Sample machines are to be built and tested to check the design and performance. No further machines would be built until D-day. The manufacture of these machines would then be put into metal working plants not engaged in other essential work. They would not be built by the machine tool industry, all of whose capacity would be devoted to making the more refined type of machine tools needed for other essential items. Gradually, as the machine tool industry was able to handle the problem, highly productive shell machines like those in the Frankford line would replace these simple single-purpose machines, resulting in tremendous saving in men and space. The essential purpose of these simple machines would have been served to secure an immediate output of enormous quantities of shells.

Our Association hopes that the development of these emergency single purpose machines will prove of substantial assistance to the War Department in meeting its greatest single problem.

In time of a national emergency the industries which are the machine tool industries best customers are the very ones the Government would be dependent upon for greatly increased production. At such a time our industry would therefore be called upon to furnish an increased number of tools to these industries, as well as to the Government.

The domestic and export business we are obtaining today is enabling us to increase our facilities and train an increased number of men so that we are getting in much better condition to meet problems of national defense should a conflict by chance ever be forced upon us.

Needless to say, all members of our industry hope fervently that no such emergency will ever arise.

Although our industry has such an important relation to national defense, the machine tool builders of this country are absolutely and unalterably opposed to war, and will cooperate to the fullest extent in helping in any way to keep this country out of war. We know, just as you gentlemen do, that war can result only in a terrible loss and disaster to victor and vanquished alike.

The welfare and prosperity of our industry are part and parcel of the normal peacetime welfare and prosperity of our country as a whole. Our industry's social and economic responsibility is the making of machinery for the production of those things which make a happier and a better life for all. It is the foundation of our industrial development which has made the standard of living in the United States of America the highest standard of living the world has ever known.

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DISCUSSION

following lecture by
Mr. J. E. Lovely, President
National Machine Tool Builders' Association

November 27, 1939

Q. Mr. Lovely, I would like to get you to tell us a little about how machine tools are made, that is, to the extent in which jigs and fixtures are used, and whether the standard tools that obviously those would be used for would cause us any difficulty in wartime, and then comment on the big heavy things like big boring mills for turrets and gun boring machines and such things as that. Do you see what I mean?

A. The smaller types of machine tools are made very extensively with jigs and fixtures. It would probably take five times as many hours to make the small ones without jigs and fixtures as it takes with them. There is tremendous competition in the making of such stuff. The larger machine tools, however, are not made to such an extent with jigs and fixtures, --large planers and large boring mills-- but, on the other hand, they require tremendous big machines for the handling of the parts involved. Those machines are never made except to order, and that being the case, you might almost class these big machines as jigs and fixtures--in the same category as jigs and fixtures. Those large machines are often the types that are used for making these various machines themselves. They have a habit of being of such a nature that they reproduce themselves. These single-purpose, single-shell lathes that we are talking about, are lathes that would be of the type that would be so simple that there would be very little machine work on them and very little in the nature of jigs and fixtures. The machines that

were made by Simon & Carr Foundry Company in the last war and by Yeomans' are the type that we are thinking of. They are not accurate enough, not suited at all for fine work on airplane parts but they would be perfectly justified in using them for shells. I think that one of the best developments that has occurred in the manufacture of shells is the forging of cavities to size. I know that some people in this country think that that is a refined art, that it would be difficult for us to get many people to forge shells in such a refined way as to have those cavities come as nicely as Bethlehem and some of the other companies that are doing that now, but I am inclined to think that it is a matter of knowing how and that that knowledge could be obtained from these places, and the saving in labor in making shells that way is, of course, tremendous. I don't know whether I have answered your question.

Q. Do you suppose that Sellers and people like that have patterns for their big machines?

A. Yes, but I presume quite probably that they have only one set of patterns. The patterns could be made rather quickly. I think that the War Department has recognized that situation on big machines and has placed orders for machines of that type that Sellers and Niles make. I think they were the first ones in the country to be really very busy. Those machines are the machines that I feel we should have available at all times. I think that our Government ought to recognize the fact that it takes a long time to make those big machines and that your Navy Yards and your arsenals ought to be well equipped with that kind of equipment. That stuff ought to be kept up.

