of you. To the colour chemist, there is the extremely interesting field of coloured cements (in fact one of your past students actually worked on the subject of coloured cements for his Master's degree). To the plastics man, the ability of cement to be moulded as a plastic into shapes or forms may be in the nature of a personal challenge. Perhaps today it is the other way round, for the field of plastics and new resins is growing so rapidly that we poor cementwallas are being threatened for some time that in houses of the future, cement will be ousted by plastics. At any rate, while we last, the plastic industry can help the cement industry in many ways. In the packing of cement for instance, I believe plastic liners for jute bags or paper bags are already a *fait-accompli*. The food and nutrition man can be thankful to the cement industry that cement plays such an important part in producing more food for the country by making it possible to dam turbulent rivers for irrigation purposes.

To the chemical engineer, the cement industry offers a tremendous challenge in various problems of drying, grinding, mass heat transfer, fuel economy and so on. For such of you who are academically-minded—and scoff at research which savours of commercial exploitation, there is the vast field of study ranging from the application of the phase rule equilibria in the glassy matrix of the clinkering compounds to metaphysical speculation about the true physical surface of fine powders and so on.

What Industry expects of the Technical Man*†

L. G. WEEKS**

I RECALL talking to a very good friend of mine who has long been a teacher of geology at one of our universities and a trainer of men and women in both classroom and field. I asked him to tell me what, in his experience, industry was most concerned with in looking for new employees. Without a moment's hesitation he replied: "Industry's interest, as evidenced by their questions, runs about in this order:

"1. Is he a fellow that you would like to have around with you?

2. Is he reliable?

3. Has he good judgment and is he independent in his thinking?

4. And finally, how well trained is he?"

Very much along the same line, a head of an oil company exploration department replied as follows to the same question:

"What I expect a new employee to be, in order of preference, is:

"1. Co-operative. Willing and ready to do what is asked of him.

2. Open-minded. Alert to listen to, and take advice from his superiors, and to give full consideration to all others.

3. Congenial. Able to get along with his fellow employees, but without lowering his own moral standards.

*Condensed from talk prepared for presentation at the Annual Engineering Conference, Virginia Polytechnic Institute Association for the Advancement of Engineering, February 21, 1952.

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†By kind courtesy of Messrs. Standard Vacuum Oil Co., Bombay.

4. Inquisitive. Keen desire to know the reason for things and to look beyond what is required.

5. Neat, both physically and mentally."

Though he did not mention it, we may safely assume that he would include also a basically sound knowledge of his profession.

Let us consider some of these points, though not necessarily in the form and order listed.

Industry expects to have technical men who can create or help create public confidence :—

This is extremely important to management. What the public thinks and expects, is on management's mind much of the time. For when everybody's thoughts about a company or industry—their expectations and their fears, their good opinions and their bad—are added up, they represent what can be boiled down into two words : "public confidence."

Ability to create and hold public confidence is a highly practical qualification. One of the primary aims of an enterprise obviously is to stay in business. Another is to prosper from its efforts. If the company is to do both of these things, it must so conduct its affairs as to *deserve* the confidence of people. Then it must go on to *secure* the confidence. Finally, having deserved and secured it, the company must *hold* the public's confidence.

By "people", or "public" let's not think of a nebulous sort of mass. Let's think in terms of real persons—customers, shareholders, dealers, housewives, educators, and—may I add, students.

Another qualification which industry expects of a technical man is a sense of responsibility to his community :—

Especially when a company is a large one, its decisions may affect the community in which it is located. People used to think about an industry's effects on a community largely in material terms, how many jobs it offered, how it paid its employees, and sometimes whether it dumped its waste in nearby streams and lakes, or disposed of it so as not to injure or annoy anybody. A company's pay rolls, and their bearing on the local merchants and the upkeep of the local streets and schools and other facilities and institutions, are indeed matters of concern. I don't think an enterprise of any considerable size would close down a shop and move it to another location today without thinking long and seriously about whether and how the removal might hurt the community. In the pollution field, industry now is tackling the question of air pollution, in contrast with the old problem of contaminated streams.

