OBITUARY NOTICES.

CHARLES STANLEY GIBSON.*

1884—1950.

Charles Stanley Gibson was born in Manchester on the 8th February, 1884. He was a member of a large family being the seventh son of his father, Joshua Gibson. He received his early education at the Manchester Grammar School, which he attended from 1897 to 1902. The educational standard of this school then, as now, was very high and it was one of the earliest schools to give an adequate training in science. After passing through the Modern Fifth he transferred to the science side where he came under the influence of Francis Jones. Francis Jones was probably one of the greatest of school chemistry masters; as a student at Owens College under Sir Henry Roscoe he, with Sir Edward Thorpe, assisted in the classical vanadium investigations and he never lost his interest in research. His lectures to the boys—and they were lectures rather than lessons—were profusely illustrated by experiments, in fact of such a high quality were these lectures that Gibson later found Professor H. B. Baker's lectures at Oxford to be largely a repetition of them. It was, however, the training in the laboratory which was particularly valuable. Each boy had his own set of apparatus and prepared all the simple gases and was then given a course of qualitative analysis. This followed the well-known Bunsen course of dry tests with the blow-pipe and borax beads. It was here that Gibson began to acquire the experimental skill which he was later to apply with such success.

In 1902 he proceeded to Corpus Christi College, Oxford, with a Natural Science Scholarship. It took him some time to settle down to life in an Oxford college, so different from his previous home life. He owed much to the advice and encouragement which he received from his tutor, F. C. S. Schiller, of whom he always spoke with respect and affection. His chemistry tutor was John Watts, who undoubtedly did much to make him the good organic chemist which he later became. Whilst at Oxford he had apparently few outside interests. It was a disappointment to him that when he graduated in 1906 he only obtained a second-class. He attributed this in part to his colour blindness and his inability to use a spectroscope in the practical examination. In spite of his defective eyesight he trained himself to be a most accurate observer with the polarimeter.

After graduation he joined Professor W. J. (later Sir William) Pope at the Municipal College of Technology in Manchester as a research assistant. Pope was then at the height of his powers, and this appointment was to influence the whole of Gibson's future life. Between these two men, so very different in physique and character, a close and intimate friendship developed. It is doubtful if, during Pope's lifetime, Gibson ever made any important decision without first consulting him.

To this laboratory (Manchester) towards the end of 1907 came John Read, who had recently taken his Ph.D. degree under Werner at Zurich; besides Gibson, the other research workers in Pope's private laboratory at that time were S. J. Peachey and George Jerusalem, a young chemist and crystallographer from Vienna. When Pope assumed the Cambridge chair in the autumn of 1908, Read and Jerusalem accompanied him. Later, in 1909, Gibson also migrated to Cambridge to work with Pope as the holder of a Senior Studentship of the Goldsmiths' Company. He undertook demonstrating work in the University Chemical Laboratory, and also gave a certain number of lectures to advanced students. At Manchester he had worked on organic compounds of gold. At Cambridge he devoted much time and effort—for he was an assiduous worker—to the synthesis and optical resolution of asymmetric phosphonium compounds; this tedius and often unpleasant work led to no satisfying result.

Gibson took the M.A. degree of Cambridge by incorporation, and became a member of Sidney Sussex College, of which Pope was a Fellow; here he undertook supervisory work in chemistry. During this period at Cambridge, Gibson's chief recreations were tennis and cycling. In the company of Read, and sometimes also of Jerusalem, he explored the countryside around Cambridge in the course of many pleasant cycling runs during fine week-ends. In the early summer of 1912 he went with Read on a tour of the West Country, starting at Bruton and ending at Porlock Weir; this he enjoyed greatly, in spite of his companion's puzzling dialect conversations with the natives, which struck strangely on his Northern ear. During this period

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he also paid his first visits to the continent, on two occasions with Dr. M. P. Applebey. He showed a keen appreciation of the continental ways of life and manners.

In his room at Cambridge, Gibson exercised his skill as a pianist and sometimes held modest musical gatherings. Together with Read, he became a frequent visitor at Pope's house in Brooklands Avenue, where upon rare occasions Pope might be induced to play the violin. Gibson also brought together a number of research men from the University Chemical Laboratory in a so-called Alembic Club. At meetings held in the rooms of the various members—among whom were Read, Jerusalem, John Thomas, and John Weir—papers on research subjects of current interest were given and discussed by the members. Gibson took a great interest in this Club, which fulfilled a very useful function during its existence of several sessions.

In 1912 he was appointed to the Chair of Chemistry in the Maharajah's College at Trivandrum, an affiliated College of the University of Madras. Although Gibson's predecessor, Dr. A. W. Bishop, had been a student of Claisen and W. H. Perkin, jun., he had done little to improve the teaching facilities which were very primitive. To this college Gibson brought new life. Undeterred by the difficulties and having re-organised the courses of instruction he immediately embarked upon original research. He succeeded in persuading the Travancore Government to supply him with a fine spectro-polarimeter but preparative work was almost impossible. Fortunately I was able to arrange for him to pay frequent visits to Madras to give courses of University lectures during which time he could work in my laboratory under conditions which, although poor, were somewhat better. We were thus able to renew a school friendship but collaboration at this time did not last long. Gibson was intensely patriotic and on the outbreak of the war in 1914 he felt he must return to England. Not being a British Government servant he was able in 1914 to get seconded for War Service and he did not return to India.

