

ADDRESSES

THE NEW ASPECTS OF CHEMICAL SCIENCE¹

By J. MERRITT MATTHEWS

The past two years have offered great inspiration both in thought and accomplishment to the American chemist. The past recent meeting of the chemical societies in this city, together with the elaborate Exposition of the Chemical Industries, has formed what might be termed the apotheosis of Technical Chemistry.

The American Chemical Society has heretofore confined its attention probably more to the consideration of pure chemistry of an academic character rather than to the industrial aspects of the science. This latter point of view has been left more to the technical societies. There has, however, been a more or less growing demand for an added emphasis to the features of applied chemistry. This demand has found its expression in the remarkable development of THIS JOURNAL so ably and successfully edited by Professor Whitaker. The general trend of our meetings has also shown the influence of this same leading force; the American chemist is evidently becoming vitally interested in the application of his science; it might almost be said that he is seeking to bring it up from the state of an art to the true dignity of a science.

This growing tendency in our Society naturally leads to some philosophical reflections on the relations of technical chemistry and pure chemistry—the human relations of chemistry as distinguished from its purely academic features.

Technical chemistry must, of course, be considered as a branch of applied science, and as such more or less in opposition to "pure science." In using the term "pure science" it is my purpose to convey the meaning of science studied as an end and an ideal in itself: science that seeks for nothing beyond its own development, and having no ulterior motive than that of its own aggrandizement. Like virtue, it is its own reward; and like virtue, it also demands many sacrifices from its devotees. Its domains are vast; its treasures are countless; its followers are those to whom the lust of knowledge is the ambition of life. It is the science of the schools and the scholars, of the life-long student and the philosopher. Its wealth is not measured in money, but in the understanding of the phenomena of Nature. It seeks after a knowledge of the laws of the world, and probes deeply into the mysteries of the universe; no fact is too humble for its recognition, nor too vast for its comprehension; no problem is too trifling for its attention, nor too sanctified for its solution. Its object is truth for the sake of truth alone; knowledge for the mere sake of gratifying the desire of knowing. The astronomer seeks for the cause of a star's variation in color, the biologist studies the life-history of a jelly-fish, the chemist prepares a thimbleful of some newly discovered compound, the mathematician speculates on the laws of a fourth dimension to space, while the mineralogist measures the angles of a microscopic crystal. These are the offerings on the altar of pure science; these are the theses of philosophers, and the life-works of scientists.

To the layman, the matter-of-fact man of the world, the study of pure science is a useless bit of mental recreation; an exercise in intellectual gymnastics which may strengthen and develop the mind, but which serves no other purpose. "*Cui bono?*" he asks, with a shrug of the shoulders. What good is it all? For as humanity is more apt to reckon its honesty in terms of policy, so will it judge of knowledge by its usefulness. We have reached a period where utility is more and more in demand; a utility, moreover, which is reckoned in dollars and cents rather than in the more esthetic currency of beauty and

truth. Things either have a money value or no value at all; ideas which cannot be patented are scarce worth the brain tissue used up in thinking them out. In an age when even the emotions are definitely assessed at certain money valuations, we should not be surprised to find that culture is rated below utility, and that the genius of the intellect is a servant in waiting to the God of Mammon. We do not rub the Lamp of Knowledge just to polish it up and keep it clean, but to summon the Slaves of Science that they may transmute for us the wealth of intellect into the wealth of the world.

