observation at the time. The actual number of species in any one group must always fall far short of the possible number, and for this reason it is out of the question for us to attempt the solution of the problem of derivation, or to hope for any solution beyond one within the most indefinite limits of correctness. If, when we take one of the most limited of the groups of the animal kingdom, we find ourselves engaged in a hopeless task, what must be the prospect should we attack the problem of other classes or groups of the animal kingdom, where the species run into the thousands, while they number only tens in the case we have attempted to follow out? Shall we say "ignorabimus," or "impavidi progrediamus" and valiantly chase a phantom we can never hope to seize?

CHEMISTRY AS AN ART, AND CHEMISTRY AS A SCIENCE.

By Professor J. M. Ordway.

Professor J. M. Ordway, of Boston, spoke of "Chemistry as an Art, and Chemistry as a Science," comparing both, and pointing out some recent lines of advancement. The past year, he said, has been one of laborious activity in chemistry, but it has not been marked by any epoch-making discoveries. Meyer's recent apparent resolution of the chlorine molecule has not, indeed, been verified by the carefully devised experiments of Crafts, but the latter does seemingly confirm the change of iodine by intense heat. The years 1879 and 1880 will rank hereafter as years in which Meyer found means to throw new light on the nature of the haloids. Twenty-four years ago Perkins sought for artificial quinine, and found instead a better than royal purple. Then, by various hands and in rapid succession, red and yellow and black and brown and blue dyes were brought out from what proved to be something more than aniline. Now the novelty is past, and the announcement of a new dye hardly creates a ripple of excitement. The twelve-year-old synthesis of alizarine has given us colors purer, brighter, faster and cheaper than those of the obsolescent madder. Of late, wool has been provided for, and the extinction of cochineal plantations is threatened by reds of surpassing brilliancy, durability and ease of application. Baeyer has recently effected the synthesis of indigo, and tropical indigo fields may in time share the fate of the madder farms of France and Turkey. But indigo itself will not continue to satisfy our demand. We have become accustomed to hues of a delicacy and richness that no one dared to dream of twenty-five years ago. The æsthetic taste of this generation has been too much pampered; and dyers will soon call for something uniting the brilliancy of the aniline blues with the fixedness of indigo, and its adaptedness to wool and cotton. And Germany which has done the most in studying out these extraordinary colored compounds, now furnished the most of the industrial fruits of seemingly unpractical researches. Investigation costs, investigation pays; in more senses than one our science "opens wide her everduring gates on golden hinges turning."

The passing years are bringing to light new elementary bodies, and new metals are becoming like new asteroids, of too little mass to influence the orbits of other planets, and too much out of sight to interest many. Within five years fourteen new metals have called for recognition; and in 1879 alone chemists have claimed the discovery of six. Of new alloys, manganesian copper is worthy of regard, since it may in a measure play the part for copper that *spiegeleisen* does for steel.

In 1620 Bacon published the second part of his "Novum Organum," wherein he pointed out the way to appeal to nature by experiment, instead of deriving all science from the teaching of the ancients. But his methods had little immediate influence on the science of the time. He relied on induction; and induction alone simply strings together dry bones. That perception of general principles which makes science comes not altogether from the mere collation of facts. We need something more than eyes to see.

The great chemist of two hundred and fifty years ago was Van Helmont. To him we owe the word gas, which he derived not from geist, but from chaos, as representing the original form of matter. When our forefathers were laying the foundations of this nation alchemy was in its dotage, and chemistry took its rise in a dim knowledge of the gases. The evolution of chemistry as a science was threefold. First, the study of the gases, then the study of heat, then the study of combining weights. Consider how much of what we now know depends on the gases that Cavendish, Black, Scheele and Priestley revealed. The study of combustion, respiration, vegetable growth, organic decay, geological transformation and hygiene involves the study of carbon dioxide. Carbon monoxide reduces the metals, and plays a part in the Bessemer process for making steel. The fuel of the future is to be coal resolved into a chaos of carbonic oxide and hydrogen. At the end of the last century Murdoch found a use for coal gas, and in its train came a host of secondary products having a marvellous effect on science and industry. A test came into chemistry when Beecher attempted to explain combustion. Vulcan of old made as good iron as the blacksmith requires to-day. As for quantity, Vulcan with all his Cyclops and the fires of Ætna could not produce as much in six days as the Cambria iron works turn out in six minutes. Glauber, with all his good sense, taught that the rays of the sun and stars shoot themselves into the earth, and finally became silver and gold. Perhaps he was a prophet, speaking in symbols which he understood not. Now we know that metallurgy does depend on the sun's rays. The sunshine of the carboniferous period has been materialized into coal beds, and now attains perfection in a metal of more real value than gold. In the chemical study of heat, Berthelot's recent work shows culminating progress, and is worthy of him who years ago almost created organic synthesis. After a review of some of the most abstruse speculations in theoretical and physical chemistry, Professor Ordway went on to discuss the importance of biological chemistry. This branch is yet in its infancy, and has few to tenderly care for it. Most chemists prefer to take easier subjects, but the interest in it is increasing. The field is large and there is room for many laborers. Proximate organic analysis still remains undeveloped, and the world does not comprehend the light that we already have. In fermentation, putrefaction, vitrification and zymotic diseases, life may intervene; but how much do we yet know as to what is cause and what is merely concomitant? It is pertinent to ask whether chemistry tends, as many think all physical science tends, to materialism? I believe no true science tends that way; it is the lack of liberal cultivation that leads to such dimness of vision. Materialism is no more prevalent now than among the Athenians, who had no physical science. We hear much of the culture of that people, as if æsthetics were the only science and floriculture the only culture. There is much in the training of the chemist to foster a wholesome skepticism and just intolerance; intolerance of human pride and skepticism of airy theories. In chemical practice the constant appeal to sensible tests and the precision of the balance checks reliance on hasty assumptions. The chemist soon learns that exact truthfulness in others and rigid honesty in himself lie at the very foundation of science and real knowledge; and he looks on laxity in experiment or statement as the unpardonable sin. No other subject is so well calculated to impress one with the idea that theories are but the changeable dress of science. We all wonder what will become of the atomic theory itself when its centennial comes round twenty-seven years hence.