Community affairs involve decisions which call for both the precision thinking that a technical education helps to develop, and the broad social, political and economic understanding that companies expect in their technical men. The wisdom with which community decisions are made goes far toward determining the social climate in which the enterprise operates. That, in turn, has a great deal to do with determining whether, and how long, the company is to achieve its primary aims of continuing in business.

Industry expects a technical man to have a strong moral sense :—

Any company can train employees in any number of skills. But a fellow's moral backbone is in a different classification. It isn't something you can just pick up as you go along. You had better bring it with you to the job. I think that by the time you have completed your academic study you've either got it, or should give first place to acquiring it.

If the technical man thinks of morality partly in terms of religious feeling, so much to the good. There is no conflict between such feelings and achievement in an undertaking with such highly materialistic objectives as the production of goods for profit and a balance sheet that commands respect. The notion that the material and the spiritual are irreconcilable, that they are mortal enemies arrayed on opposite sides of a great barrier, is a myth.

Problems of a physical nature obviously form the technical man's main area of operations. But industry is having to deal more and more with questions of human nature. Society in the laboratory, in the plant, out in the oil fields, and elsewhere on the job, involves just about as many complications as those with which human society outside these activities has to contend. And these problems are not to be analyzed mathematically or solved with a slide rule.

Another trait which industry expects of a technical man is ambition :—

Even though ambition was blamed for unhappy results in the case of Julius Caesar, it is by and large an excellent quality. We owe a tremendous debt to human ambition. It is the prime mover. The progress which this country makes from today onward, and the good things in life which countless people will enjoy, will be the fruit of the will to do things, of courage to take risks, and confidence in one's own ability.

These qualities are of utmost importance in the world of the chemist, the engineer, the architect, the geologist and the manufacturer. The frontier of technological progress isn't even in sight, and it won't be in our time. The door of opportunity for the technical man is as wide open today as the geographical world was for the explorer and settler in the era of the sailing ship and the covered wagon.

While industry expects the technical man to have courage and patience, it also wants him to make the most of his opportunities :—

I would therefore counsel you not to let your ambition lead you to discouragement. If you are an engineer, your first job will not be to build a new bridge across the Hudson. You will first have to demonstrate your capacity in many lines, not the least of which is the ability to co-operate and to handle men. So do not be disappointed if your first job is to build the tool shed, or perhaps just to help draw up the plans or rustle the materials.

Consider opportunity ahead of security and you will usually find that security will then take care of itself. One of my firmest beliefs is, if all Americans observed this simple principle there would be a vast improvement in our national morale, and particularly in our soundness as a nation. Someone has very aptly said that "each man should cut a niche for himself—not chisel it."

Industry expects the technical man to be co-operative :—

In industry today, perhaps more than ever before, the individual is judged by his capacity to be a good team worker. Today, more and more, industrial operations require a variety of special skills. This is particularly true in such complex businesses as the petroleum industry.

Even in a single branch of a business, such as, say, oil exploration, we often have to deal with problems involving a variety of expert talent. It is not uncommon to call on the advice of three or four or even all of the following : geologists, geophysicists, lawyers, landmen, economists, accountants, engineers, and experts in drilling operations. Certain types of problems or plans may require the assistance of still other talent.

such as pipe line experts, etc., for a sound decision.

This means that there is a considerable amount of committee work in modern business. But whether in committee or in following out your routine special tasks there is always the need for sincere and enthusiastic co-operation.

Industry today expects the technical man to have a thorough grounding in the fundamentals :—

It is much more important that you spend your time in college learning the basic fundamentals of your science than in trying to master the industrial applications or the methods of using basic knowledge. Neither Virginia Polytechnic Institute nor any other college can keep up with all of the advances in the application of basic knowledge in industry. No industry expects a young technical employee to know all about these methods. They are not difficult to learn and the employer expects to have to train a new man.