In England he immediately rejoined Pope and their work on the manufacture of mustard gas is too well known to require a detailed discussion. Unfortunately during the course of this work, owing to an accident in a works, Gibson suffered from gas poisoning and there is little doubt that he never fully recovered from this. His services to the country were recognised in 1919 by the award of the O.B.E. and during the same year he was appointed Professor of Chemistry at the Egyptian Government School of Medicine in Cairo. His stay there was, however, to be very brief and on the transfer of the late Professor T. M. Lowry to Cambridge he succeeded him in 1920 at Guy's Hospital Medical School. Here he was to remain until September 1949, when he became Emeritus. He took his teaching duties very seriously and devoted much attention to the preparation of his lectures and to the practical courses of his medical and dental students. Evidence of this is to be found in his publications, and by his membership of the Board of Studies he did much to improve the standards of the teaching of chemistry in the London Medical Schools. Whilst greatly appreciating the work which he was doing, he was disappointed never to have had the opportunity of training advanced students and building up a school of research.

His duties in the medical school did not exhaust his energies and he gradually became involved in the work of scientific societies. In company with Pope he attended many international meetings and he greatly enjoyed his continental visits. His major interest for many years was, however, the Chemical Society, and in 1924 he was appointed one of the Honorary Secretaries, a post which he continued to hold until 1933. These were years of great difficulty and as the Senior Secretary he shouldered most of the burden. It was during this period I enjoyed for a time the hospitality of his laboratory and I saw how heavy the burden was and how seriously he took his duties. After ceasing to be secretary he was Vice-President for two periods, 1933—1936 and 1942—1945, whilst he was for many years a member of the Publication Committee. His loyalty to the Society was shown once again in 1945 when on the sudden death of the editor, Dr. Clarence Smith, he undertook the onerous editorial duties until a successor could be found. His long connection with the Chemical Society resulted in close friendships with Emile Mond and A. J. Greenaway and for a number of years his holidays both at home and abroad were spent with them. From his friendship with Greenaway arose his interest in organic nomenclature. He was for many years a British representative on the Organic Chemistry Nomenclature Commission of the International Union. Although his health was already very precarious he attended meetings of the Commission in Amsterdam in September 1949.

On the formation in 1935 of the Academic Assistance Council (later the Society for the Protection of Science) he was with Sir William (later Lord) Beveridge appointed as Secretary.

No better choice could have been made. He possessed just the right abilities of tact and sympathy required for carrying out what, in many cases, were somewhat distasteful duties. He was interested also in the British Association, being the Recorder of Section B from 1927 to 1931 and President of the Section at the Cambridge meeting in 1938. He also served on the Councils of the Royal Institute of Chemistry and of the Royal Society of Arts.

At the outbreak of war in 1939 Gibson at once placed his services at the disposal of the Government. For a time he worked at the Board of Trade but he did not find the work congenial nor of a kind to offer sufficient scope for his qualifications. Later he became the Senior Gas Adviser for the London Region and subsequently for Region 12. Undeterred by the difficulties involved in the removal of the Medical School to Tunbridge Wells he carried out his duties most energetically. He organised an excellent course of lectures for gas identification officers and he himself conducted anti-gas practical classes. At the same time he vigorously carried out his research on gold films and it was an intense disappointment to him that the anti-glare glasses which he designed were found to be unsuitable for use in the R.A.F.

These very varied activities gradually affected his health and in 1947 he had a slight stroke, from which, however, he made a remarkable recovery. In 1949 he had a second, severe stroke, which was followed by pleurisy and pneumonia. He made a partial recovery and when I saw him last January he spoke with his usual optimism and courage of travelling to either Torquay or the South of France to recuperate. In spite of the devoted nursing of Mr. and Mrs. Nield, who had looked after him for more than 20 years, he gradually failed and died on the 24th March.

Gibson was not married and when he first settled in London, he lived in St. Thomas Street near the hospital with Professor T. B. Johnstone. In 1930 he built a house at Kingswood, Surrey, laying out a garden from which he derived much pleasure. He had many interests besides chemistry. In his younger days he was an accomplished pianist but he was always critical of his own performance and latterly satisfied his love of music by listening to the B.B.C. concerts. He had a large collection of pestles and mortars and from his friend, A. J. Greenaway, he inherited a number of Kate Greenaway's paintings. His physique did not enable him to become a very active participant in games, but he was a good swimmer.

His services to science did not pass unrecognised. As already mentioned he received the O.B.E. in 1919 and was elected to the Fellowship of the Royal Society in 1931. He was an honorary member of the Société de Chimie Industrielle.

SCIENTIFIC WORK.

Gibson's output of original work was very considerable and he was the author of about 120 memoirs and a number of books. This output was the more remarkable since, except for a few years whilst he was a member of the Gas Warfare Board, he had no paid assistant and the majority of his collaborators were members of the teaching staff. Apart from a few minor papers, his researches were limited to four main fields—stereochemistry, organic arsenic compounds, natural products, and organic compounds of gold. It was in the last-mentioned field that he made his most important contributions to science.

