proper consideration of the allied sciences (Grenzgebiete). The single editor of the fourth volume (1883–1902/3), Dr. von Oettingen, has followed in the footsteps of his predecessors. In the fifth volume, edited by Dr. P. Weinmeister under the auspices of the Saxon Academy of Sciences in Leipzig and other academies, there are further limitations in the scope of the work. "To prevent the increase in the volume we have taken less consideration of the allied sciences." This policy of the editor and the academies which fathered the new volume is in my opinion a great mistake.

With the publication of Volume 5, the time had come not to limit but to widen the scope of the Handwörterbuch. Physical anthropology, biology (animal, botanical and human), comparative zoology, physiology, medical chemistry and entomology—these subjects should not have been omitted.

On the other hand, the new volume considered from a bibliographical standpoint deserves the highest praise and is a worthy successor to the previous volumes of this monumental work.

The policy of the previous editors to request scientists, especially those living outside of Germany, to prepare their own biographical statement was continued in this volume, without consideration of political boundaries. "Real science does not know political boundaries," says the editor. All the requests were answered and there will be found quite a number of original contributions by American, Belgian, English and French scholars.

In the preface of the fourth volume the editor recommends, in case the work should be continued, that for each branch of science to be dealt with an advisory board should be appointed to decide on the names to be included. It seemed that this suggestion was not carried out in the fifth volume. For the publication of future volumes I would like to recommend the election of such a board in each country, which would prevent regrettable omissions.

FELIX NEUMANN

ARMY MEDICAL LIBRARY,
WASHINGTON, D. C.

Eleventh Report of the Committee for the Investigation of Atmospheric Pollution. Observations in the Year ended March 31, 1925.

WE have in this report[1] a review of the work done by nineteen authorities cooperating in collecting data from forty-eight different stations. Forty-four of the forty-eight gave complete results.

Extensive tables give the deposits in grams per square dekameter for each month, or metric tons per hundred square kilometers.[2] It is noted first that Birmingham, farthest from the sea, has least chlorine both for the past year and in the general average for five years. A rather curious relation appears to exist between the amount of sulphate deposited from the air and the amount of total impurity. The greater the total impurity, the lower the percentage of sulphates. Also there appears to be an inverse relation between percentage of carbonaceous matter and sulphates.

The effect of wind on impurity is graphically brought out by plotting the mean values of the suspended matter for all observations at particular wind velocities against wind velocity in meters per second. The result is a curve, the equation of which is $I = \frac{0.55}{V} + 0.27$, I being the concentration in milligrams per cubic meter and V the velocity in meters per second.

It is remarkable that this curve indicates a variation of the concentration of impurity inversely as the first power of the wind and not as some higher power, which one would expect if there had been free lateral and vertical spread of the smoke as well as the stretching-out downwind. The actual results show what a profound effect wind has on concentration.

When the wind drops below one meter per second in winter, a smoke haze or fog in London appears almost inevitable under present conditions.

From some experiments made by Dr. Owens, assuming that the density of the particles is 1, and the average diameter 0.8 micron, the velocity of settlement will be 0.003 centimeters per second and the number falling on one square centimeter per minute should be 2880. Actual results are greatly in excess of the theoretical number, indicating that other factors are operative.

"London Particular," it appears, is found by a replacement of water particles by smoke and not by a dirtying of the condensed water by smoke.

A. MCADIE

BLUE HILL OBSERVATORY

SPECIAL ARTICLES

THE IONS OF INERT GASES AS CATALYSTS

IN SCIENCE of December 25, 1925, several gas reactions were reported in which we had found that the ions of certain inert gases, produced by radiating a mixture of inert and reactant gases with alpha rays,

[1] Abstracts of earlier reports are to be found in SCIENCE, August 8, 1924, June 2, 1922, April 22, 1921, and November 28, 1919.

[2] To convert metric tons per hundred square kilometers multiply by 0.0256 to get English tons per square mile; 0.09 to get pounds per acre.

accelerated the rate of reaction without themselves reacting. The ions of the inerts were found to contribute just as much to the reaction as if the same quantity of ionization had been produced on the reactants in addition to the amount actually produced on them by direct action of the alpha rays. In other words, the reaction is proportional to the total ionization, not to the ionization of reactants alone. It was pointed out that this relation could be readily accounted for by exchange of charge if the positive ion of the inert could take an electron from the reactant molecule, thus leaving the latter positively charged. Such a theory appeared the more plausible, since the inert gases employed up to that time had ionization potentials higher than those of the reactants.

