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MOTION-TIME-ANALYSIS AND THE ARMY

by

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MOTION-TIME-ANALYSIS AND THE ARMY

Mr. Chairman and members of The Army Industrial College

I am proud, this morning, to be talking to a group of administrators. Naturally, all administrators are interested in discovering some definite rules which will guide them in their job of administration. Specific rules for administration are very few. Some 2,000 years ago the most successful organizer laid down one such rule. It was, "He who would be greatest among you let him be your servant."

Now to go to civilian industry. Let us see what this means to any manufacturing concern. Since the Army travels on its stomach, suppose we consider a meat packing plant and to be more specific, suppose we state that this plant belongs to Swift & Company. Out on the farms of Iowa, Illinois and Wisconsin are cattle, hogs, and sheep. Out in the homes of New York, Boston, Philadelphia, and Chicago are housewives in homes who need those cattle, hogs, and sheep in the form of food for their tables, shoes for their children, gloves for their hands, and clothing to keep their families warm. Now if the cattle, hogs and sheep from the farms can be brought to the homes who need these cattle, hogs and sheep better or cheaper by reason of the existence of Swift & Company, then there is a reason for the existence of Swift & Company. If, for any reason, these cattle, hogs and sheep can be placed through the market better or cheaper without Swift & Company then Swift & Company will cease to exist.

Putting the matter in another way. Down on the South side of Chicago are men with skill for sale. Likewise, out in the homes are people who need that skill in the form of meat for the table, wool for the clothing, and soap for their bathrooms. If this skill can be marketed to a better advantage by reason of the existence of Swift & Company, then again there is a reason for the existence of Swift & Company and the Company can prosper and grow. But, if this skill can be marketed to a better advantage without Swift & Company, then Swift & Company will cease to exist.

Now, on the inside of the plant, if by reason of the existence of the sales manager, the production manager, the master mechanic, or any other officer in Swift & Company, these workers can do a better job of serving humanity by moving the products from the farm to the homes of the nation, then there is a reason for the existence of these divisions of the management. If, for any reason, the job can be as well or better done without the existence of these divisions of management, then these particular individuals will cease to exist in so far as Swift & Company are concerned. It is the old service law in operation for each company, and each member of that company--it is a question of serve or die. In the long run the law is as inexorable as the law of gravity.

Now let us consider the same rule from the standpoint of the various units of our national defense.

Out in this great broad country of ours are some millions of homes. In these homes there are some millions of people needing protection from potential enemies without and within. Now, only because that protection can be furnished better or cheaper to each family by reason of the various branches of the service as the Army and Navy there is a reason for the existence of the Army and Navy.

If, now, we look still further, we discover that the officers and the soldiers of the Army are the ones who must in the end perform this duty for society. If that duty can be better performed by reason of the various departments such as the Quartermaster's Department, the Ordnance Department, and other units, then there is a reason for each of these departments and they will be retained. But, if the time should ever arrive that that service can be performed as well or better without the existence of these departments or units, it is only a question of time when they will disappear. Now, if we look to the officers, we discover that we have commissioned officers varying from Lieutenants to Generals, and noncommissioned officers varying from Sergeants of various grades down to Corporals. Now, following the old service law, if the soldiers on the field can perform their service to society to a better advantage by reason of the existence of these officers, or any one of them, then there is a reason for the officers to retain their places. But, if this can be performed just as well without any one of the officers, then it is only a question of time until the duties of that officer are no longer required.

Now, in certain branches of civilian life a knowledge of the fundamentals of skill enables the supervision, especially in manufacturing, to render a much better service in industry than they were able to render before For about 25 years that has been my field. During a majority of that time I have had a fairly large corps of engineers working with me. We have had anything from one to a hundred engineers investigating various phases of this problem and during that twenty-five years the findings of these engineers have been clearing across my desk. Regardless of how dumb I might be, the engineers would learn a few things in twenty-five years. Before me, others had been investigating the various fundamentals of skill. From the work of the entire group many lessons have been learned. Among the most important are:

1. There are only seventeen motions ever used in industry. Regardless of what you may be doing or how you are doing it, whether you be in the Army or in industry, whether you be in a steel mill or a flour mill, you are simply going through a combination of some of these seventeen motions.