Stereochemistry.—Through his close association with Pope, Gibson naturally developed a leading interest in stereochemistry. He carried out much excellent and painstaking work in this field over a long period, the results of which were published chiefly in our *Journal.* Already during his first period at Cambridge (1909—1912) he devoted much of his time and energy to work on the preparation of quaternary phosphonium salts of the type $PR_1R_2R_3R_4X$, starting from monosubstituted chlorides, $RPCl_2$, and endeavouring to introduce other radicals by means of such reagents as mercury diaryls and Grignard reagents. It was hoped that a suitable halide salt of this type, when treated with the silver salt of one of the optically active camphor acids, would prove capable of optical resolution, after the pattern of Pope and Peachey's allylbenzylmethylphenylammonium iodide. Gibson found, however, that the synthesis of mixed phosphonium salts of the required type presented great difficulties, and in spite of repeated attempts he was unable to obtain a satisfactory product.

The bulk of Gibson's stereochemical work was concerned with optical resolutions of externally compensated acids and bases of various kinds. In 1910 (with W. J. Pope, *J.*, **97**, 2207), in studying the resolution of pavine with (+)-α-bromocamphor-π-sulphonic acid, he found that, conversely, the (±)-acid was also readily resolved by pavine, the (+)-base leading to the (−)-acid through the less soluble diastereoisomer, (+)-B, (−)-A. At this time also (with W. J. Pope, *ibid.*, p. 2211) he made accurate measurements of the rotatory powers of (+)-camphor-10-sulphonic acid and some of its inorganic salts.

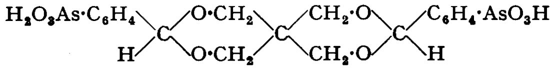
Considerably later (with H. Burgess, *J. Soc. Chem. Ind.*, 1925, **44**, 496T) he devised what is probably still the best way [unless a supply of (−)-camphor is available] of gaining access to the (−)-form of this acid, so valuable for many stereochemical purposes. The (±)-acid, prepared by sulphonating synthetic camphor, is treated with brucine in such a way as to remove most of the (+)-acid in the form of the salt (+)-A, (−)-B; the impure (−)-acid obtained from the mother-liquors is then recrystallised about five times from ethyl acetate, until optically pure.

A particular interest in optically active forms of bases and amino-acids is exemplified in Gibson's optical resolution of benzoylalanine, using strychnine and brucine (with W. J. Pope, *J.*, 1912, **101**, 939); of (±)-*sec.*-butylamine, using the (+)-form of the π-acid (with W. J. Pope, *ibid.*, p. 1702); of (±)-toluene-*p*-sulphonylalanine, using strychnine and brucine (with J. L. Simonsen, *J.*, 1915, **107**, 799); of (±)-tetrahydro-β-naphthaquinaldine (-5 : 6-benzquinoline) (with J. L. Simonsen, *J.*, 1915, **107**, 1148); of naphthalene-α- and -β-sulphonylalanine (with W. M. Colles, *J.*, 1924, **125**, 2505); and of (±)-*p*- and (±)-*m*-nitrobenzoylalanine (with W. M. Colles, *J.*, 1928, 99; 1931, 270).

In collaboration with G. M. Bennett (*J.*, 1923, **123**, 1570), alone (*J.*, 1927, 342), and with J. H. Nutland and J. L. Simonsen (*J.*, 1928, 108), he published a series of investigations on the isomerism of reduced derivatives of quinoxaline.

Finally, a special interest attaches to his introduction in 1929 (with B. Levin, *J.*, 1929, 2754) of (+)-nor-ψ-ephedrine as a basic resolving agent. This airly strong base of low molecular weight has the structure, $HO{\cdot}CHPh{\cdot}CHMe{\cdot}NH_2$, and is readily obtainable from a Chinese drug, Ma Huang. Gibson used it (*loc. cit.*) for resolving (±)-benzenesulphonylalanine and (±)-*N*-phenylalanine-amide-4-arsinic acid, and also (with B. Levin, *J.*, 1929, p. 2759) (±)-*N*-2-methylphenylalanine-amide-4-arsinic acid.

Later (with B. Levin, *Proc. Roy. Soc.*, 1933, *A*, **141**, 494) he provided the most striking example of the successful introduction of this resolving agent by the use of its (+)- and (−)-forms, achieving the resolution of an arsonic acid having molecular dissymmetry. The condensation of benzaldehyde-*p*-arsonic acid with pentaerythritol gave the tetrabasic (±)-*spiro*bis-3 : 5-dioxan-4 : 4′-di(phenyl-*p*-arsonic acid),



Tetrasodium salts of this acid were obtained, having in aqueous solution $[\alpha]^{20}_{5461}$ ±70·2°.

Natural Products.—On taking up his Indian appointment Gibson continued for a time to work on stereochemical problems but he soon realised the importance of studying the natural products of the country. Our plans to collaborate in these investigations were abruptly terminated by the war and Gibson's departure to London. Only one short paper on the constituents of the bark of *Hymenodyctyon excelsum* was published (*J. Roy. Asiatic Soc., Bengal*, 1916, **12**, 161).

Later when I was afforded two periods of hospitality in his laboratory at Guy's Hospital we were able to resume our joint work, the results of which were published in eight papers communicated to the Chemical Society. Here reference need only be made to the publications on angustione and dehydroangustione (with A. R. Penfold and J. L. Simonsen, *J.*, 1931, 1184; with R. S. Cahn, A. R. Penfold, and J. L. Simonsen, *ibid.*, p. 286). In an earlier examination of the oil from *Backhousia angustifolia* Penfold had separated an oil with strong phenolic properties. A detailed examination of this material showed it to be a mixture of two optically active β-diketones, (I) and (II), the structures of which were conclusively established. At the

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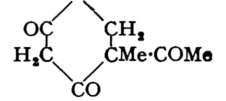
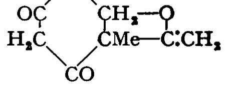


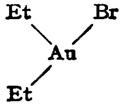


(II.)

time only one other natural β-diketone, diosphenol, was known, but more recently Penfold and his collaborators have described a closely allied substance, leptospermone.