The study of pure Science is essentially a study for culture. Leaving aside the consideration of any application of its results, it makes for increased intellectual powers by extending the intellectual vision; it elevates the type of knowledge and broadens the character of the individual. It differentiates from the universal "thought-stuff" another form of truth—a form, perhaps, which may exist as a piece of statuary which appeals to the artistic contemplation of the scientist, but which will never be animated with the energies of life. The question is narrowed down to one of appreciation and taste, and we must put to ourselves the query: Is the cultivation of pure science the essential element in the advancement of knowledge; or is it but a plaything and a hobby for the enthusiast, and does applied science become the absorbing purpose of knowledge and the ultimate foundation of truth? On the very threshold of this discussion we are struck with the disparity and wide separation of these two sides of scientific thought. On the one hand we see pure science being carried out in the laboratories of universities and colleges, taking little or no thought of anything but itself. It labors faithfully and diligently onward to the working out of some engrossing idea—perhaps its end is the preparation of a hexachloride of molybdenum, or a determination of a velocity of a star through the shifting of lines in its spectrum; or possibly its goal is the tracing back of some English word to its derivation amidst its Aryan ancestors. But whatever the subject may be, the student of pure science will almost invariably lose sight of everything outside of that focus towards which all his lines of thought converge. He never stops to think for a moment what practical advantage to the world in general it will be whether Capella is moving away from the earth with a velocity of seventeen miles a second and not thirty-two, as some previous observer may have erroneously computed. He may spend five years in preparing a single gram of the hexachloride of molybdenum, and after having established its composition and formula, and having used up all his product in so doing, he will experience a feeling of satisfaction at having so successfully completed a difficult problem in scientific research. After all, do not such things appear somewhat outside of the world's interests; are they really as much in touch with humanity as they should be? Can we altogether blame Swift for his little sarcasm about extracting sunbeams from cucumbers? It brings us around to the opinion that all science should be animated with a human motive; it should appeal to a wider interest than that of the mere student; it should be a living and organic force active within the life-history of thought itself. The truths of astronomy should appeal to more than a mere personal gratification of the star-gazer himself; every discovery of science should possess a universal significance before it becomes embodied in the general form of knowledge.

But on the other hand pure science, or science *par excellence*, is essentially a mode of intellectual culture, and as such cannot be regarded too highly as an end in itself. Whatever makes for the further development of the mind is more truly a factor in human progress than that which merely serves a utility in supplying the momentary demands of sense. The money value

¹ Chairman's address, New York Section American Chemical Society, Chemists' Club, October 13, 1916.

of a thing does not in any manner represent its final utility, but merely serves to measure the present ratio between its demand and supply. Galvani spent years in patient study and research in observing the twitchings of the hind-legs of a frog; he did it purely for the interests of the science to which he had devoted his life, and no one paid him a cent for his trouble. But his seemingly trivial and ridiculous studies into the causes of the twitchings of the frog's legs proved to be the fount of inspiration from which flowed in a direct stream the discovery and knowledge of the electric current, and all the possibilities to which modern ingenuity has applied it. There is not a fact, however humble, but which by its understanding adds a dignity to human knowledge; there is not a theory, however abstruse, but which by its confirmation and comprehension adds a new purpose to and widens the possibilities of human life. Our lives, in reality, are not made up so much of "things" as of "thoughts," and whenever science broadens the field of thought, she not only enlarges, but elevates the sphere of life. In estimating the utility of things we are inclined more to regard their individual practicability than their universal significance; a specific invention which earns its originator a material fortune is considered of more value in the opinion of most people than the broad law of nature to which that very invention owes its possibility and its conception. Men of science seldom patent the result of their research; they bend their energies towards the general expression of the truth of which they are in search; they care little, and in fact, know little, of the practical applications of that truth to the various needs of life. They find their greatest satisfaction and recompense in the consciousness of having advanced the general type of knowledge.

Perhaps we of the present time are inclined to depreciate the value of pure culture below that of mercantile utility, and give more attention to the transactions of commerce than to the speculations of science, literature, and art. The cry is often heard that we are rapidly going away from a civilization of pure culture to one of specialized utility; nor is this movement one peculiar to science alone, for we find it as an active factor in the fields of literature and art. Even the most conservative mind must admit the apparent fact that there is a strong force continually active in the direction of specialization, with the ultimate object in view of practical utility. The cause of its existence is found in the fact that human life is no longer commensurate with the infinite possibilities afforded for its activity; the ramifications of science have become so extended and numerous that should the individual desire to develop further, he must take up the burden of some specialized line and carry it forward in the rapid march of progress.