2. The variables of each one of these motions, when taken by themselves, are controlled by definite mathematical laws.

3. The proper combination of these motions into a cycle that we call either an industrial operation or an Army operation, is controlled by definite mathematical laws. These mathematical laws are constant throughout industry.

4. The time required by all experts to perform a fundamental motion is a constant. In other words, all this supposed difference in speed between the citizens of various countries and climates and men and women does not exist within manufacturing limits. There is a difference in speed at times between different individuals, but that difference is generally occasioned by the difference in the number of motions used to accomplish a given result and not in the speed of each motion.

I believe that we can illustrate that point very well this morning. I imagine that for anyone here the job that you can do better than any other one thing is writing your name. I wonder if someone here will just write his name on a piece of paper and hand it to me. I don't care to see you write it. Just let me know when you are ready. Now, when you wrote your name all that you did was to go through a set of fundamental motions at which you are an expert. When you held the pencil as you went through that set of motions you gave me a record of those motions, didn't you? So that if the time required of all experts to perform a fundamental motion should be constant, if I know the constants, I should be able to add up these constants and to tell you how long it took you to write your name even though I did not see you write it, shouldn't I? All right, let's see. (Check up the signature. Have him write his name one minute full speed then at slow speed. Make a comparison of the two and check out the time for writing their initials rather than by writing their name.)

Now, you can see that if I were interested in finding a wage payment plan, a method of driving or a method of regulations by which I could drive to the last drop of blood, I would only stand to save a fraction of a cent per hundred signatures in writing names, wouldn't I? If I reduced the number of motions that enter into the signature I have a chance to save several cents per hundred signatures in writing the name. I wonder if I could illustrate the principle in another way? I wonder if you would light a match for me? As you light the match keep track of the number of motions you go through in lighting that match. (Have him light the ordinary type of match.) All right, how many motions did you get? (Take his answer) Now, I wonder if you would light a match? (Give him the Pull-Quick) Suppose our job were that of lighting matches. Let us assume that you have the Pull-Quick package and that I have the ordinary package. How much chance would I have to compete with you in lighting matches? Would it make any difference how hard I might work or how lazy you might be? You would still have me beaten. Now in Publication #598 - 74th Congress and in Publication #636 - 74th Congress, we find:

"No part of the appropriations made in this Act shall be available for the salary or pay of any officer, manager, superintendent, foreman, or other person having charge of the work of any employee of the United States Government while making or causing to be made with a stop watch, or other time-measuring device, a time study of any job of any such

employee between the starting and completion thereof, or of the movements made in this Act be available to pay any premiums or bonus or cash reward to any employee in addition to his regular wages, except for suggestions resulting in improvements or economy in the operation of any Government Plant."

I will call your attention to the fact that I did not use a stopwatch to tell you how many signatures you could write in one minute. In actual practice we do not use a watch or any other timing device to determine how long a job will take. Knowing the number and kind of motion, we know the time.

Again Motion-Time-Analysis is not generally concerned with the payment of premiums bonuses or cash rewards. We are not interested in the effort put into the job. We are interested in the intelligence shown on the job.

There is so much more to be accomplished by reducing the number of motions that enter into a job than there is in the speeding up of the motions that it does not need to speed them up. The body tends to be self-timing. So long as you can get the methods followed, the output will necessarily be about a constant figure. The difficulty is in getting the methods followed. For that reason, you are primarily interested in methods whereby the habits of the worker or soldier may be followed around proper motion paths. Such a training program is in no way affected by the Act of Congress above referred to. Furthermore, there has never been any demand on the part of any labor union in any plant at any time for the elimination of Motion-Time-Analysis. These labor people who become sufficiently well acquainted with Motion-Time-Analysis to make an intelligent demand for its elimination become enthusiastic about Motion-Time-Analysis and demand for elimination never materializes.