Organic Compounds of Arsenic.—Immediately after the war Gibson published (with W. J. Pope, *J.*, 1920, **117**, 271) the more scientific aspects of their work on di-2-chloroethyl sulphide and also on some related problems involving selenium compounds (with W. H. Bausor and W. J. Pope, *ibid.*, p. 1453; with H. C. Bell, *J.*, 1925, **127**, 1877). His membership of the Gas Warfare Committee resulted in his taking an interest in arsenic compounds and on this subject, in collaboration more especially with Dr. (now Professor) H. Burton and Dr. J. D. A. Johnson, he published some 20 papers dealing with the chemistry of 10-chloro-5 : 10-dihydrophenarsazine. Although there were previous references in the literature to this substance, Gibson (with H. Burton, *J.*, 1926, 450) was the first to devise a convenient method for its preparation and also to report a synthesis which left no doubt as to its structure. Methods were devised also for the preparation of numerous derivatives containing alkyl, halogen, and nitro-groups, whilst many errors in the literature were corrected. A full résumé of this work was published (with J. D. A. Johnson and D. C. Vining, *Rec. Trav. chim.*, 1930, **49**, 106) in reply to certain criticisms which had been made on the structure assigned to phenarsazine. There can be little doubt that the experience gained in this difficult experimental work was of great value when Gibson returned to the study of the organic compounds of gold.

Organic Compounds of Gold.—Gibson's interest in the organic chemistry of gold was first aroused whilst he was working in collaboration with Pope (*J.*, 1907, **91**, 2061). With the comparatively recently described Grignard reagent, they examined the reaction of ethylmagnesium iodide on the ethereal solution of gold tribromide, being able to isolate diethylmonobromogold, but in poor yield. At the time little study was made of the chemistry of this first organogold derivative beyond noting that it formed a compound (II) with ammonia and reacted with bromine to give what was believed to be monoethyldibromogold, (III). Nor was it realised that (I) and (II) were dimeric.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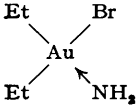
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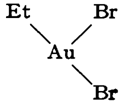
(III.)

Work in this field was not resumed until 1930 when (with J. L. Simonsen, *J.*, 1930, 2531) improved methods for preparing this compound were devised and a study of its properties and reactions was begun. To this field of research Gibson devoted the remaining years of his active career. The poor yields obtained in the first preparations were probably partly due to the insolubility of the gold halides in ether and in his early work Gibson spent much time in the search for more suitable starting materials. In the course of this several co-ordination compounds of gold halides with amines were isolated, notably bisethylenediaminogold tribromide (IV) and pyridinotribromogold (V; Py = C_5H_5N, X = Br), the latter an analogue of the

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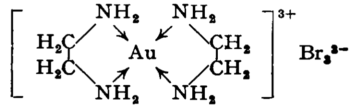
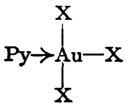
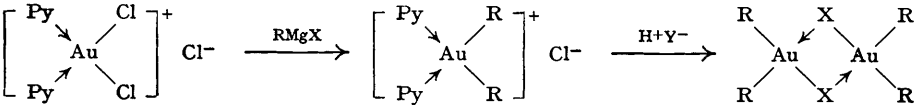


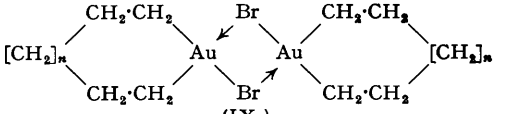

(V.)

chloride (V; X = Cl) isolated by François in 1903. Although the addition of Grignard reagents to cold suspensions of pyridinotrichloro- and -tribromo-gold in ether, in which they are very slightly soluble, and in pyridine, in which they dissolve sparingly, gave little improvement in the amount of dialkyl derivatives isolated, the former compound was destined to be the chosen starting material for many of Gibson's preparative experiments. This compound dissolves in hot pyridine, as François had shown, to give dipyridinodichlorogold chloride (VI), which separates, on rapid cooling of the well-stirred solution, in the form of very small red needles. The addition of Grignard reagents to such a cold well-stirred suspension, together with improvements in the isolation of the products, resulted in yields of dialkylgold halides as high as 45%, calculated on the gold compound used. The course of the reaction is believed to be :


(VI.) (VII.) (VIII.)

the first product being the dipyridinodialkylgold chloride (VII) which, having no halogen directly attached to the gold atom, is unable to react further with the Grignard reagent and is therefore " protected " by the pyridine. If the acid, HY, used in the liberation of (VIII) from (VII) is a halogen hydracid, the halogen X which appears in the dialkyl gold compound is found to be whichever is the more polarisable, or less electronegative, of X and Y. The halogen-bridge constitution which was assigned by Gibson, after cryoscopic data had revealed that these compounds were dimeric, was subsequently confirmed in the case of diethylmonobromogold (VIII; R = X = Br) by an *X*-ray investigation by Hampson and Powell.

In addition to diethylmonobromogold, Gibson described dimethylmonoiodo-, di-*n*-propylmonobromo- and di-*n*-butylmonobromo-gold, and also *cyclo*pentamethylenemonobromo- (IX; *n* = 1) and *cyclo*decamethylenemonobromo-gold (IX; *n* = 6), both of which were formed by the action of the Grignard reagent prepared from pentamethylene dibromide, and both of which were markedly unstable.