1:12 pm

Q. Mr. Lovely, I have two questions I would like to ask. In relation to your capacity index, which I understand is about 85%, that is one shift. Would it be possible to have three shifts on a machine?

A. Well, I will tell you, all of our plants have had the experience of having their product changed so rapidly that there are definite bottlenecks scattered through, and some of these have ended those bottlenecks running 24 hours a day, even when business was as it was down in here or as it was along in here (indicating on chart). We have gotten away from that one shift and I presume the reason for it is that it takes a long time to get the necessary machinery after a demand is developed, and then we look back to see whether we are apt to have that demand continue, and past performance indicates that we are not. We are not apt to want to dip into our capital and by machinery that we could never pay for on any business that is in sight. This capacity index is based on a total number of direct labor hours and it is compared to the maximum total of direct labor hours of each individual plant in the past, taking the performance since 1926. Now there are some of these plants that are represented in this aggregate chart that are operating at a higher rate of capacity than they ever did before, while some of the others only operate on a 30 or 40% of capacity. No one holds down to a single shift capacity today. The cost of getting all of your operations going for the kind of product you are putting out at any one time would not balance it.

Q. Considering a national emergency and a national emergency of unknown length, probably 2 or 3 years, in relation to plans —we plan a great deal in the Armed Services for industry— has the National

Association of Machine Tool Builders any plans where it could expand any of the present plans that would facilitate the delivery of machine tools?

A. The Association has not felt the necessity of getting into that particular problem. Right now what is happening, though, is that some companies, who are having a demand for something that they are not equipped to make, let those parts outside. There are other plants in the country that can make certain individual items. They call on them for help. They will run their plant full capacity for doing that. It is a lot easier to have those plants made under your own company, though.

Q. Mr. Lovely, is there any special idea of how you should select labor for the Machine Tool Industry from your reservoir?

A. I think that the industrial activity of the country in the last few years has been large enough so that there haven't been or are today any real skilled mechanics that are out of work. Increasing the number of men now means training green men. If a man comes to our plant today—my own plant—and says that he has had a lot of experience, we wonder what is the matter with him. We think he hasn't been able to get along somewhere else. A fellow who is a good husky, intelligent looking man, who has come off the farm and had to tinker up his own car and make a lot of his own stuff would be a better mechanic than one who may have had some experience. We have different classes of labor, of course, in our plants. Some of them merely have to learn limited operations like, perhaps, running a drill press, which is not a difficult thing to learn to do. You can make an operator for such a machine of a green man in perhaps a few months time. We put green men on a machine like that with

a skilled man and let them stay there for some weeks watching the other fellow at first and then gradually doing a little of the work. Then we only give them the poorer work for a while. It is about the quickest way of increasing your force—make new men. It is an expensive proposition.

Q. In relation to selective draft machine tool labor might be excluded from the draft. If you needed to expand immediately, would you have a special type of person like a high school graduate, a college graduate, a farmer — what type?

A. I don't know as I have any definite answer for that. I don't think that we have many college men who make good mechanics. Usually if they have the ability to use their heads as well as their hands we have a place in our organization for them on planning. If a college man can get a better job somewhere else he will take it. You can't run your plant entirely with college men. They would all want to be head of the company. I think that some years ago the realization was forced upon me that there is only about 5% of the people in this country anyway that want to take responsibility. I remember a fellow shoveling sand. I had some connection with stone work and there was an operation that didn't look any more difficult than shoveling sand--putting blocks of marble on a running belt so that the surface would be smoothed. I put him on that job but he stood it about two days. Then he got so nervous he had to go back to his old job. I think we have so many different types of jobs in a machine tool plant that we can use intelligent capable men who are in good health and quite a number of them. They all have to have training. The time element is the thing that is bad.

Colonel Miles: Do you think the disposition on the part of men to be trained along mechanical lines has grown or decreased over the past decade?