What does this all mean in the life of the Army? Let us consider the safety program in firing for instance. Again allow me to take an illustration from civilian industry.

I imagine that most of you are familiar with the second operation punch press work where I take a piece which has been cut out as a blank. (Illustrate with a key) I place it on a die and a heavy punch descends upon the piece and they form it, stretch it, pierce it, trim it or any one of a dozen different things. The hand is supposed to be removed befor the punch comes down to perform the operation. The difficulty has always been that the hands do not always get out of the way. The results are apt to be missing fingers, hands and arms. Consequently, safety guards have been placed on the press such as:

1. Sweeps that push the hands away.
2. Buttons to push outside the path of the press.
3. Ropes that pull the hands away by the time the punch descends.

The difficulties are that these safety devices do not always operate properly and that the operators still lose hands and arms. Each of these devices costsmoney to install and to operate. The speed of the punch press operation on second operation work is limited by reason of these devices to from 600 to 1500 per hour. The design of these devices has never attacked the real problem as I will try to illustrate.

This job was studied from the standpoint of Motion-Time-Analysis. Obviously, the best approach was to prevent the hand from reaching the danger zone, load the piece outside the die, fence off the die completely. As soon as that is done the speed of the operation is immediately raised from an average of 1,000 per hour to an average of 2,200 per hour. The expense for doing such loading need not be any greater than the expense for providing the ordinary safety device. There are two methods of doing the job. One by means of the slide feed where you are using a close limit die and the other by means of a hand-operated die where you are using a rough limit die. The surprising thing was that when the patents were applied for on the slide device, twenty out of twenty-two claims were granted immediately because no one had ever thought to attack the safety device on a punch press on this particular angle.

I imagine in firing that you will find unsafe conditions are due to:

1. A faulty motion set up in the firing program itself.
2. Lack of understanding of the proper use of the set-up that has been made.
3. A misuse of the prescribed method on the part of the person using the set-up at the time the accident occurred.

If you can attack a problem at its source and eliminate the cause of the faulty set-up, you can probably increase the speed of firing at the same time. In fact, it is my understanding that at one Army Post the rate of fire has already been increased by means of a careful analysis of the motions, but without the use of mathematics.

A large rubber company is located next door to the Watertown Arsenal. The man in charge of manufacturing of this rubber company is Raymond Blanchard. Mr. Blanchard decided to study the motion patns required in the manufacture of rubber shoes. He discovered over a period of three years that about 30% of the motions used in the plant were useless motions. It was necessary to tolerate a very unstable labor relation due to the fact that there were many different types of shoes to build. Each type of shoe required a different group of skilled workers in order to make the shoe. The time required to train a skilled shoe worker on a single line of shoes varied from four months to two years. In figuring the output from the making conveyors 2½% were rejections due to poor quality of workmanship. All of these conditions existed in one of the best organized and best managed shoe companies in the United States.

When the present motion paths were analyzed the reasons for each set of losses were first determined and means were invented to eliminate these particular lost motions. A sample conveyor was set up based on the ideal motion path with the waste motions eliminated. The number of people required to build the same quality of shoes per day was reduced by 30%. But the new method required much closer attention to all details than was required under the old method. The question came up as to how to control these details. The problem was solved in a very thorough manner.

Every foreman, subforeman, time study man, or anyone else responsible for quality or quantity of production in that plant was taught Motion-Time-Analysis. Their own teaching staff was developed. An analysis was made of every new shoe which came into the plant and the correct motion path for building that shoe was worked out and laid out on the conveyor. They very quickly discovered that there were certain motion paths which predominated in all shoes.

The next move was to train an instruction class to teach the operators how to build shoes. This was done by making instructors out of from 5 to 10% of the piece work operators. These operators were taught how to describe the proper motion paths. They were taught how to put it in plain English that the average operator could understand. When there is no new instruction to be given, all of these special operators, aids, so-called, work on the conveyors as piece work operators. They receive the same piece rates as any other operator in the plant. Consequently, there is no overhead charge added during ordinary times.