On the other hand, the province of the college, and the thing for which it is peculiarly adapted and set up, is to give you fundamental training. Now, fundamental training includes a variety of things, some of which I shall enumerate:

Industry expects the young technical man to have a good basic understanding of his science :—

You will not have time in five years of college to take all the courses and develop a sound understanding in the subjects I am going to enumerate. But, to make the fastest and surest progress, we should set ourselves certain goals. It is concerning the fundamental elements of those goals that I propose to talk. Even though you probably will not attain the goals in college, just keeping them steadfastly in mind will result in your arriving a lot closer to them, and in having the proper mental orientation, at the time you do leave college.

Let us consider the field of geology, with which I am most familiar. A good basic understanding of geology means a solid grasp of fundamental geology, the framework of the earth, particularly its crust, and the dynamic processes that affect that crust. Among these processes are : diastrophism (orogeny, epeirogeny and taphrogeny), the various processes of basin development and an understanding of the various basin types that result therefrom, the processes of sedimentation, the processes of igneous activity, the real composition of sediments and the significance thereof, the environments of deposition and, most important of all, the close interrelation, even dependence, that each of these processes bears to every other.

A good geologic training includes a fundamental knowledge of petrology, petrography and lithology, and mineralogy. It includes the relationship of all of these to the dynamic geology of the crust, and to temperature, pressure and other environment factors.

A sound geologic training must include a good historic perspective. I do not mean just a memorizing of geologic dates and names, but an understanding of the nature and significance of the processes in terms of crustal evolutions. Geologic history was not just a succession of recurrences or of unrelated phenomena. It was a progression of events that were as much related to each other and to succeeding geologic history as anything in human history of the past ten thousand years, or in the history of organic evolution.

A geologist will advance much farther with his understanding of geology if he has had some basic training in allied sciences, such as chemistry, physical

chemistry, physics, mechanics, mathematics up to, if not including, calculus, and a knowledge of simple bacteriology. The reason for this is that most problems in geology are difficult to really visualize and solve without a comprehension of either or both physics and mechanics on the one hand and environment on the other.

Unless we have built ourselves, then, a sound foundation in fundamentals, we cannot erect a substantial edifice in geology. A few geologists learn these truths the hard way after they leave college, but unfortunately this entails a tremendous amount of spinning of wheels.

The college is the place to set the corner-stones, so that when we get to the application of our science we need not be so often embarrassed by the toppling of the edifice we are trying to erect.

Industry expects that its young technical employees have been trained to think :—

Perhaps the most important thing that an education should give one is the ability to think—to think critically, analytically and constructively. A properly maturing mind should develop a healthy skepticism and a spirit of intelligent inquiry. That is the kind of mind industry needs to give its business a dynamic and flexible nature, and on which it can depend for maintenance and improvement of its organization and methods. That is what a business needs if it is to progress. There is no security for business, any more than there is for the individual or for society or the nation, in a *status quo.*

There is a lot of loose thinking in our national life today that masquerades as progressivism. True progressivism is a product of sound thinking and a balanced flexibility of mind. Furthermore, it has nothing whatever to do with youth, but may be displayed by men and women of all ages.

A trained mind, one that is trained to think and to judge, is the mark of the educated man. So be able to show your employer a college degree of intellectual competence rather than merely one of credit hours.

Another qualification of great value is the ability of expression :—

There is a Chinese proverb which says that "He who knows and cannot say is just as if he did not know." There is also a great deal in knowing *what* to say.

A plumber who discovered that hydrochloric acid was a good opener for stopped-up drains wrote to the Bureau of Standards about it. Some technical man at the Bureau wrote back to him, and ended his comment with a very high-sounding statement warning that "the corrosive residue is incompatible with metallic permanence." The plumber was so pleased with what he took to be an endorsement of his discovery that he wrote back thanking the Bureau. The Bureau sent him another letter pharsed in much the same fancy language as the first, and once more the plumber sent back his thanks. Then the technical man at the Bureau made his third and last reply to the plumber, and this time he wrote : "Don't use hydrochloric acid. It eats the hell out of the pipes."

