it is possible for them to assist us to create conditions which make for more efficient operation.

I am under the impression, from remarks that were made at the Philadelphia meeting, that some of my friends here feel that we are not scientific enough in our plant. I hope to dispel this misconception by giving you four illustrations, which are typical of hundreds of others, showing the nature of the work that we are doing.

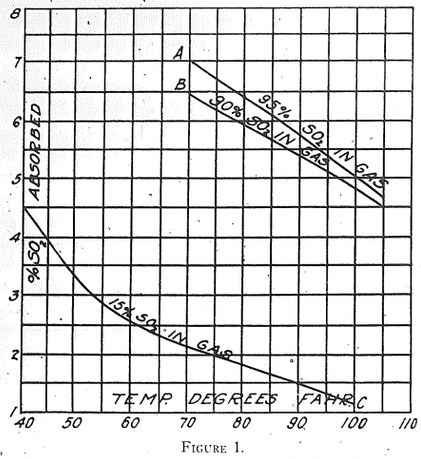

FIGURE 1.
Chart Showing Laws of Absorption of SO_2 in Water.

Figure 1 shows the result of a long series of experiments that we made to determine the laws that have to do with the absorption of SO_2 in water. It was only after we had determined the exact effect of the temperature of the water and the percent of SO_2 in the gas upon the amount absorbed that we were able to create the special conditions in our plant whereby we increased the percent of free SO_2 in our cooking acid from two and a half percent to six and a half percent. In order to accomplish this it was necessary to change completely the character of our acid making apparatus and this was all done within a very short time, because of the freedom that was given to the men actually operating the acid plant to help us create the necessary conditions to obtain the desired results.

It is unnecessary for me to describe to you in detail the immense amount of research work that we were obliged to do to determine the necessity for a stronger acid with which to cook our pulp. I will simply say that our exploration, which took us, of course, deeply into the realm of the natural, or generic law, showed clearly that the maximum temperature in the cooking operation had a great deal to do with the yield of cellulose we obtained from a cord of wood. There were, of course, many other factors that had to do with the character of the pulp turned out of the digesters and you can easily imagine that with nine different men cooking (three men on a shift and three shifts during 24 hours) we got nine different kinds of pulp, since each man had his own particular notions about how the work should be done. The first thing we were obliged to do was to agree upon some standard method of procedure. By coöperating with the cooks, we finally decided upon a set of uniform cooking instructions. We worked up a system of graphical charts, which the men themselves plotted as the cooking operation progressed, and in a comparatively short time obtained a degree of uniformity which was absolutely impossible under the old conditions. We further were able to get a lower average maximum temperature and increased our yield from a cord of wood from five to seven percent, by this first step of simply introducing uniformity into the cooking operations.

The charts (and recording instruments from which the charts are plotted) you can see, simply made it possible for the creative faculty, which belongs to the field of "The Will of Man," operating through the cooks, to guide and direct the reactions in the digesters in such a way that the desired results were obtained and these results came only because we produced a desire on the part of our men to do good work, by first educating them to a knowledge of the chemical and physical laws which entered into the cooking operation, and then giving them some means of recording their progress. A man who constantly sees the result of his efforts cannot help doing creative work.

We found, however, that in order to lower our maximum temperature still further, to get a still greater yield, it was necessary either to lengthen the cooking time or to increase the strength of the acid. The former affected our production too seriously to be considered, so we began investigations which resulted in the determination of the laws affecting the absorption of SO_2, as illustrated to you on the chart which you have just seen. The final result of obtaining this stronger acid was to bring about a drop in our maximum cooking temperatures of an additional twenty degrees, and finally an increase in the amount of cellulose obtained from a cord of wood of over seventeen percent. Of course, all of this was not due to the cooking and acid making, as other changes were made in our wood preparing and bleaching departments, all of which contributed to the final result, the work in these other departments being carried on in the same manner as the work I have just described in our digester building and acid plant.