But when a new operator is hired, the new operator is not assigned to a conveyor to build shoes. The new operator is assigned to a certain instructor who is next in line and selected by reason of the ability to teach other operators. This instructor first takes from half a day to a day to teach the beginner the Hood Rubber Company. They are given a thorough instruction in the location of the wash rooms, pension system, the payroll system and everything else regarding the ordinary routine affairs of the company. They then go into a room which is about ten by twelve. In this room are located the fixtures which are ordinarily used for building shoes. The instructor then goes through the exact method required for doing the job to which the novice is to be assigned. The motion path itself may not require to exceed ten seconds but the instructor may take a full half day to a day to explain every motion required in going through this operation. Furthermore, the reason is given for every motion as the instructor goes through it. Then the operator is closely questioned continually to make sure that he or she understands the instructions that are being given. The teacher knows the time required on each of these motions but no mention is made of time while they are talking to the new operator. Quality requirements are stressed along with each description. When the novice has seen the job gone through, motion by motion, the instructor then goes through it at full speed once or twice to let them see what the job actually is.

The novice then attempts to train the instructor and to go over this motion path again. They keep on trying until they are able to give a correct description to the instructor and to go through the job properly. By this time, they have begun to gain some facility in doing the job. This stage may take from a half a day to two or three days. It is never short circuited. Either the operators know what they are going to do or they never go into the factory.

They are next taken to the line. The instructor is an expert operator. Whatever production the novice cannot turn out, the instructor turns out for them. The novice is instructed never to hurry but to do the job accurately. The result is that in a remarkably short time the novice is keeping up with the conveyor. The instructor then leaves them for perhaps a half an hour to an hour and comes back to see whether they are performing the job properly. If not, they are again instructed in those features which they have missed. This instruction keeps up, with the time between visits being gradually prolonged and until perhaps about two weeks have elapsed. At the end of two weeks the average operator has reached full speed production. In other words, they have obtained a speed which is about 25 to 30% greater than they ever attained before in from one to two years.

But the important feature is that the $2\frac{1}{2}\%$ quality allowance has been reduced to $1\frac{1}{2}\%$, and the $1\frac{1}{2}\%$ is being easily met. Operators state that the work is very much easier under the new scheme than it was under the old because they no longer need to worry about the quality of the job they are turning out. They know that if they go through the motions properly they will have the right results. Fear is removed and production takes its place.

It is no longer necessary to change crews between rubber shoes, tennis shoes or boots. The same crew is used the year around. Training now takes place so rapidly that the hiring in of especially skilled workers has disappeared. A flexibility of production is attained which was never possible before. The labor force is far more contented under the new plan. The loyalty to the company is never questioned.

As a side issue to the training program, I might mention a few other things that took place at this rubber company. When the personnel department selects workers, they no longer select almost anyone who comes into the employment office. Since they are not called upon to select especially for skill, they put their attention into mental and physical traits which are required for a good plant operator. Since they know the motion paths that these operators must go through they likewise know what physical traits they must select.

Complaints which formerly flooded the personnel department bother them no more. The operators understand how the jobs are built up. If something goes wrong with the job they do not run to the personnel department immediately with the grievance, but they work with the foreman

in trying to find out what is wrong with the way the motion path works. The foreman likewise knows how the motion paths are built up. He has nothing to cover up by taking a brusque attitude. Therefore, he is highly sympathetic with the workers viewpoint. The two working together are generally able to work out most of the job difficulties before the personnel department or the higher supervision ever hears of it. As an illustration. In lasting shoes, it became necessary to get more production out per conveyor. The jobs were subdivided so as to use more workers on the conveyor, but when they were subdivided some of the girls' fingers began to crack open and bleed. It was soon discovered that the reason was that in the former job heavy pulling required on the part of these fingers had been diluted with other work. When the jobs were subdivided all this pulling was thrown onto one girl. The solution was very simple. Instead of pulling altogether with the thumb and first finger, it was pulled the first time with the thumb and first finger and the second time with the thumb and second finger, then back again. This corrected the cracking of the fingers. Everybody was happy.

