The Ernst Julius Cohen Memorial Lecture.

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Amongst the distinguished Dutch men of science of the generation that is now passing, or has already passed, away, a very high place must, by universal consent, be assigned to the subject of this Memoir. It would be no exaggeration to say that the name, and very often the personality, of Ernst Cohen have been known to students of chemistry and physics throughout the world for nearly fifty years. His famous researches in the fields of polymorphism, electrochemistry, thermochemistry, and piezochemistry, the excellent books he wrote, his many visits to other countries and the lectures he gave therein, and—last but not least—the important part he played in the national and international organisation and development of chemical science, made Ernst Cohen one of the most outstanding and well beloved men of science of his day and generation.

He was the devoted pupil and disciple of the great van't Hoff, and belonged to that famous Dutch school of physicochemical science associated with the names of van't Hoff, Roozeboom, Cohen, and Schreinemakers. Although van't Hoff is, perhaps, best known to students of chemistry for his pioneer work on optical activity and the " tetrahedral carbon atom ", the laws of osmotic pressure, and the application of thermodynamics to the study of chemical equilibria and " chemical dynamics ", he became interested in the conditions of formation and decomposition of double salts before he left Amsterdam, and during his Berlin period (from 1895 onwards) devoted himself to the study of the formation of oceanic salt deposits. The famous work of Roozeboom on " Heterogene Gleichgewichte " is well known to physical chemists and metallurgists, whilst Schreinemakers, the mathematician and geometer, became the great investigator and exponent of " geometrical " thermodynamics as applied to the transformations and equilibria of heterogeneous multicomponent systems. Broadly speaking, we may say that Cohen took a line of his own, and devoted a large proportion of his researches to the investigation of the polymorphism of one-component systems : the conditions of equilibrium, the transitions, and the stable and metastable states of the various solid (crystalline) modifications of chemically pure substances, especially the elements. His work was characterised by the use of exact electrochemical and thermochemical methods, and by the study of equilibria and transformations at high pressures (up to 1500 atmospheres). Apart from these extensive " piezochemical " researches, he made a long-continued and intensive study of electrochemical thermodynamics, especially in relation to the study of standard galvanic cells (so-called " normal elements ").

Ernst Cohen may well be regarded as the greatest of the disciples of van't Hoff. His thesis for the doctorate in Amsterdam under van't Hoff (1893) was probably the starting point, perhaps indeed the fundamental stimulus, of much of his subsequent research work. It was entitled " The Electrical Method of determining Transition-points and the Electromotive Force of Chemical Reactions ". If under a given external pressure a chemical reaction be conducted isothermally and reversibly it will yield the maximum external work possible under these conditions. This maximum work, according to van't Hoff, measured the " affinity " of the reaction. Hence the importance of determining the reversible E.M.F. of a galvanic cell in which a chemical reaction occurs isothermally and reversibly, for in this case the maximum work per unit reaction can be calculated. So in his thesis for the doctorate Cohen entered the field of electrochemical thermodynamics, a subject which he developed throughout a long series of researches and which underlay his very important and detailed work on standard cells and other galvanic combinations. It may not be unnecessary to remark that, as probably every student knows now-a-days, the fundamental principles of electrochemical thermodynamics were established by Willard Gibbs in the period 1876—78. We may indeed say that the general *physical* theory underlying the researches of Cohen on the polymorphism and equilibria of solid phases of one-component systems and on galvanic cells, namely the principles of thermodynamics as applied to heterogeneous systems (*i.e.*, multi-phase systems), were established by Willard Gibbs. It is well known that van der Waals directed the attention of Roozeboom to this earlier work of Gibbs, and it is also well known that this indebtedness of the famous Dutch school has been very generously acknowledged. Needless to say, in mentioning the work of Gibbs there is no intention to underrate in the slightest degree the originality and the great scientific value of the work of van't Hoff, Cohen, Roozeboom, and Schreinemakers.

ERNST JULIUS COHEN.

[*To face p.* 1700.