So, say what you want to say in simple terms. You are not being paid to turn out something for others to puzzle over. When you get so all wound up in big words that you have difficulty in completing your sentence, just stop and ask yourself : "What is it that I want to say ?" And if you really know your subject, you will answer yourself in a few simple words. Then, ask yourself this second question: "Why don't I say so ?" Then go ahead and say it just as simply. Or, if you are writing, write it as you would say it, in the simplest, clearest terms possible.

Another suggestion I would make is, be ready to correct your mistakes :—

If you don't make any mistakes in the careers you are soon to start, you will be miracle men. There is no disgrace in being wrong—so long as you change your opinion when you find out you've made a mistake. Experimental work is nine-tenths a matter of discarding. Some of the greatest discoveries of history have come in the search for something else. Thomas Edison is said to have tried out anything he could lay his hands on when he was looking for a substance for some new purpose. Lack of success need not be failure. Glenn Frank, when President of the University of Wisconsin, summed up the thought here pretty well when he said, "No man ever failed unless he had succeeded." A turtle is smart enough to know he can't make progress unless he sticks his neck out. But he also knows enough to pull it in when he finds he has guessed wrong.

I might add, however, that sticking one's neck out just to make an impression isn't generally the best way to get ahead. Industry isn't as likely to honour one who does that as someone who works diligently and honestly. It is well to have pride in your work. It is equally important that others have pride in it too. Technical work is more blood, sweat and tears than some people think.

To a readiness to correct your mistakes, I would add awareness that others make them also :—

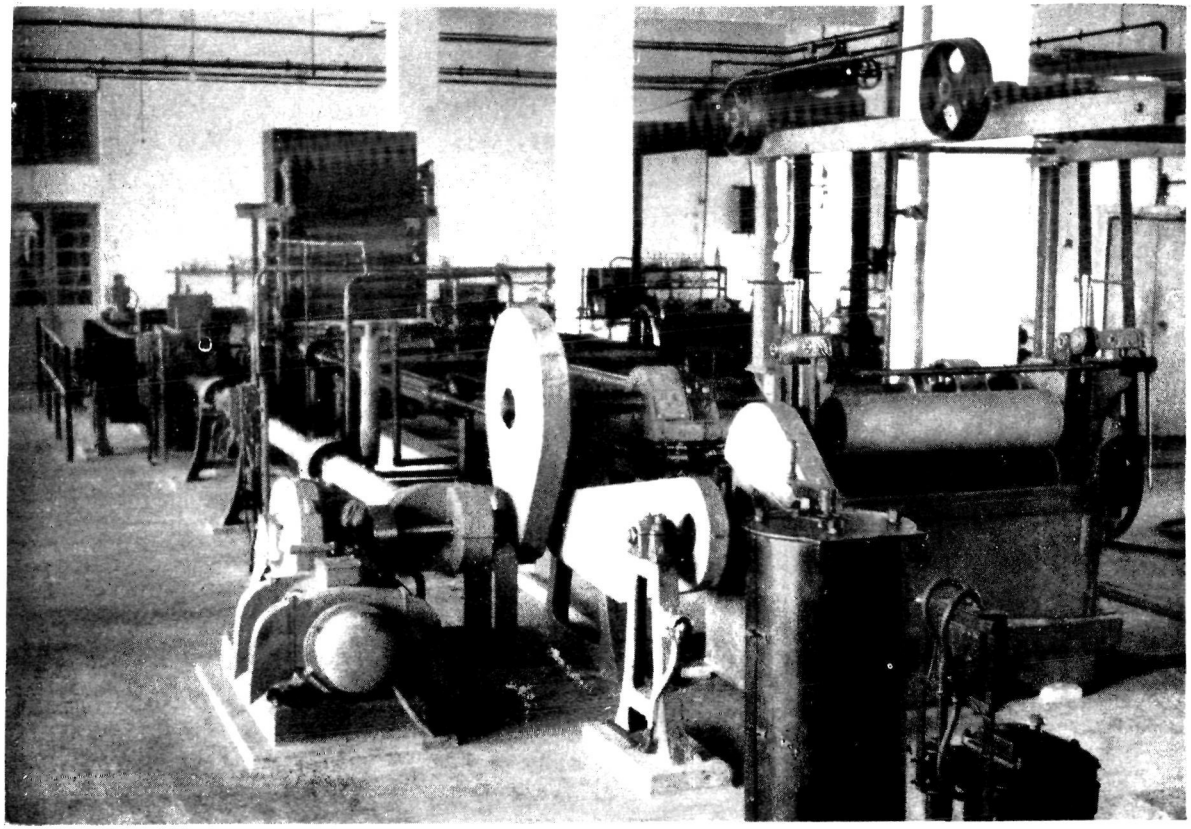
Returning to the example of geology, the geologist is notoriously a conservative person. Years ago oil man after oil man passed up a certain area in Texas as being no good as oil country. But there was one man, the now fabulous "Dad" Joiner, who thought the other fellows had made a mistake. He was sure enough of it to bring in the famous East Texas field, at the time the biggest in the world. So, have a mind of your own and do your own thinking. The other fellow is not always right. It was Emerson who said : "If a man plant himself on his convictions and there abide, the whole world will come around to him."