One of the product designers checked over the motion paths required to make a shoe. He found that one of his requirements was forcing a marked increase in the time required to perform the operation. He immediately set about to change the design of the shoe so as to eliminate this extra work. He had never thought of it as taking extra time when he put the specification in in the first place.

One characteristic that comes out in each of scores of plants where this work has been done, is that the men who build the tools and fixtures give more attention to the operator who is to use these fixtures. The result is that the job starts right instead of needing correction later.

In the Inspection Department, the inspectors tend to determine why the defect took place rather than simply marking the defect with a grim satisfaction that they are going to force someone to toe the mark. They know that the defect occurred not because of some willful negligence on the part of the operator, but because something went wrong. Such an attitude tends to very much higher quality and to a much better satisfied labor force.

Let us see what such an example means to the Army. The best aeroplane engines in the world are probably made in the United States. It is my understanding that these engines are made in two factories. The entire air superiority of the United States Army and Navy rests upon the ability of these two plants to produce. Due to careful design required in aeroplanes, each mechanic in each of these plants is carefully selected. It is indeed an organization that our country can be proud of.

But the difficulty is that in so far as I have been able to discover, by very careful inquiry, no adequate provision of any kind has ever been made for greatly increasing this personnel in time of war. For some time, at least, after war has been declared we would be confined to the same number of aeroplane engines that we now provide in times of peace. If

a Motion-Time-Analysis were made of the operations of building aeroplane parts, and if the same type of training organization was worked out that Ray Blanchard had worked out at Watertown, the country would be in a far better position in the air than it has a chance to be now in the case of declaration of war.

The army can only travel as fast as its industries can provide it with materials. Certain materials are always easy to obtain but there are bottlenecks or individual materials which are hard to obtain. In the majority of these bottleneck situations every care has been made through the procurement division to be sure that there is sufficient machine equipment to produce the parts required, but apparently no provision has been made for providing the skilled workmanship required to operate these machines. This would be especially true in case the draft should take certain of these skilled workers as Army officers or as Army personnel.

The best knowledge of motion study of its type in the world exists in the United States Army. Yet I have noted mistakes of this kind happening in the Army.

The man who afterwards became one of the leading pistol shots in the United States tells that when he first entered the Army Reserve Corps he was ordered to appear on the pistol range. When he arrived he was given a short talk on safety precautions and then marched up to the firing line to fire the service pistol a prescribed number of rounds in order to "qualify". He had never had any previous instruction or practice, you can imagine the results. Now this young man was not content with that kind of training, so, at his own time and private expense, he secured instruction from an Army Colonel who did know something about pistol shooting. From his experience as a shooting master, he took the young man and put him through the same type of training that Ray Blanchard gives to his shoe makers. The result was a transformation from a raw recruit to one of the leading pistol shots in the country.

The same young man was afterwards ordered to appear on the rifle range. There he received the same type of instruction that he had first received when he went on the pistol range. The only difference was that on the rifle there was a strange strap called a sling which was to be used as an aid in shooting the rifle. It was improperly adjusted. There was no instructor to give instruction on how to adjust it. It caused anything but comfort. The blame was put on the strap for a nice waving red disc which indicated clear misses. Under such instruction the rapid fire possibilities of the rifle were a total loss. Again the young man was dissatisfied with this kind of instruction and again at his own time and expense secured private instruction. This time it was an Army Captain. The proper firing positions were then learned along with other fundamentals of shooting.

Of course, at Camp Perry we have some of the greatest shots in the world, but if our Army must be limited to what these shots at Camp Perry would do, I am afraid that the Camp Perry experts would hardly go around.

Perhaps the simple instructions placed in a simple way as was done by the two Army instructors that I mentioned, might go a long way towards increasing the efficiency of the raw recruits in our Army and in our Reserve Corps. Such a set of instructions need not call for any more ammunition, as most of the improvement would come through study of improv firing positions and the use of "dry-shooting".