Ernst Julius Cohen was born in Amsterdam on March 7th, 1869. It is in the highest degree probable that he would, in normal circumstances, be alive to-day. But, alas, the circumstances were terribly and horribly abnormal. Owing to the fact that he was a man of Jewish descent, it is now a practical certainty that he was foully murdered on or about March 5th, 1944, in a gas chamber at the " extermination " camp of Auschwitz. Concerning this tragic event something more will be said at the conclusion of this Memoir.

Chemistry was in his blood, for his father, Jacques Cohen, born at Düsseldorf in 1833, studied under Liebig at Giessen and afterwards under Bunsen at Heidelberg, where in 1853 he obtained his doctorate in chemistry. Having held posts in technical chemistry at Brussels and Amsterdam, Dr. Jacques Cohen, together with several friends, formed in 1864 the " Company for Chemical Industry " (the Netherlands Coal Tar Distillery), of which he remained Director until his death in 1881. He married in 1863 Johanna Rosenthal, a native of Hanover. Both Jacques Cohen and his wife became Dutch by naturalisation. Ernst Julius was the third of their children.

At the secondary school (Hoogere Burgerschool) in Amsterdam the young Ernst studied chemistry and took a great interest in photography, for which the summer holidays, often spent with his parents in Switzerland, gave him plenty of opportunity. His earliest publications dealt with subjects relating to the art and science of photography. After the school " passing-out examination " came the preparation for the State examination giving access to the University. During this period he was fortunate to obtain excellent private lessons in Latin and Greek from Dr. J. S. Speyer, teacher at the Amsterdam Gymnasium (higher secondary school) and later Professor at Leiden University. This classical and literary training was invaluable to him in later years. In June 1888 he passed the State examination and was then able to devote himself to the study of the exact sciences at the University. The lectures of van't Hoff, van der Waals, and Korteweg particularly attracted him, and with Dr. Ch. M. van Deventer (one of van't Hoff's assistant) he made an investigation of heats of solution. Having passed the " Candidate Examination " in 1890 he went, on van't Hoff's advice, to Paris and worked for a short time in the laboratory of Moissan (then very famous for his isolation of fluorine in 1886). Armed with introductions from van't Hoff, he also visited Berthelot, Pasteur, and Gabriel Lippmann, and saw something of their work and their laboratories. Professor Marey also showed him his photographs of animals in motion. Returning to Amsterdam, he soon afterwards spent some time at the State Agricultural Experimental Station at Breda, where he acquired valuable experience in analytical chemistry. Then came the preparation for the " Doctoral Examination " at the University and attendance at the senior lectures of van der Waals and van't Hoff. This examination was successfully passed in November 1892.

The young candidate for the Doctorate had now to choose the subject for his Doctor thesis. Apparently his reading of van't Hoff's " Études de Dynamique Chimique " induced him to request of his prospective sponsor permission for an investigation of the electromotive force resulting from a chemical reaction. Van't Hoff agreed—but with a warning about the difficulties. However, all went well in the end, and on November 8th, 1893, Cohen attained the doctorat ein chemistry with honours. The title of his thesis has already been given (see p. 1700).

With his appointment as a demonstrator in van't Hoff's laboratory, there now began a very strenuous period of teaching and research, lasting nine years. Shortly after graduation he married Miss Louise Gompertz, who greatly contributed to the happiness of his home life and the efficiency of his University work. Van't Hoff's new laboratory at Amsterdam became a very active centre of research. In the old laboratory Arrhenius and Meyerhoffer were already working, and to the new laboratory came many men whose names became well known in chemical science—W. D. Bancroft, H. C. Jones, R. Löwenherz, V. Rothmund, and J. Verschaffelt.

Ernst Cohen soon became a Lecturer (Privat Dozent) and a very active and successful investigator. In collaboration with Bredig and van't Hoff he continued the work on " transition elements ", and published several papers on subjects related to his interest in photography, *e.g.*, the action of hydrogen on silver bromide gelatine plates; the solubility of silver halides in various solutions; the supposed influence of gelatine on the double decomposition of salts.

A great change came in the Amsterdam laboratory when, in 1895, van't Hoff resigned, and was succeeded by Bakhuis Roozeboom. Cohen now took a much greater part in the lectures on physical chemistry, but this did not interfere with his output of research. Besides work on the decomposition of arsine and on the ionisation of substances in alcohol–water mixtures, his famous series of investigations on the allotropic modifications of tin began, at first in collaboration with van Eijk, whose attention had been drawn to this problem by Roozeboom.