The alternative possibility was also mentioned, that *addition* of reactant and inert, not *exchange of charge* might prove to be the case, and that these points could be tested by using inerts like xenon and krypton with potentials lower than those of the reactants. For clustering by addition, a high *positive* catalysis would be found, but a high *negative* one might be expected for exchange under the influence of ionization potential, assuming the inert ion itself to have no clustering power.

Dr. R. B. Moore kindly put at our disposal several cubic centimeters of xenon and of krypton, portions of the original gases which he had fractionated for atomic weight determination[1] in Sir Wm. Ramsay's laboratory. Each of these after thorough drying was given a vigorous treatment with metallic calcium at 475° C. to remove any impurities that might have been accidentally introduced since they were prepared. They were then used to mix separately with reactants, acetylene, cyanogen and hydrogen cyanide. The velocity of polymerization was manometrically determined in the mixtures under the alpha radiation of known amounts of radon. The results unambiguously showed catalysis in proportion to the krypton and xenon ions, just as for the other inerts, He, Ne and A. The order of ionization potentials for all gases concerned is: He (24.5); Ne (21.5); C_2N_2 (16.3); A (15.2); HCN (14.8); CO_2 (14.3); Kr (12.7); C_2H_2 (12.3) and Xe (10.9).[2]

Since in all cases the reactions were positively catalyzed in proportion to the specific ionization regardless of the ionization potential, it is evident that the latter is not a factor, and that clustering about both kinds of ions as reaction centers is indicated. Of course, this catalytic evidence does not show that exchange of charge may not take place physically in the direction predicted by ionization potential, but it does prove conclusively that such exchange even if occurring is probably simultaneous with addition and does not influence the rate of reaction, which is proportional to the total ionization regardless of whether it be on an inert or on a reactant.

Indirect evidence of clustering about an inert may be seen in the fact that a small fraction of xenon in all three gases, C_2H_2, C_2N_2, and HCN, was found to have been removed from the gas phase along with the precipitated polymer. The xenon was easily recovered quantitatively by heating to about 300° to 350° C. By integrating the separate ionizations of xenon and of acetylene over the entire course of the reaction, the amount of inert removed by occlusion was calculated on the assumption of complete coprecipitation of the inert with each ion cluster of which it formed the nucleus. The quantity so calculated was five times greater than that found, showing that quantitative occlusion does not result from clustering. If all instead of part of the clustering had taken place around xenon, the discrepancy becomes yet greater. Apparently the inerts of higher molecular weight are more readily occluded in the polymer, as might be expected, than those of lower. The case of CO_2 removal with C_2H_2 precipitation, previously mentioned (*loc. cit.*), is more probably accounted for in this way than through true chemical action, but does not support exclusive clustering about the gas of lower ionization potential, since the ionization potential of CO_2 exceeds that of C_2H_2; and moreover the 12 per cent. disappearance of CO_2 exceeds the prediction even had 1 CO_2 been removed for each cluster of 20 C_2H_2 molecules.

Our inability to fasten any exceptional behavior upon CO_2 and N_2 as catalysts leaves all the more puzzling their failure to auto-catalyze reactions in which they are generated, as in the decomposition of NH_3 or of CO. Both of these decompositions have just been found to be normally catalyzed by neon, so that further work will be required to explain the behavior of CO_2 and N_2, which now appears quite anomalous in these particular cases.

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[1] R. B. Moore, *J. Chem. Soc.*, Lond., 93, 2181 (1908).

[2] We are indebted to Professor K. T. Compton and Dr. Barton for some of the latest values in advance of their publication.

THE NEW STATUS OF NET ENERGY DETERMINATION

ATTENTION was called, in the April 18, 1924, number,[1] to the net energy conception of Armsby, as the

[1] Forbes, E. B., "The Net Energy Conception," SCIENCE, April 18, 1924, Vol. LIX, No. 1529, pages 350–351.