A. I don't think it has changed much. I remember I had an old 1916 roadster and after I'd had it a while, about every time I used it I had to "get out and get under". I think a lot of other people that ran automobiles at that time before they got into a machine tool plant were forced to know more about machinery than they do today. Those fellows that get a piece of junk — a broken down car — are more apt to learn something about handling their hands than those that buy a new one.

Q. How about the machine tool industry of Japan? Considering England and Germany as out of the picture so far as supplying those tools ~~are~~ is concerned, have our orders increased to Japan? Are they greatly dependent on the United States?

A. They are quite dependent on us. As a matter of fact, they have been buying more tools, I think, of the type that they are using now largely for planes and automobiles from the United States than they have from Germany and England. I would say that they got the shipbuilding machinery and the machines used for big guns, stuff of that kind, almost entirely from Germany. They have in the past. And they were starting to get some of their smaller machinery from Germany before the war broke out. I know of some orders that they attempted to transfer to this country, after the war broke out because they couldn't get them from Germany. I suppose there is a way across the Trans-Siberian Railroad, but they tell me it takes months to get a shipment across that

railroad. Japan was quite a large customer of machinery from this country last year, but they are not getting anything like the amount that is being ordered by England and France, and I think that though we are still a neutral nation, there are a good many of us who feel we prefer shipping machine tools to England and France than we would to Japan. On the other hand, we realize there is really no appreciable machine tool industry in Japan and Japan is more apt to be a customer in the future than England is, for instance. England has a large industry herself and she hates to buy anything outside of her own country.

Q. I think I understood you to say that most of your highly skilled people were over 40?

A. No, I won't say that. Most of our highly skilled people are, but part of them aren't.

Q. Would you expect any greater number in case of voluntary enlistments?

A. You see, our highly skilled men that are over 40 are those who have been with us for a long number of years. The newer men are mostly younger men. If a man gets established in life somewhere or other and has something to do he doesn't ordinarily change, so that the new men coming into our industry are not the older men, but they are the young men. Possibly my own plant might illustrate the point. In the early part of 1937, I think it was—no, 1936 -- there was quite a little slump in through here — about 1935 — you see, we are just coming up from this depression, we had about 300 men in our shop force at that time. Well, now, out of those I would say that perhaps half of them

might be over 40, but since then we have added probably 7 or 8 hundred men, and a large proportion of those fellows are younger men. They are men that now have had two or three years training. We also hope that men that we are taking in will make their life work with us. That is, we are putting in a long number of years with them to make them good for something. We hope that they are going to stay and we are more apt to take those younger men in than we are older men. But after a man has been established in the company and has proven his usefulness he isn't laid off because he grows old in the business. We have a number of men who are up in the 70's. There is one man that I know of who is 85. I happened to be out to dinner with him out in the country last Sunday and he did all the chopping of wood out there. There are a number of younger men there but he chopped the wood and made the fires. We have got a few men who have served 50 years in our company, and that is typical of other companies in the industry. You see, unfortunately, when the depression comes, we naturally lay off those who are of the lesser value to us, and that tends to take off these younger men who haven't had much training. We have a feeling of responsibility for the older men. They have loyalty to us that the younger ones haven't, so we tend to keep our older men through the depression, but when we really get active we are very dependent on those younger men who have been with us from six months up to a couple of years. If we lose those it merely means starting over again and a very serious loss in production as a result.

Q. Would you care to say a little bit about the organized labor situation in the industry.

A. I think the industry is less affected by organized labor than any industry. There are a few plants where the men are organized, but I think there are more plants that are non-union. I believe that the reason for this is — this is just my personal opinion — that the union does more for those industries that are made up more of unskilled men whose importance to the company can be graded more in a uniform way. Our men vary so greatly in pay from those that are starting to those that are most skilled. The most skilled workers are getting wages so high that they are not interested in anything that a group as a whole would offer them. They are more individualistic. A lot of plants that have been organized for a while go through periods when the men seem to fall away from the union. I think the labor movement in the country in the last few years has probably brought more men in our industry into unions than there were just before, but I think there was a period, well, the period when the A.F.L. was quite active in the machine tool industry, I think it might have been 20 years ago, before the war. I don't know but that the larger proportion might have been organized then than there are now. It isn't a problem that seems to be a very acute one.