Cohen's reputation as a physical chemist had now risen so high that in 1898 he was offered the Chair of Physical Chemistry at McGill University in Montreal. He was, however, so happy in Amsterdam and his relations with Roozeboom were so friendly that he declined the honour. In 1901 he became " extraordinary " Professor of Chemistry in the University of Amsterdam, with special reference to Physical Chemistry.

His reputation as a physical and inorganic chemist was now established, with the result that in 1902 he was appointed to the Professorship of Inorganic and General Chemistry at the University of Utrecht. At first he had to occupy the old and very inadequate laboratory which dated from the time of G. J. Mulder. But he had accepted the Chair at Utrecht on the condition that a new laboratory should be built. The new and excellent laboratory, built to his own designs and named the van't Hoff Laboratory in honour of his great teacher and inspirer, was opened on May 18th, 1904, with van't Hoff himself as the guest of honour.

Now began the great period of his life as Professor at Utrecht and Director of the van't Hoff Laboratory, a period which lasted until his retirement in 1939. During this period of thirty-five years he built up one of the world's great centres of teaching and research in physical chemistry. However, it might have happened that Utrecht soon lost Cohen, for, after he had been only five years there, Roozeboom died (1907), and the Professorship at Amsterdam became vacant. It was offered at first to Schreinemakers, who declined. Then the invitation came to Cohen. But he was so happy in his new laboratory and amongst his new colleagues that he also declined the honour.

A very large proportion of the researches in Utrecht due to Cohen and his collaborators and students dealt with the polymorphism of substances, both elements and compounds. The work on tin, begun in Amsterdam, was continued and much developed. This is perhaps the most famous of all his investigations. It had been known before his time that certain organ pipes made of tin in the old castle church at Reitz had largely crumbled into a grey powder during a cold winter (as reported by G. L. Erdmann in 1851), and Fritzsche in 1869 had described a case where blocks of Banca tin had similarly " decayed " in the store of a custom house in Russia. These extraordinary phenomena were explained by Cohen, who showed that they were due to the transformation of ordinary " white " tin into another modification, " grey " tin. By dilatometric and other methods he found the transition temperature to be 18° (corrected later to 13·2°). Below this equilibrium temperature, ordinary white tin is unstable with regard to the stable modification, *i.e.*, the grey tin. But under ordinary conditions the change does not occur, the white tin being then " metastable ". The change may, however, be greatly accelerated by various means, *e.g.*, lowering of temperature, presence of certain solvents, " inoculation " with grey tin, etc. Cohen drew attention to the fact that objects of tin kept in museums sometimes develop warty " intumescences ", owing to the gradual and local onset of the change to grey tin. He called this the " museum disease ", and such changes became celebrated as the " tin disease ".

The next case he investigated was the phenomenon known as " explosive antimony ". If a concentrated solution of antimony chloride in water (plus some hydrochloric acid) be electrolysed with an antimony anode and a platinum cathode, the metallic deposit on the cathode, if scratched or struck, shows a sudden large evolution of heat, accompanied by clouds of white fumes. Cohen showed that this phenomenon is due to the fact that the original metallic deposit is an unstable (*i.e.*, metastable) modification which changes with evolution of heat to a stable modification, the clouds being caused by the volatilisation of occluded antimony chloride.

He was now well embarked on his great series of investigations of the " physical metamorphosis " (as he called it) of solid substances. In the case of tin, the grey tin is (at ordinary atmospheric pressure) stable below the corresponding transition temperature, the white tin stable above it. This is a case of *enantiotropy*, the two forms being *enantiotropic*. In the case of antimony, one modification has no temperature region of true stability (always metastable). This is an example of *monotropy*. In a long series of researches these phenomena of polymorphism of solid (crystalline) substances were investigated in numerous instances—phosphorus, tellurium, cadmium, bismuth, zinc, copper, the " explosive " platinum metals of Bunsen, lead, silver, potassium, sodium, antimony iodide, cadmium iodide, silver iodide, thallous picrate, ammonium nitrate, etc.