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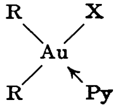
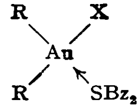
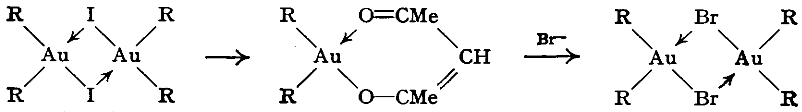


(X.)



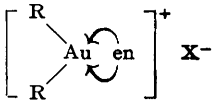
(XI.)

The halogen-bridged structure of the dialkylgold halides was shown to be split on treatment with many reagents, to give non-electrolytes or salts. Thus pyridine and dibenzyl sulphide yielded the non-ionic pyridino- (X) and (dibenzyl sulphide)-gold halide (XI), respectively; the ammonia derivatives, one example of which, (II), has already been noted, were of the same type. In consequence of the insolubility of the thallous halides, thallous acetylacetone reacted with (VIII) to give the corresponding dialkylgoldacetylacetones (XIII), which could be used as intermediates in the replacement of one halogen by another in a given dialkylgold halide since (XIII) was readily reconverted into (VIII) by the appropriate halide ion. As example of this may be instanced the conversion of the iodide, (XII) into the bromide (XIV), as follows :

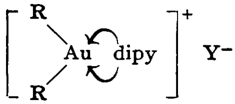


(XII.) (XIII.) (XIV.)

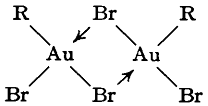
Ethylenediamine (en) caused fission of the halogen bridges, chelating with the gold atom with the formation of salts (XV; X = halogen) containing a complex gold cation. These were quite stable compounds and provided a very convenient means of storing the parent dialkylgold halides which could be liberated from them readily by acid. Di-2-pyridyl gave rise to salts (XVI), also containing a cation in which the diamine was chelated, but differing from (XV) in that no solid examples could be isolated in which the anion was halide, though evidence was obtained that such salts existed in aqueous solution. The nature of those examples of (XVI) which were obtained and of similar ethylenediamine compounds is discussed below.



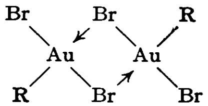
(XV.)



(XVI.)



(XVII*a*.)

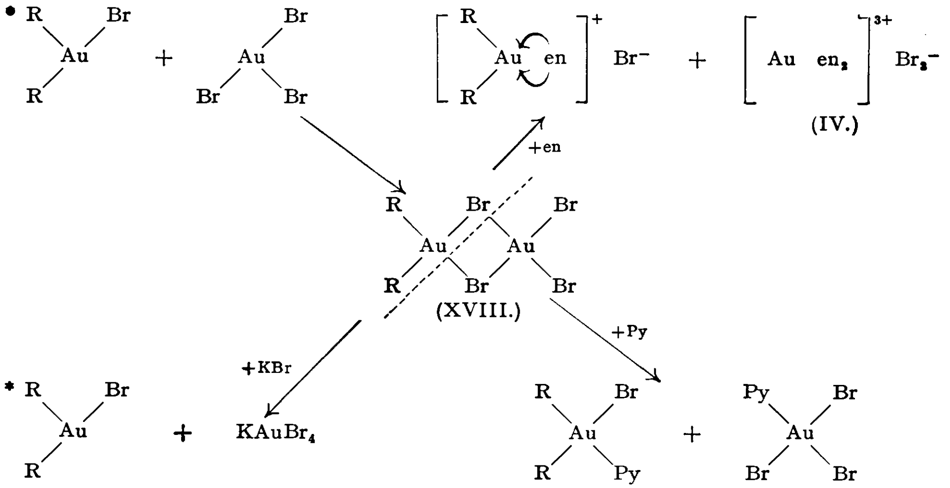


(XVII*b*.)

The reaction between diethylmonobromogold and two molecules of bromine, whereby monoethyldibromogold, (III), apparently resulted, proved on re-investigation to be general, and to give dimeric products. The manner in which these reacted with potassium bromide, pyridine, and ethylenediamine, together with their formation from the dialkylmonobromogolds and gold tribromide, outlined diagrammatically below, compelled Gibson to abandon his original belief that they were genuine dimeric monoalkyl derivatives, which should be able to exist in *cis*- and *trans*-forms (XVII*a* and *b*), and to formulate them as (XVIII). True monoalkylgold compounds have yet to be prepared.

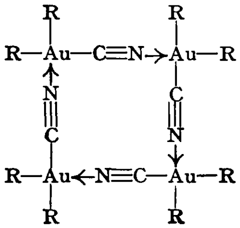
By the interaction of dialkylgold halides with silver salts the halogen atoms were replaced by a variety of other groups. Diethyl- and di-*n*-propyl-monocyanogold, prepared in this manner, were non-electrolytes containing no less than four atoms of gold per molecule. These were assigned the constitution (XIX) in accordance with the accepted planar distribution of the valencies of four-covalent gold, and, in the case of the *n*-propyl compound, this was confirmed by an *X*-ray examination by Powell and Phillips. The but recently isolated diethylthiocyanatogold, on the other hand, was dimeric and for this the structure (XX) was preferred.