The same young man is, in this case, acting as Commander of a battery of ten-inch mortars manned by a completely inexperienced gun crew A few regular Army Sergeants did the best they could among a great deal of confusion to elucidate some of the instructions which had been given. Unfortunately, the only written instructions provided were those written when the gun was made at the turn of the century. All the experience of the United States Army in developing improved methods of firing of mortar was largely lost in so far as that particular gun crew is concerned, exce for the fact that the commander having remembered his former experiences, did succeed in doing a little bit towards making use of a part of the experience gained by the Army in improving methods of firing. Perhaps a Motion-Time-Analysis of this particular job and a Motion-Time-Analysis method of training might have made it easier for this gun crew and other gun crews to get going.

When shells cost from $100 to $1,000 each, it ould seem rather worthwhile to give as much thought to instruction as possible so as to increase the percentage of direct hits during maneuvers.

Had every commander in the Army realized the value of good training of the raw recruits to the extent that the rubber company realized the value of training its green employees, such instances as those given above would be impossible.

In closing, I wish to make the following comparison. Before the da of modern sighting and calculating instruments the gunner was probably justified in firing by trial and error. The cost of his gun as well as the cost of his ammunition was on the same basis. The standard of workma ship was a trial and error standard But when advanced methods were devised, competitive markmanship was raised to fit the new possibilities.

Before the development of a modern method of handling skill, so-called ingenuity of labor-saving developments and the driving of recruits in the Army and in industry were probably justified. When better methods of the study of skill have been devised, the nation's servants, both in industry and in the Army, are entitled to a higher standard of service on the part of those who are to serve them through proper command.

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"Time-Motion Analysis"

Discussion

by

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Q -- Is there a text book on the technique of time analysis?

A -- You'll find Alfred's Handbook on Management gives some parts of it in full In his latest copy of the handbook you'll find a chapter given over to time study and motion analysis. You will find some parts there on motion time analysis. We have refrained carefully from very much publication.

Q --Is there any difference between time motion analysis and motion time analysis?

A -- Time motion analysis and motion time analysis. Time motion analysis would be defined by the motion picture machine, I should say, because there you get the motions themselves timed wherever you can catch the motions. The only difficulty with the motion picture machine is that you can not catch the plane in which motion takes place-for instance, let's take an example in something. If I hold this piece of cloth in this fashion before the sewing machine and run the presser foot over it, I can sew from 200 to 400 inches a minute; if I move my hand an eighth of an inch to the side I can only sew 50 inches a minute Now I'd like to know where somebody would place the camera to photograph that finger. That is what I

found out in 1919 to 1921 when I lost everything and $35,000 besides trying to make the motion picture machine work.

Q -- I take it that you did not use the time watch. Is that correct?

A -- The basic time, the fundamental time, for any motion all goes back to one figure That is forty-five millionths of a minute, the time required for the nerve impulse to travel one foot over the human body. From that, all motion time can be built up. But I take the motion picture machine. To begin with the motion picture industry and then you can find out what those times are for those particular jobs and generally take that away Of course, you can see if the hands were still you'd have a straight line horizontally If the line would go at infinite speed, you'd have a vertical line. You don't use a time watch out in the plant where the worker is at all.

Q -- I'm interested in how you might approach this in a Government plant with that restriction which you read How are you going to dodge that?

A -- First of all, bring your foremen and your staff people all the way through into classes and if you have a labor organization in there bring their representatives in too and teach them motion time analysis so that they know that Then go out into theplant and simply take motion by motion. If I'm going to pick up this package of cigarettes I've a transport of 450 or 450 - 100,000ths of a minute; a grasp of, say, 200, that's [redacted] 200 - one hundred thousandths of a minute, a transport of, say, 365 or 365 - one hundred thousandth of a minute The total of it all is just that Now when I

get the laborpeople and the other people so that they recognize those standards of time, I'll have no diffuculty in agreeing how many motions are needed on that particular job. Now of course, the thing that always happens is that when we start into that job, they become interested in the fact that most of those motions should not have been there anyway and your improvement is well on its way.