Special attention was paid to the existence of metastable phases and to their usual formation under conditions where the stable ones would be " thermodynamically " expected. The phenomena of both enantiotropy and monotropy were found to be exceedingly common amongst both elements and compounds. From 1909 onwards a series of papers entitled " The metastability of our metal world on account of allotropy, and its significance for physics, chemistry, and technology " were published by Cohen, who had gradually come to the conclusion that most metals in common use were, if not entirely metastable, at least mixtures of stable and metastable forms (phases). The same thing applied to the majority of solid non-metallic substances. He was also forced to the conclusion that the well-known tables of physical constants, *e.g.*, density, specific heat, etc., contained unreliable data owing to the *physical* " impurity " of solid chemically pure substances.

Reference may be finally made to Cohen's investigations of what he called the " strain disease ". Cold working, especially polishing, of metals produces, according to him, metastable conditions as a result of partial disruption or deformation of crystalline structures and the formation of " amorphous " states which, owing to vibration or other causes, are liable to a sort of " recrystallisation ", *i.e.*, reversion to the stable crystalline state (compare the " flowed " state of Beilby). Hence the technically troublesome phenomenon of " season cracking ".

In his work on the transformation of solid substances from one stable phase to another one, stable at higher temperatures, a very characteristic feature of Cohen's researches was the employment of what he called " transition elements ". Various types of such galvanic cells were used, of which a few examples may be mentioned here. If the E.M.F. of the cell

Metal M in the *stable* solid phase	A solution of a salt of M	Metal M in the *metastable* solid phase

be measured at a constant pressure but at different temperatures, it will have a zero value at the transition temperature (equilibrium temperature). The transition cell

Metal M in the *stable* solid phase	A solution of a salt of M	An amalgam electrode of the metal M

will show a break in the curve relating E.M.F. to temperature at the transition temperature, provided that the amalgam suffers no change of condition (such as a change from a purely liquid to a heterogeneous state, or vice versa), and that the phase change of M is not retarded.

The cell (analogous to the standard Clark cell)

Zinc amalgam	Saturated solution of $ZnSO_4,7H_2O$ in contact with the solid salt	Hg_2SO_4,Hg

will show a break in the E.M.F.–temperature curve when the solid heptahydrate changes to the solid hexahydrate.

A study of galvanic cells led him to a long series of researches on the electrochemistry of the standard Clark and Weston cells, including also the Daniell cell and the calomel cell of Lipscomb and Hulett. A close and accurate investigation of all the actions occurring in such cells and the conditions of stability or metastability of all the phases present, whether solid metals, metallic amalgams, or solid salts, led to great and important advances, including, for example, the demonstration that the standard Weston cell (as then employed) was quite unreliable. This close and accurate analysis enabled him to determine with high precision the various quantities occurring in the Gibbs–Helmholtz equation. His work in this field was indeed a most valuable contribution to electrochemical thermodynamics.

An important part of the researches carried out in the Utrecht laboratory by Cohen and his collaborators concerned the effect of pressure on the reactions and equilibria occurring in condensed (liquid and solid) systems. To this branch of chemical science he gave the name " piezochemistry ". An account of the work carried out in this field up to 1914 was published by Cohen and Schut in a book entitled " Piezochemie kondensierter Systeme " (Leipzig, 1919). This valuable work contained detailed references to the existing scientific literature. An excellent and detailed account of his researches in piezochemistry (up to 1925) can be found in his book entitled " Physico-chemical Metamorphosis and some Problems in Piezochemistry " (McGraw Hill, 1928), which contains the twenty-one lectures which he delivered at Cornell University as the George Fisher Baker Non-Residential Lecturer (1925—26). It may be said in passing that anyone wishing to obtain a first-hand and detailed account of Cohen's principal fields of research may be referred to this book.