Q. You stated the number one bottleneck in time of actual emergency to be the skilled labor problem, and you stated that your committee of cooperation with the Government has recommended as the solution for the problem the establishment of some kind of service organization which would put the men now in the machine tool industry automatically into a status of wartime service, you might say, right in the machine tool industry, and the Selective Service would consider carefully

each individual case before they made a decision as to whether or not they would be released from the machine tool industry to other service. Could you give us what you would consider as other bottlenecks besides this skilled labor bottleneck and your recommended solutions of those?

A. Well, of course, new machine tools themselves are bottlenecks, but I think one of the other bottlenecks is the number of men you have available and, probably, the number of machine tools that you have in a plant. Most of our plants are operating in such a manner that they are not completely balanced all the time. Hardly any plant that I know of is a completely balanced unit. I know that in Germany some utilization was made of that. A man organized a business of building machine tools on his own. He sublet those parts, that is, he had this little piece made by one machine tool company and that piece made by another. I don't know whether that is feasible. It is awfully difficult to plan the program of work through a machine tool plant, because the modern machine tool is made of so many intricate different pieces. Instead of having a single line of machinery for producing one component, you may have a thousand different pieces that are made in a comparatively small plant, so that it is hard work to say what machine will be available a month from now. You know from your past performance about how it runs and if you change the nature of the product going through the plant it is difficult to analyze what that will do to the output of the plant. The safest way to do is to go by what your past performance has been and duplicate that performance or increase it somewhat. I have a feeling that our industry is much larger here in

proportion to the use that we would make of it than the industries in England or Germany. At the bottom of the depression our industry was operating about 15% of what was considered the normal capacity, and that is only 6 or 8% of the capacity that we have reached since. One of my friends over in England felt very badly because he said they were way down to 40% capacity, but our industry is over-expanded to our normal needs more than in other countries. It is just a characteristic of the average American, I think, to overdo everything he tackles.

Colonel Miles And his willingness to take a chance. We will have to close the questions from the class. Are there any questions from any of our guests or from the faculty? Mr. Burna, have you anything that you would like to say?

Mr. Lovely I think I might have surrendered to you a little while ago, Mr. Burna. I think you might add something to the discussion that maybe I failed to give.

Mr. Burna. I've been sitting here wondering what you had left for me to say if I were called upon. I might say, though, Mr. Lovely, we made a spot check about this question of men who might be taken by the draft, and while it isn't an accurate statement and shouldn't be taken too seriously, it would seem about 15% of the employees in the typical machine tool plant are between 21 and 30 years old, and who would be in the first class. We have been trying to figure out what type of employee we wouldn't mind losing, but there has been some confusion and it is hard to say. We would like to have them all for a period sufficient to allow for training. For instance, a crane operator isn't a particularly skilled man, yet, as a matter of safety for the men under him, we

like to keep a man that is good. Then, too, he can save a whale of a lot of time in putting work on machines. A sweeper isn't a skilled man, but he knows his way around a plant and he knows where raw materials are, etc. So that/that question of how many of our men we could afford to give up we would answer by saying "None". As to the matter of bottlenecks, we would strike first the difficulty of finding trained men in our own plants willing to take responsibility.

Mr. Lovely That is a very distinct bottleneck and the men above him, too, are more difficult to get. You overload your key men. I know of a good many plants which are not going outside to get stuff who might go outside if they had good men who knew their business who could supervise the work that was done outside. There is a very small proportion of men that know enough about the business to go out to import knowledge to another organization and to pass judgment on what the other organization does. We need those fellows so much in our plants that maybe they are one of the chief bottlenecks. Of course, the more brilliant younger men are being developed. We are surprised ourselves sometimes that a fellow really has a lot of ability way down the line where he hasn't had an opportunity to show what he can do.

Colonel Miles If there are no further questions I think we will close the meeting and thank Mr. Lovely for his fine talk which has opened up a better view of the machine tool industry than we could possibly have otherwise. Thank you very much, sir.