Silver sulphate and diethyl- and di-*n*-propyl-monobromogold yielded colourless crystalline compounds of peculiar properties. Though sparingly soluble in hydrocarbon solvents, they dissolved in ethanol and acetone, and the determination of the molecular weights in boiling acetone showed the ethyl derivative to contain four atoms of gold per molecule. No proof of the structures of these substances has yet been obtained but chemical and stereochemical considerations point to (XXI) as the only reasonable way in which the required number of atoms could co-exist.

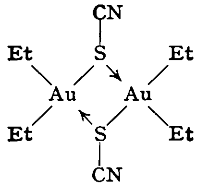


* Half molecules of (XIV) for clarity.

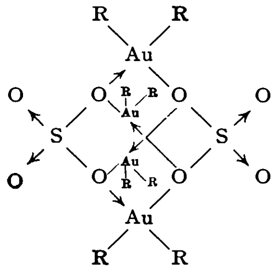
Unlike the halogeno-, cyano-, and thiocyanato-complexes, the sulphato-compounds were soluble in water. Their solutions gave an immediate reaction for sulphate ion and were presumed to contain the aquo-salts resulting from the disruption of the sulphate bridges by water, though no such salt has been isolated in the solid state. No other type of bridged complex has yet been found to behave in this way, indeed diethylthiocyanatogold (XX) was unaffected even by such powerful co-ordinating agents as ammonia, ethylenediamine, and di-2-pyridyl. Thiourea and thioacetamide alone of the reagents examined split the four-membered ring system to yield identifiable products, (XXII and XXIII). The halide and cyanide bridges appear to be of intermediate stability.



(XIX.)

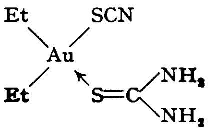


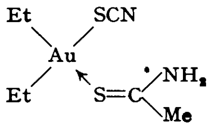
(XX.)



(XXI.)

(XXII.)

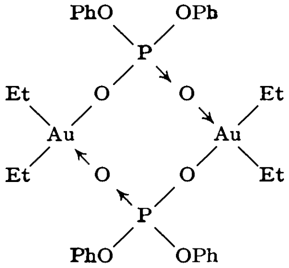


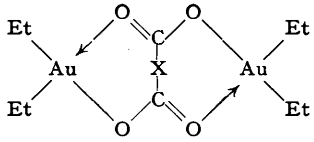


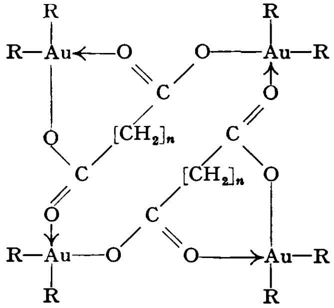
(XXIII.)

Non-electrolytes, exactly analogous in constitution to (XXI), resulted from the action on diethylmonobromogold of disilver phenyl phosphate and disilver phenyl arsonate, whilst silver diphenyl phosphate yielded the dimeric non-electrolyte (XXIV). Unlike (XXI), these are insoluble in water.

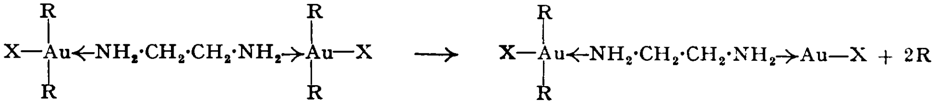
Interaction of the sulphato-complexes in aqueous solution with salts of dicarboxylic acids led to the isolation of non-electrolytes of various molecular complexities. The oxalato- (XXV; X = nil) and the phthalato-compound (XXV; X = o-$C_6H_4<$) each contained two atoms of gold per molecule. To the complexes derived from malonic up to suberic acid, containing four atoms of gold per molecule, Gibson assigned provisionally the structure (XXVI; n = 1—6). The *iso*phthalate compound had no less than six gold atoms per molecule, whilst that derived from terephthalic acid was so insoluble that molecular-weight determinations were impossible, and extended linear polymerisation was postulated.


(XXIV.)


(XXV.)


(XXVI.)

As had already been indicated, two molecular proportions of ethylenediamine convert dialkylgold halides into salts (XV; X = halogen). In the case of the cyanides no such salts could be isolated, the only products of the reaction being compounds, $(R_2AuCN)_2en$, in which it was believed that the diamine was " bridging " two R_2AuCN units, as in (XXVII; X = CN).

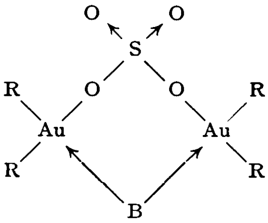


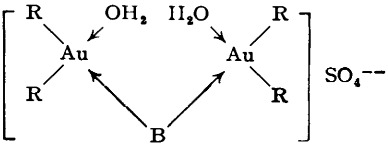
$$X{-}\overset{R}{\underset{R}{Au}}\leftarrow NH_2\cdot CH_2\cdot CH_2\cdot NH_2\rightarrow\overset{R}{\underset{R}{Au}}{-}X \longrightarrow X{-}\overset{R}{\underset{R}{Au}}\leftarrow NH_2\cdot CH_2\cdot CH_2\cdot NH_2\rightarrow Au{-}X + 2R$$

(XXVII.) (XXVIII.)