The elaborate high pressure apparatus constructed in the Utrecht Laboratory enabled measurements to be made up to 1500 atmospheres. A mere enumeration of the principal types of effects which were studied will indicate the extent of this work. These included the effect of pressure on : (1) rates of chemical reaction ; (2) transition temperatures of solid phases ; (3) electromotive force of galvanic cells ; (4) solubilities of solid substances ; (5) Faraday's first law ; (6) velocity of diffusion in liquid systems ; (7) viscosity of liquids ; and (8) electrical conductivity of solutions. So great was the extent and detail of these investigations that only a few remarks can be made on an occasion such as the present. The rate of inversion of sucrose at 25° in an aqueous hydrochloric acid solution was found to be reduced by about 26% when the pressure is increased from one to 1500 atmospheres. In the hydrolysis of ethyl acetate by sodium hydroxide in aqueous solution a rise of pressure from one to 1500 atmospheres increased the reaction-velocity constant by 37%. In these and other similar cases of reaction-velocities the measured effects could not be related to thermodynamical equations dealing with equilibrium states. In the case, however, of transition temperatures of solid phases, use could be made of the well-known Clapeyron equation

$$\frac{\mathrm{d}T}{\mathrm{d}p} = \frac{T(v_2 - v_1)}{q},$$

where $v_2 - v_1$ denotes the volume change, T the transition (equilibrium) temperature, p the pressure, and q the corresponding heat absorption. In connection with the effect of pressure on solubility, Cohen was able to relate his experimental data to the thermodynamical equation known as " Braun's law ", namely

$$\left(\frac{\partial x}{\partial p}\right)_T \Big/ \left(\frac{\partial x}{\partial T}\right)_p = - T\Delta v/Q,$$

where x denotes the solubility (as moles of solute in a given mass of solvent). On the right-hand side of the equation, Δv denotes the so-called " fictitious " volume change, *i.e.*, that corresponding to the solution of one mole of the solute in a large quantity of the saturated solution at T and p, and Q the corresponding amount of heat absorbed under such conditions, *i.e.*, the " fictitious heat of solution ". These fictitious quantities are simply the *limiting* values approached as the concentration of the solution approaches the saturation (equilibrium) value at the given p and T. A fuller and more precise discussion of these matters and a mathematical proof of Braun's equation would have been desirable, but the foregoing remarks must suffice for the purpose of indicating the general nature of Cohen's work in this particular field of investigation.

The measurement of the effect of pressure on the E.M.F. of a reversible galvanic cell at constant temperature enabled Cohen to ascertain the effect of pressure on the " affinity " (in the sense of van't Hoff's definition) of the chemical reactions occurring in the cell, and led him to a very interesting series of investigations (which included measurements of the effect of pressure on the Clark and Weston cells and the lead accumulator). In connection with his work on the effect of pressure on diffusion velocity, a brief reference may be made to the potentiometric measurement of the rate of diffusion of cadmium into mercury. It was found that the velocity of diffusion of cadmium into mercury at 20° is reduced by 5% on application of an external pressure of 1500 atmospheres. Measurements of the viscosity of mercury (at 20°) at pressures of one atmosphere and 1500 atmospheres led Cohen to the conclusion that the product of the diffusion velocity and the viscosity is equal to a constant *independent* of the pressure. Finally, it may be mentioned that he proved experimentally that the electrical charge of an ion in solution is unchanged by an increase of pressure up to 1500 atmospheres.

This brief sketch of some of the main lines of investigation carried out by Cohen and his collaborators might be much extended, did space permit. For example, much excellent calorimetric work on specific heats of solids and solutions and on heats of solution deserves mention, especially the very interesting investigation on the (negative) heats of solution of the various polymorphic forms of cadmium iodide, and their mixtures, which was made possible by the use of a specially constructed and very accurate form of electrical adiabatic calorimeter. Many other lines of work would be worthy of discussion, but the mere mention of a few of them must suffice : osmotic pressure and its measurement; corrosion of metals; effect of traces of water on equilibria in solutions, and superheating in relation to the intensive drying of liquids; influence of dispersity on solubility and physico-chemical constants; velocity of polymorphic changes and the influence of mechanical deformation; polymorphy of ice at one atmosphere pressure.