Q -- Would you care to comment on the status of this science abroad as compared to its development in this country?

A -- I would say that your development in this country is very much higher that it is abroad You have in this country the management division Such things exist very sparingly abroad.

Q -- Of vital importance in the study of expansion in industry in time of war is an estimate of what training has to take place in peace time to train skilled workmen for that expansion. It seems to me that in my short contact with the subject three terms rather confused me. That is the definitions of skilled, semi-skilled, and unskilled labor. Would you mind defining those?

A -- I think very largely that is a question of degree A great many things which are called unskilled are really very highly skilled When I was a boy it used to be my job to work in the bottom of a ditch next to the tile layer It was my job to shovel out the dirt ahead of the tile layer On that job that distance up there might be ten or fifteen feet and it was very difficult to put above us any racks to hold the dirt because the tile had to come down there through that space so I had the job of throwing

that dirt up fifteen feet, and to get it out very rapidly I know there was a definite trick in using that pick and shovel , a skill that is a great deal higher than some of these tool makers, yet digging ditches is called unskilled labor. If you're going to handle a shovel there is a very decided trend in knowing how to pry that shovel across your knee and also a very definite trick in knowing how to flex yourknees so that you may pull up that shovel of work and yet they call that unskilled labor. I don't think so, not properly done. Now there is, I would say, a good bit of skill in that. Yo might define skilled labor as that labor which requires some knowledge outside of the particular task that you are doing, in order to perform the task. A butcher, for instance, needs to know the characteristics of cattle in order to know where to use the knife in order to keep from cutting the hide when he is skinning the animal and he has to know the difference between different kinds of cattle, etc , which he can not get with the knife alone. For that reason, he might be called skilled.

A real tool maker needs to know the characteristics of different alloys of sttel He needs to know their expansion in order to build that die and that is not concerned with the operation of the drill, press, lathe or anything he has; for that reason we might call him skilled labor The same thing with a carpenter. He has to know the triangulation of porches in order to put up that roof. So we might call that skilled labor Unskilled labor would be those jobs in which there was no skill, nothing required, except what [redacted] was before the operator and then semi-skilled

would be the parts in between.

Q -- You indicated that there was a limited number of fundamental motions Is there any way in which you could illustrate a few of those so as to get the nature of them?

Q -- (Using blackboard, Mr Segur marked up the following list.)

Transport empty.

Grasp

Preposition

Transport loaded

Position

Release load

Use

Rest

Avoidable delay

Unavoidable delay

Hold

Inspect

Direct

Select

Search

Plan

Change direction

Transport empty - moving control means without load or without resistance outside of the resistance required to handle the control means.

Preposition - the act of preparing the tool for the next act to be performed.

Grasp - the act of obtaining control.

Release load - the act of relinquishing control.

Transport loaded - the act of moving the transportation with loads or with resistance.

Position.- the act of bringing one thing in with the exact and predetermined relation with something else.

Use - the act of performing any chemical or physical operation

Avoidable delays - within the control of the operator.

Unavoidable delays - outside the control of the operator

Rest - The time required for the recovery of the body or machine from any labor.

Hold - the act of maintaining control

Inspect - the act of examination of anything for any desired characteristic.

Direct - the act of using the eyes or other parts of the body for the purpose of directing or perhaps of telling the hands or other parts of the body of any tool.

Select - the act of making a selection from a predetermined location.

Search - the act of determining the location of anything.

Plan - the act of discovering or working out a solution to any problem.

Change direction - the act of changing the muscular control from one direction to another direction.

Q - In a group of willing and reasonably well trained people doing one motion, what is the spread between the slowest and fastest?

A -- Fifteen per cent.

Colonel Miles - I think we are very much indebted to Mr Segur for having opened the door, so to speak, to a new conception which I think is new to many of us, and we hope that we may be able to take some advantage of his good advice. Thank you very much