This is a period in which we are becoming steeped in education, flooded with knowledge. Our motto is becoming "It pays to know," and the particular knowledge which most pays to know appears to be of the scientific type. This is no doubt necessitated by the predominating influence science is exerting upon the numerous branches of industry and commerce. And our scientific education must be of a technical character in order to fulfil the exactions placed upon it. The development of technical sciences so closely allied to the arts is the direct result of the specializing of higher education so needful in the forming of acutely and minutely trained minds. This influence is becoming a potent factor in the educational problem of the times, giving knowledge a practical tendency and a body more in keeping with the flesh and blood of human needs. In making science assume a technical character there is an attempt to infuse the facts and energies of living industries into the rather inert and spiritual mass of general principles and theorems. What we know of as "pure science" has little to do with the real problems of human life; these must be met and answered by the technical sciences, dealing as they do with practical applications of human knowledge.

You will pardon, I trust, these rather generalized reflections on the two aspects of chemical science, but I cannot help but feel that we are realizing a higher dignity for our science as a *profession* in contrast with its dignity as a purely academic form of scholarship and culture. Perhaps it was not so long ago that the Chemical Engineer was regarded somewhat as a pipe fitter and plumber, rather than as a real scientist. The chemist in England is still a drug clerk, and even to the layman in this country the chemist has been considered as a compounder of pills and hair tonics. The past two years I think, however, has seen a better appreciation by the layman and the press as to just what the chemist is and what his profession consists of and can accomplish. There is still that idea, however, prevailing that chemistry is a hodge-podge of mysterious secrets, the discovery of which is made by accidental and haphazard methods. The popular mind has evidently not yet progressed beyond the age of the alchemist. In things chemical the public has still the innocently receptive mind of a child; it will accept as gospel truth the most absurd and illogical statements of supposed discoveries. Some so-called chemist announces the remarkable discovery that by the addition of a few drops of a mysterious green liquid to water he creates a perfect substitute for gasoline for use in automobiles. The daily press devotes column after column to this truly remarkable process, and the public evidences the keenest and most serious interest. The thing could not be more absurd than if a physician announced that he had discovered that he could make new legs grow where those members had been amputated, by rubbing a decoction of hen's teeth on the parts affected. I hardly believe either the press or the public would take this latter announcement seriously and any editor would consider it too foolish to be printed. And yet how often have we been regaled at breakfast table with glaring head-lines announcing with all seriousness that Dr. So- and So, a celebrated chemist (whom none of us had ever heard of before), has just discovered the *secret* of the German dyes.

Fortunately, however, I think the public and the press are becoming perceptibly educated to a saner idea of chemistry. We have all appreciated more or less the wide publicity given by the press to the recent meeting of our Society and we surely have not failed to notice the remarkably sensible and rational reports that were printed in our daily papers. We also could not but be impressed with the fact that the great throng of visitors to the Chemical Exposition was made up quite largely of laymen and the unscientific public, and they seemed interested and appreciative.

It is apparent, therefore, that chemistry is coming into closer contact with human life; it is becoming more and more a part of the every-day life of the world, and as such is acquiring a breadth and a dignity which only a wide understanding can give it. And not only is the world at large being benefited by this wider understanding, but chemistry itself, as a profession, is acquiring new forces and inspiration from this wider contact with human life.

50 EAST 41ST STREET
NEW YORK CITY

THE DAY OF THE CHEMIST¹

By FRANK S. WASHBURN
President American Cyanamid Company

"Si monumentum quaeris, circumspice!" (If you seek his monument look around you.) As we look around us, we see hardly a single object that has not required in its preparation the service of a chemist. The tungsten lights illuminating this room are the product of many years of patient toil. The glassware on the table and the eye-glasses that many of you are wearing are representative of two thousand different grades of glass

¹ Address delivered at the banquet of the American Chemical Society, Waldorf-Astoria Hotel, September 29, 1916.