A very characteristic part of the many activities of Ernst Cohen was due to his deep interest in the history of science, especially, of course, chemical science. Anyone visiting his laboratory or his home was at once struck by the abundance of old prints relating to personalities and events of interest or importance in this history. In his own country he was the moving spirit in the establishment of the historical Committee of the Dutch Chemical Society and the formation of its valuable historical library. He was also one of the founder members of the Dutch Society for the History of Medicine, Natural Sciences, and Mathematics, becoming its Chairman in 1916. A long series of " chemical-historical " articles and notes in the *Chemisch Weekblad* bear ample witness to his activity in historical research, as do also various books, namely one on the history of " laughing " gas, one on Herman Boerhaave, and his great book on the life and work of van't Hoff.

For a man so actively engaged in the laboratory, his scientific–literary output of books was quite remarkable. In addition to those to which reference has been made, the following may be mentioned : " Studien zur chemischen Dynamik " (an enlarged edition of van't Hoff's " Études de Dynamique Chimique ") ; Monograph on Tin in Abegg's " Handbuch der anorganischen Chemie " ; two textbooks for medical students, one on physical chemistry, and one (with van Romburgh) on inorganic chemistry.

In the field of national and international organisation and co-operation in science, Ernst Cohen took an active and distinguished part. He was a member of the original executive Committee of the Dutch Chemical Society (founded in 1903), and became its first President. He took a very active share in the work of this Society, becoming President again ten years afterwards and finally Honorary President. Elected a member of the Royal Netherlands Academy of Sciences in 1913, he did much to promote the scientific work, organisation, and prestige of this famous Academy. He became a member, and subsequently Chairman, of the Dutch Committee on Coinage. In the international field he took an active part as a member of the Council of the International Union of Pure and Applied Chemistry, becoming President of the Union in succession to Sir William Pope. For many years he was a valuable member of the International Committee responsible for the annual tables of physical and chemical constants. It is no exaggeration to say that as time went on he became one of the great cosmopolitan representatives of chemical science. Invitations to give lectures came to him from many countries. These lectures were very successful, for he was not only a good lecturer but a good linguist, speaking fluent English, French, and German. In this country he delivered the Kamerlingh Onnes and Messel lectures, and also a number of other lectures during his frequent visits to London, Oxford, and Cambridge. Perhaps the most famous—certainly the most extensive—visit was one to Cornell University in the second semester of 1925—26, when he gave a course of twenty-one lectures, as Non-Resident Lecturer in Chemistry on the Baker Foundation. Besides such invitations for special lectures, he took part on various occasions in the meetings of the Faraday Society, the German Bunsen Society, the German Naturforscherversammlung, and many similar societies. So high indeed was his position in the esteem of chemists throughout the world that it would scarcely be possible on the present occasion to enumerate the many invitations he received to visit various countries for special ceremonies. Perhaps it may be permissible to make one exception, namely his visit to Liverpool in 1906 on the occasion of the opening ceremonies of the Muspratt Laboratory of Physical and Electro-Chemistry.

Honours came to him from many countries. It is pleasant to remember that in this country he was elected a Foreign Member of the Royal Society, an Honorary Fellow of the Chemical Society, and an Honorary Member of the Royal Institution.

One of the greatest things Cohen did in the cause of international friendship and co-operation was the famous meeting at Utrecht in the summer of 1922. When staying with Donnan in 1920, the suggestion was made by the latter that it would be a fine thing if an international meeting of chemists could be held in some " neutral " country, preferably Holland. This idea was eagerly taken up by Cohen, who, ably assisted by his colleague, Professor van Romburgh, formed a small international Committee to discuss the matter. This Committee, consisting of E. Biilmann (Copenhagen), G. Bruni (Milan), Victor Henri (Zürich), R. Schenck (Münster), Paul Walden (Rostock), and R. Wegscheider (Vienna), together with Cohen, van Romburgh, Kruyt, and Donnan, met at Cohen's house in 1921. Invitations to 100 chemists in many countries were issued in March 1922, and the great Reunion was held at Utrecht during June 21st—23rd, 1922. Unfortunately, no Belgians or French were present, but from Germany came Bodenstein, Bredig, Hahn, Pfeiffer, Schlenk, Schenck, Stock, Walden, and Wieland. Cohen opened the meeting with words of warm welcome (in five languages), many scientific lectures were held, and magnificent hospitality was provided by our generous Dutch hosts. The Utrecht Reunion was a great success, and a very splendid and noble deed in the cause of international friendship on the part of Dutch men of science.