The net result of all this was an increase in our

production from 225 tons per day of the poorest quality of fibre to 400 tons per day of fibre which today is recognized as a standard of excellence all over the world. This was done without adding a single digester or putting in a single additional wet machine for handling the finished product. Of course, the physical equipment of the plant was changed very radically; in fact, with the exception of the digesters and wet machines just mentioned, there is hardly anything left of the old equipment. In our wood room practically everything has been changed,—the method of barking wood, chipping wood, screening and sorting it; our entire bleaching plant has been rebuilt, a different method of bleaching being used; our entire acid plant has been changed so completely that anyone who has not seen it since seven or eight years ago would not recognize it at all. I am merely mentioning these things because they are important in showing how the creative faculties of the men, turned loose and given freedom for self expression, will work wonders in a comparatively short time. It was the accumulation of knowledge regarding the laws that are essentially a part of the "natural, or generic field" and then bringing the knowledge of these laws to the attention of the second great field, which we may call "The Will of Man," and the utilization of this great creative force that has brought about such wonderfully rapid changes in the physical equipment of our plant.

Some of you may feel that any organization which is making scientific investigations, and has a department for that purpose for the information of its executive branch, will get results; but our experience has been that unless the free will of the working force, which expresses itself in creative power, is consciously utilized, these results will not be obtained to any appreciable extent. I have had personal experience in one or two large industrial organizations that have splendid equipments for doing research work, where hardly a single change has been made in the manufacturing processes and where no improvements have been made in obtaining larger yields or appreciable betterments in quality for fifteen or twenty years, all because these laws worked out by their highly specialized research department were not made available to the men; and where they were made available, the men themselves had not the opportunity to assist in creating the new conditions necessary for the specialization of these laws.

To illustrate further our investigations in the natural or generic field, I submit Figure 2, a chart indicating the result of our research work on the effect of velocities upon the conductivity of lead tubes. We have succeeded in increasing the conductivity more than twenty times as a result of this work and I want to call your attention to the fact that, as a pulp mill,

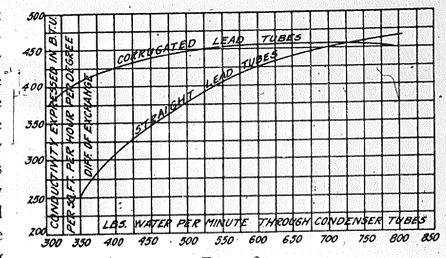

FIGURE 2.
Chart Showing Effect of Velocities on Conductivity of Lead Tubes.

we designed and built a condenser of lead with a conductivity more than twice as great as the best guarantee we could obtain from manufacturers of copper condensers.

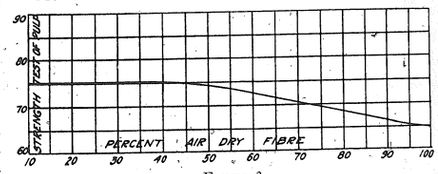

FIGURE 3.
Chart Showing Effect on Strength of Fibre of Increasing Temperature of Pulp.

Figure 3 shows the effect upon the strength of our fibre of increasing the temperature of the pulp in order to drive off a larger amount of water on our drying cylinders. This chart requires no further comment, except that as a result of this work we are completely redesigning this machine.

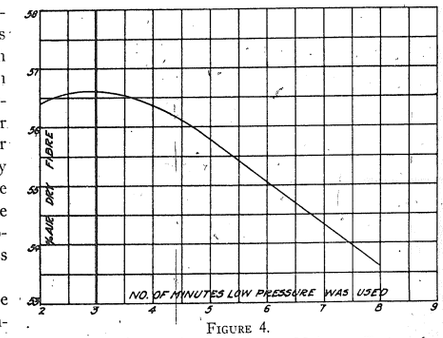

FIGURE 4.
Chart Showing Relation Between Moisture, Test and Duration of Hydraulic Low Pressure.

Figure 4 has to do with the operation of our hydraulic presses, where we squeeze out the last