Gibson showed that under suitable conditions it was possible to prepare analogous compounds of dialkylgold halides and tetra-alkylsulphatodigolds (XXI), with ethylenediamine and di-2-pyridyl. Thus to the " bridged " sulphato-complexes the structure (XXIX; B = en or dipy) was given, their solubility in water to give sulphate ions being ascribed to the formation of aquo-salts (XXX), as in the case of the sulphato-complexes themselves.

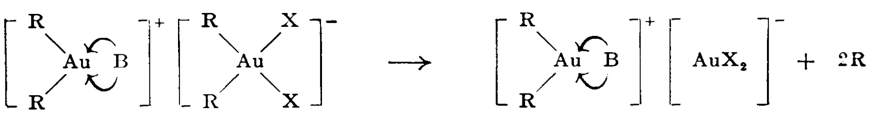
The clue to the true constitution of these supposedly " bridged " compounds came as a result of a study of the dealkylation reactions which they underwent when heated. As early as 1935 Gibson recorded that ethylenediaminotetra-n-propyldibromodigold (XXVII; R = Pr^n, X = Br as then formulated) lost only *half* its alkyl groups when heated in chloroform solution, to give a substance which he believed to be (XXVIII; R = Pr^n, X = Br). At the time no comment was made on the fact that whereas in the solid state dealkylation of (XXVII; R = Pr^n, X = Br) set in with uncontrollable vigour below 100°, (XXVIII; R = Pr^n, X = Br), though so closely related, lost its alkyl groups only at temperatures approaching 140°. Later in 1935 was published an account of the parallel reactions of monoethylenediaminotetraethyl- and tetra-n-propyl-dicyanodigold [believed to be (XXVII; X = CN, R = Et or Pr^n)], the products of the semidealkylation of which were recognised to be salts and correctly formulated


(XXIX.)


(XXX.)

as aurocyanides (XXXII; X = CN, R = Et or Pr^n, B = en). These so similar reactions were, however, not correlated at the time.

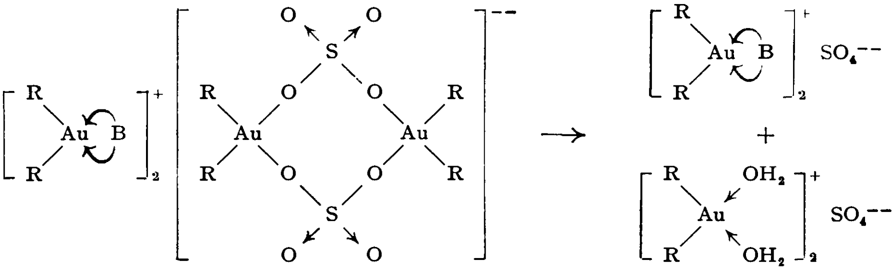
Further investigation of ethylenediamine- and dipyridyl-bridged halides and cyanides, not only of type (XXVIII) but also of type (XXVII), showed that in dilute solution in nitrobenzene their molecular weights approached half their formula weights and that their solutions in nitrobenzene were conducting. These were hence re-formulated as (XXXI) and (XXXII) B = en or dipy), and the semidealkylation reaction was represented by :



(XXXI.) (XXXII.)

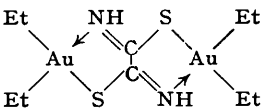
This is thus seen to be the entire loss of alkyl groups from the *anion only*, the cation being known to be stable.

The bridged ethylenediamine and di-2-pyridyl compounds (XXIX) of the tetra-alkylsulphatodigolds behaved in a similar manner but, in re-formulating them as (XXXIII), it was necessary to postulate the presence of a dimeric anion since the salts in solution were found to give rise to three ions. The effect on them of dissolution in water, as a result of which sulphate ion is disengaged, is hence represented by :



(XXXIII.) (XXXIV.)

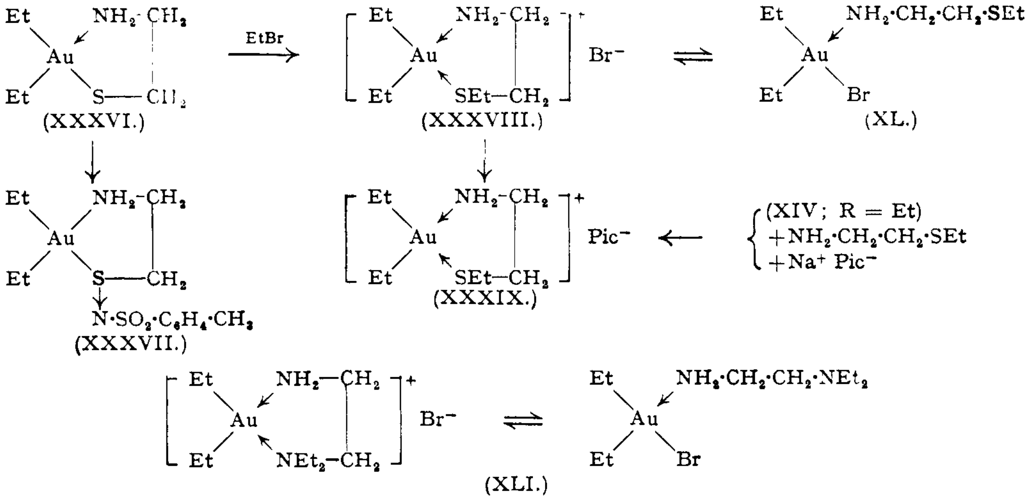
As a result of these investigations much information accumulated regarding the stability of heterocyclic ring systems containing gold, and to augment this still further the reactions of diethylmonobromogold with 2-aminoethanethiol and dithio-oxamide were studied. Whilst the latter yields a stable complex (XXXV), the complex (XXXVI) derived from the former, though stable in the solid state, underwent in benzene and bromoform solution a rapid change which was attributed, at least in part, to inherent instability of the five-membered ring. The stability of (XXXV) was ascribed to resonance in the five-membered rings. The compound (XXXVI) gave also a sulphilimine (XXXVII) and reacted with ethyl bromide to give an oil for which, in spite of its physical characteristics, the ionic structure (XXVIII) was most favoured since it could be converted into a picrate (XXXIX), identical with that obtained by the action of sodium picrate on a solution containing diethylmonobromgold and 2-aminoethyl sulphide. The possibility of an alternative non-ionic structure (XL), or an equilibrium mixture of this and (XXXVIII), similar to that suggested to explain the properties of the *NN*-diethylenediamine complex (XLI), was thought less likely.