Ernst Cohen was a man of firm and sincere character, who had many friends in the world of science. The writer of this Memoir met him first in 1904 and was privileged to enjoy his friendship for thirty-five years. His equable and kindly, though serious, temperament, his dry wit and good-natured humour, his constant regard for the wishes and wants of others—all these qualities endeared him to his friends. He was very methodical and systematic in his ways of life, which was one of the secrets of his huge accomplishment of work. He was thrice married, and is survived by his third wife, nee Miss W. A. T. de Meester (now Mrs. van Ginneken-de Meester). His friend and colleague, Professor H. R. Kruyt, has written an appreciation of Cohen's personal qualities as a University teacher and director of research. He possessed in high measure the power of inspiring and guiding his research students and collaborators. Great freedom of thought and initiative were encouraged by the director, but if necessary one had to defend one's point of view by reasoned argument. The result was a happy and co-operative band of successful workers. So great was the number of his research collaborators and assistants that only three can be mentioned here, namely, Miss W. A. T. de Meester (who later became his wife), H. R. Kruyt, and A. L. Th. Moesveld. As is well known, H. R. Kruyt later became a University Professor and colleague of Cohen at Utrecht, and created in the van't Hoff laboratory a famous school of teaching and research in colloid chemistry.

The tragic end of Cohen's life has been described by Kruyt in the *Chemisch Weekblad* (1945, **41**, 126—128). In 1941 his property was seized and in April 1942 his house was taken for German officers, but fortunately friendly neighbours took Cohen and his wife into their house. In May 1942 he was obliged to wear the " yellow star " and became subject to the restrictions imposed on Jews. Matters came to a head in 1943, when on a visit to the laboratory he was arrested and taken to a prison in Amsterdam, the charge being that he had entered a " public " building. The many efforts of his friends to secure his release were unavailing, and Cohen was sent to the concentration camp at Vught in Holland. At a discussion of this state of affairs by the Council of the Dutch Chemical Society, it was proposed by Dr. Kappelmeier that an approach be made to the S.S. authorities at the Hague. This was successful, Cohen was released, and soon afterwards was freed from practically all the restrictions imposed on Jews. But the enemies of the Jews had not yet finished with him. On February 28th, 1944, a friend, having found out that an order for his arrest had come from Amsterdam to the Utrecht police, telephoned Cohen, who then, on good advice, moved to another friend's house (thus evading immediate arrest), and when night fell came to see Kruyt. Kruyt advised him strongly to " dive ", and so give his many friends time to approach the German headquarters at the Hague. But this he refused to do, maintaining that he had done nothing wrong and that the whole affair must be due to some misunderstanding. Moreover, he refused Kruyt's advice to approach the S.S. headquarters at the Hague himself. Instead, he informed the Utrecht police of his whereabouts, was arrested and taken to Amsterdam, and on March 1st to Westerbork. Here further efforts were made by his friends to induce him to approach the Hague, but all in vain. The end was now not far off. All the evidence goes to show that on March 3rd he was transported (with many others) to the notorious " death " camp at Auschwitz and there murdered in a gas chamber. It is only fair to say that the good treatment Cohen received at the Hague was due to a certain Fräulein Slotke and her chief, Zöpf, who stood next in rank to Rauter. But towards the end of February 1944 Zöpf was not in Holland ! So the enemies of Cohen seized their chance. As regards Cohen himself, Kruyt's opinion was that the shock of the earlier events had shaken his morale and enfeebled his judgment. It seems very probable that if he had taken Kruyt's good advice, his many friends would have safely hidden him until Zöpf returned to the Hague, and so saved his life.

So was murdered by some Nazi criminals the man who had worked in the friendliest co-operation with German men of science for fifty years, the man who had published a large proportion of his scientific work in the German language, the man who had organised the " Peace of Utrecht ".

In conclusion, I express my sincere thanks to Professor H. R. Kruyt who kindly supplied me with a number of reports on the life and work of Ernst Cohen. I am also much indebted to Dr. S. Coffey and Mr. Francis Bolam for help with translations from the Dutch originals.