Dr. C. T. Langford, professor of chemistry in the school of chemical engineering, has been an important factor in the growth of his school. An idea of the importance of chemical engineering in the industrial world today may be gleaned from the article he has written.

The Chemical Engineer

By CECIL T. LANGFORD, Professor of Chemistry

THE chemical engineer has been defined as one who is engaged in the design and maintenance of those processes in which chemistry is applied on an industrial scale. This definition, like many others, it entirely inadequate, for it happens that in the application of chemistry to industry many of the operations bear not the slightest resemblance to the analogous laboratory procedure. Furthermore, these processes find application outside the purely chemical industries.

Analysis of manufacturing activities reveals a large group of industries in which the utility of the raw materials is increased through what are called chemical engineering unit operations. A partial list of these includes: heat flow, fluid flow, crushing, grinding, filtration, evaporation, distillation, drying, absorption and mixing. These operations are not the subject matter of chemistry as such nor of mechanical engineering. Their treatment in a quantitative way with a study of the laws controlling them is the province of chemical engineering.

The field of the chemical engineer lies in those industries which utilize the above mentioned unit operations and which, in consequence, require his services. They are classed as chemical engineering industries and may be divided into the following groups: (1) Chemicals and allied products, such as acids, alkalies, coal-tar products and dyes, explosives, etc.; (2) Ceramics and allied products, such as glass, cement, clay products, lime, etc.; (3) Fuels and derivatives of fuels, such as coke, artificial gas, wood chemicals and charcoal, carbon black, etc.; (4) Metals, smelting only; (5) Colloidal products, such as rayon, paper, rubber, paint and varnish, glue, etc.; (6) Refined natural products, such as vegetable oils, sugar, rosin and turpentine, etc. It will be apparent that chemical engineering, which has as a basis chemistry, physics, mathematics and economics, plays a vital part in many industries that the layman does not ordinarily associate with these sciences. It is much broader than chemistry alone, and utilizes that science, together with the others just mentioned, through the medium of the so-called unit operations, which in proper sequence and coördination constitute an industrial process.

Any engineer is vitally interested in the economic aspects of the industries within his field. It will be instructive to consider the strictly chemical industries apart from all the others. While they constitute only one group of the chemical engineering industries, they are of paramount importance to the chemical engineer. From a comparatively insignificant status prior to the World War, the chemical industry has made rapid forward strides in this country, and is today our fourth largest industry. It is the third largest, on the basis of corporate capitalization, and in 1932 paid taxes which were exceeded in amount only by the food and tobacco industries. It occupies a basic position of unquestionable importance and its products are practically indispensable to a veritable host of industries including automobile, textile, food, soap, glass, paint, paper, radio, leather, rubber and steel alloys.

Due to diversification on the one hand and elasticity on the other, the chemical industry was able to resist strongly the business depression. It was devoid of financial casualties; and the industry has been an immediate and generous participant in the business recovery which has taken place thus far. The industry's confidence in the future is given tangible expression in the expenditure of ten million dollars for new plants and equipment in 1933, and it is estimated that similar outlay for 1934 will aggregate twenty million dollars.

If, to the strictly chemical industries, we add those other groups which utilize chemical engineering unit operations we find that the chemical engineering industries are responsible for a large share of our manufacturing activities. Their magnitude is illustrated by the fact that the combined value of their products comprises approximately twenty per cent of the value of all manufactured goods in the United States; and the capital invested in them amounts to about twenty-five per cent of all the capital invested in factories in this country. The field of the chemical engineer is truly enormous.

It would seem on first thought to be impossible to train adequately an engineer for service in such a diversity of industries. However, it happens that a particular manufacturing process consists simply in the proper coödination of certain unit operations. Furthermore, in so far as the fundamentals are concerned, it makes no difference what material is being processed. Thus we find the same laws of fluid flow involved in the pumping of liquid air, hydrogen gas or petroleum. A study of the unit operations is obviously an important part of the chemical engineer's training.

Since the chemical engineer is dealing with chemical reactions he is at once a chemist and an engineer. Indeed, his training in pure chemistry, mathematics and physics must be just as thorough as the training given to a chemist who expects to confine his work to the laboratory.

Although all chemical engineers receive some training in economics, the importance of this subject cannot be too strongly emphasized. A chemical reaction, be it ever so interesting from a theoretical standpoint, will not be conducted on a commercial scale unless the value of its products exceeds, by a comfortable margin, the total cost of producing them.

The chemical engineer does not need to be an expert cost accountant, for that is a field in itself; he does, however, need to be familiar with the rudimentary principles of cost accounting. It is quite possible to proceed along strictly scientific lines with the development of a process from the laboratory stage to the commercial plant only to find that the cost of some step has been overlooked or inadequately estimated.

We find that the training required for a chemical engineer is rather broad; it should, however, be none the less thorough on that account.