

RESEARCH AND ITS APPLICATION.¹

RESEARCH in the distant past was the privilege of the few. In chemistry, during the Middle Ages, the alchemists were practically the only men pursuing it, and they in secret, and not always from the highest of motives. Working by themselves as they did, they had not the great advantage of meeting and discussing with others similarly engaged, and using their progress and mistakes to intensify their own increase in knowledge. Thus it has come about that the science of chemistry is little more than a century old, and its tremendous advances only a few decades.

As the foundation of all these advances research is firmly embedded. Without it the structure could not have arisen or the glowing anticipations of the future been even imagined. Twenty centuries ago we were told, "Seek, and ye shall find; knock, and it shall be opened unto you." No one can deny that there have been accidental discoveries, some of great moment; but this has not been, and will not be, a safe dependence. Accidental discoveries are not to be relied on, although they are not to be scorned. In chemistry the accidental good fortunes have usually come to those who were really seeking, although possibly for something far different; but, note this, they were usually made by men qualified to recognise an important discovery when it flashed across their vision.

Research, of course, is not of necessity to result in invention. It may in that respect terminate in a *cul-de-sac* from which with present knowledge there is no egress; or, what more frequently happens, it may lead to a line of reasoning which in time leads to another, and so on, until suddenly a bright light illumines the way and a goal of the greatest importance is attained. Many instances illustrative of this could be mentioned. One only need here be cited, and that because of the importance it has assumed in the light of recent developments.

As early as 1882 men of science rigidly established by chemical research what chemists call the "constitution" of the blue vegetable dye indigo, and clinched that scientific conclusion by preparing the identical material in the laboratory. This particular important addition to human knowledge has remained a discovery merely, yet it so stimulated the search for practicable methods of applying that discovery to human needs that voluminous researches in a number of European countries were undertaken almost at once for that purpose. It remained for a college professor, working in quite a different field, to hit upon the central idea of the successful indigo method of 1897, and to clinch it by appropriate laboratory methods. In 1901, however, one of the so-called "inorganic" chemists, in searching for new worlds to conquer, evolved an idea which he thought would make one of the discarded and discredited methods of making indigo a worthy rival of the only commercially successful indigo method of that day. And he was right! The owners of the 1897 method were forced to look to their laurels.

The chemical knowledge and research that enter into the synthetic production of indigo, as we know it to-day, come from more than three generations of chemists, scattered all over the globe, speaking many languages, researching on many different and separate problems which touch almost every phase of human endeavour; and the end is not yet.

True research must be intentional and intensive. We must really seek if we would find. We must really knock at the doors of the secret chambers of knowledge if they are to be opened to us. We must have imagination, it is true, but we must have more than that. There must be the foundation of sound

education and the ability to extend it to embrace new and unexpected knowledge, and apply this in its turn as we progress upwards.

The importance of research is being more and more recognised and understood by the public. One of the most encouraging evidences of this is shown in the preamble and resolution adopted recently by the American Federation of Labour at Atlantic City, indicating as these do a clear appreciation by that great association of how much we all depend on what science will disclose to ameliorate the conditions of the future.

But let our friends of the federation not be content with what the Government can do in the line of their resolution, good as it has been and will be. Let them start a carefully planned series of researches themselves, and follow them up until the truth stands revealed. Employers of labour have been doing this for years. The shining goal of all research is the truth, the whole truth, and nothing but the truth. Thus, starting from different angles, with fairness and thoroughness, the various so-called interests will arrive at the same truth, for there can only be one truth concerning any question. Thus will it come to pass that capital and labour will discover that the true interest of one is the true interest of all, and instead of bickerings and suspicions we shall have that cordial co-operation which is absolutely essential if we are to get the best out of this world of ours.

Scientific discovery is really not a haphazard matter. The art of making it can be cultivated, and definite rules of research can be laid down. Many elements enter into the problem, and these have been very well tabulated by the late Dr. G. Gore in his book, "The Art of Scientific Discovery." He defines the difference between discovery and invention as follows:—"Discovery consists in finding new truths of Nature, whilst invention consists in applying those truths to some desired purpose"; and that definition is sufficiently accurate. Research does not always lead to discovery or discovery to invention, but the sequence is logical.

The application of research has always required a high order of talent. In the future a still higher order of talent will be necessary, but in addition this talent must be prepared by education to do this very thing. How can we produce the leaders who shall adequately combine both the scientific and the practical qualifications that are necessary? This is one of the greatest and most interesting problems awaiting solution by our educators, and on its correct solution depends, in a larger degree than many imagine, the future of successful and contented industry in this country.

The candidate for leadership should have a healthy body, good habits (which involves good character), and a good mind educated to the highest degree attainable. This education should be specialised in the desired direction, while good all round. He should have a thorough knowledge of human nature. To play on the "harp of a thousand strings" requires an unusual acquaintance with the instrument. How many men, otherwise great, have broken down here, sometimes because they have given too much confidence, sometimes not enough, sometimes because they did not know how to select assistants.

Let us proceed to fill our high places of every kind with the men and women specifically prepared to fill them, being assured that the effort to do so will produce an army of those not quite qualified for the top, but of the greatest value to assist those who are. Let us educate for living, certainly; but let us also educate for leadership—that superlative leadership of which civilisation will stand more and more in need as it increases in complexity and reaches higher and higher planes.

¹ Abstract of an address delivered by the President of the American Chemical Society, Dr. W. H. Nichols, at Philadelphia, September 4.