I would also suggest that you be not blinded by the other fellow's brilliance :—

Even Da Vinci, Darwin, Edison, and Marconi had their predecessors in science, even in most of the things that they are credited with inventing or creating. I spoke earlier in this talk of the practice of some personnel men of interviewing the top part of the class. I apologize to those who aren't in that scholastic bracket by urging them not to be too much concerned if they are not in the upper one-third in scholastic standing. Some of the greatest successes have come from the lower third.

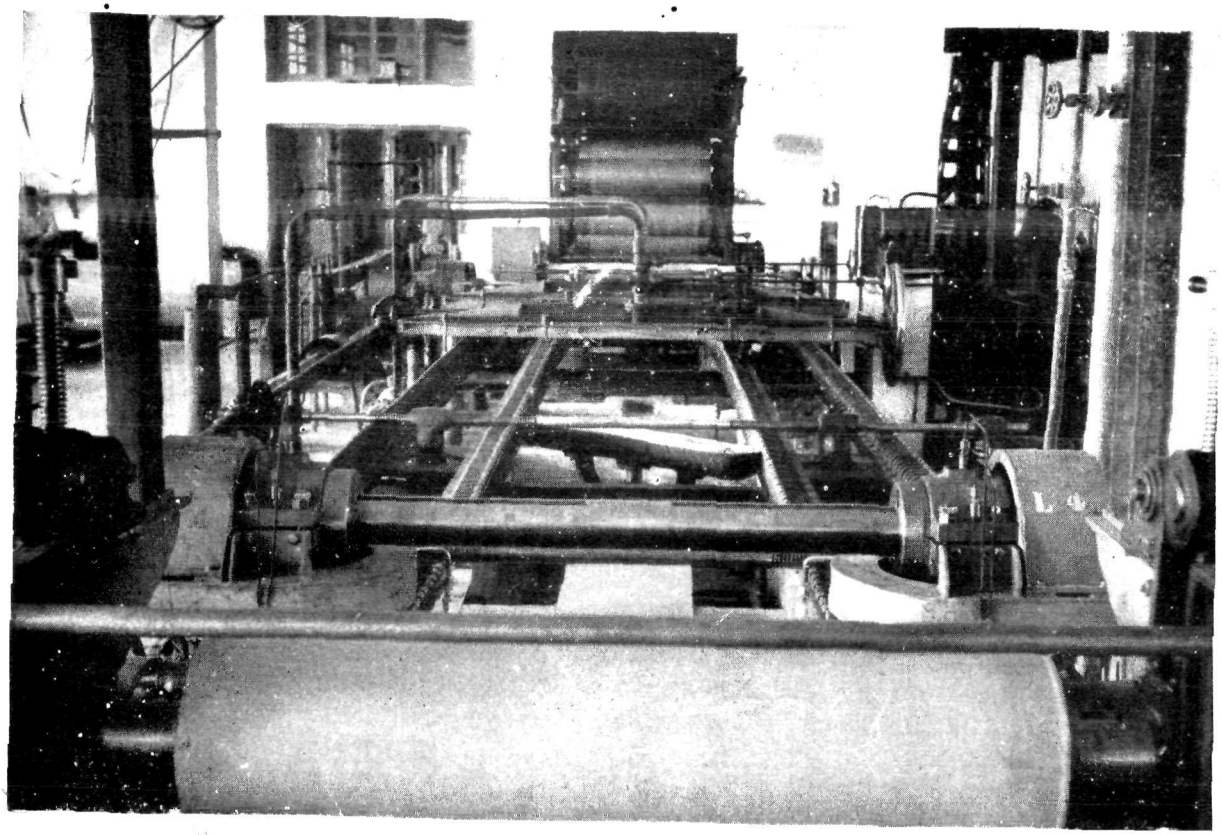
We develop by doing. That is why so many of our great men rose from the ranks of the humble. Their early struggles developed in them a priceless quality and capacity. Those whose circumstances have brought them to man's estate without struggle are to be pitied rather than envied, for they have missed many chances for development. Those who achieve great things despite the fact that they did not experience adversity are also to be congratulated, for theirs may have been the greater handicap. The truly best things in life are never free, but they are worth working for.