(XXXV.)

Every investigation which Gibson undertook in this field produced more evidence for the correctness of his main beliefs—that simple aurous and auric ions, Au^+ and Au^{+++}, cannot exist and that the gold atom, in either state of oxidation, must for stability acquire an additional covalent link, univalent gold thus becoming two-, and tervalent gold four-, covalent, and in the present account an attempt has been made to illustrate the diversity of the structural types which result.

No account of Gibson's work on gold would be complete without reference to his much prized process for the deposition of thin gold films on glass and other surfaces. The origin of the discovery is uncertain but it would have been surprising if, sooner or later, the action of alkali on an alcoholic solution of the dialkylgold halides had not been examined, though the resulting bright coherent " gold mirrors " which deposited on the walls of the vessels must have astounded all who beheld them. Gibson spent several years of painstaking investigation in perfecting the process which in its final form consisted in exposing the surface to be gilded, after scrupulous cleaning, to a solution of diethylmonobromogold, calculated in amount to give the required film thickness, and sodium ethoxide in pure ethanol. Not only was it possible in this way to produce bright reflecting mirrors, which Gibson took great delight in presenting to his friends, but also uniform transparent films so thin as to appear blue in transmitted light. The films were easily detached by rubbing and were floated off by water but, by a simple procedure discovered later, it was found possible to cover them with a thin protective layer of silica. So treated, they required no special care in handling and could even be submitted without damage to the lamination process employed in the manufacture of "safety glass." It is indeed unfortunate that Gibson never lived to bring his process to that state of commerical development upon which he had set such high hopes.



In the preparation of this notice I have been greatly assisted by Dr. M. P. Applebey, Dr. F. H. Brain, and Professor J. Read, F.R.S. Dr. Brain prepared the section dealing with the organic compounds of gold and Professor Read that on Professor Gibson's stereochemical investigations.

J. L. SIMONSEN.

DONALD CUMMING WILSON.

1898—1950.

THE untimely death of Donald Cumming Wilson on 4th September, 1950, while on holiday at Boat of Garten, Inverness-shire, has all too soon removed from a unique sphere of influence one of Edinburgh's best known personalities in the chemical profession.

"D. C.," as he was affectionately called by his friends, was born in Tranent, East Lothian, on 3rd January, 1898, and received his early schooling at the local Higher Grade School and later proceeded to Broughton Secondary School, Edinburgh. He entered the Heriot-Watt College in 1915 and studied under the late Professor A. A. Boon, completing his course for the College Associateship in Applied Chemistry and simultaneously graduating B.Sc. (Edin.) in 1919. He was elected a Fellow of the Royal Institute of Chemistry in 1944 and a Fellow of the Royal Society of Edinburgh in 1945.

On leaving the College he joined the staff of Messrs. T. & H. Smith as a Works Chemist, being chiefly concerned with the Opiates Department. He won steady promotion in the firm and in 1941 he became a Director and in 1946 he was appointed Managing Director.

Mr. Wilson took a keen interest in foreign trade connected with pharmaceutical raw materials and products. In recent years he had visited the U.S.A., Canada, India, Sweden, France, and Denmark in pursuance of his Company's interests in such matters. Immediately before his death, he attended at Geneva as trade representative for Britain on the Commission on Narcotic Drugs held under the auspices of the Economic and Social Council of the United Nations Organisation.

Mr. Wilson's health was not always of the best, but at no time did he spare himself in the service of his firm or in connection with matters of public interest in which he engaged. He was a Governor of the Heriot–Watt College, a Director of the Edinburgh Merchant Company, a Member of the Edinburgh Chamber of Commerce, Chairman of the Scottish Wholesale Druggists' Association, and a Member of the Council of the Association of the British Pharmaceutical Industry. He was a Past-Chairman of the Edinburgh Section of the Society of Chemical Industry and was one of the forces behind the foundation of the Lister Memorial Lecture of that Society.

Apart from professional interests, Mr. Wilson was a Past-President of the Corstorphine Literary Association and an Elder in St. Ninian's Church, Corstorphine. He was a keen lover of his native county, East Lothian, and spent many of his holidays in the Scottish Highlands where he was able to indulge in his hobbies of photography and motoring.

Mr. Wilson endeared himself to all with whom he came into contact by his absolute integrity, his constant consideration for others, and his sense of justice and fairplay.

To the chemical and pharmaceutical professions in Edinburgh, his passing, in the prime of life, is indeed a sad loss.

Mr. Wilson is survived by his wife and two daughters.

H. B. NISBET.