A company executive one day was speaking to employees on making the most of their opportunities. He held up a large sheet of paper. At the centre he had placed a black dot. He asked each employee what he saw, and each promptly replied, "A black dot." The executive then said, "Yes, there is a little black dot, but none of you saw the big sheet of white paper. That is the real point of my story."



CLOTH MERCERISING RANGE. *View* 1.
(Textile Chemistry Section)

Photo by: C. B. WADIKAR



CLOTH MERCERISING RANGE *View* 2.
(*Textile Chemistry Section*)

Photo by : C. B. WADIKAR

The real point of *my* story is that industry the world over needs technical men, more than it can get. The reason is that people the world over want more and more of the good things in life, faster than industry can devise them or turn them out. The technical man who is soon to take his place in industry has a wonderful opportunity to make a place for himself.

He also has a wonderful opportunity to serve others. People aren't mere economic entities. There is a need to let them see constantly that industry regards them as human beings, that it wants their confidence, and that our kind of world deserves their faith. Industry will have to receive a great deal of help from you in meeting that responsibility.

What industry can give its employees depends primarily on what the employees, through their efforts, make of industry. This is true because, from the employees alone comes the vitalizing force, the yeast that gives life and energy to such inert ingredients as capital and raw materials, and determines the amount and kind of benefits that can flow to all concerned.

Sodium Chlorite—A New Bleaching Agent.

S. SUNDARAM*

COTTON fabrics and yarns as received in the fininshing department are discoloured and difficult to wet, due to impurities like fats and waxes, pectins, starch and coloured bodies. These impurities seriously interfere in the bleaching and dyeing operations and hence necessitate their thorough removal. A good bleaching must impart to the goods a pure and permanent white and level dyeing properties without tendering or diminishing their textile quality. It is also necessary that the bleached goods should have a good absorbency and a low ash content.

Prior to scouring, desizing is carried out on the goods to remove the starch and other soluble impurities. The process is usually to impregnate the cloth with mineral acid or with hydrolytic enzymes.

Scouring is the process where the pectins, proteins and waxes are removed by the combined action of alkali, soap or other detergents at a high temperature under pressure. This boiling treatment takes usually six to twelve hours depending upon the quality of the material treated.

Scouring is followed by bleaching. Sodium hypochlorite or bleaching powder is commonly employed as bleaching agent.

Hypochlorites are very powerful oxidising agents and strict control is necessary when bleaching is done with them. They not only oxidise the colouring matter and impurities but also transform cellulose into oxycellulose. Hypochlorites also bring about accelerated oxidation. During the bleaching of coloured goods if active vat dyes are present on cellulose and if light falls on the goods, enhanced tendering of cellulose takes place. Though hypochlorite bleach is cheap, it is attendant with all the above difficulties and hence requires careful control

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