

The base was oxidised by a 5 per cent. solution of potassium permanganate, to picolinic acid, which crystallised in fine tufts, of m.pt. 134° C.

4. *Methylpyridine* (γ -picoline). From the fraction boiling at 145°—150° C. a mercury-chloride compound was obtained in fine needles of m.pt. 121° C. which melt in hot water to a heavy oil. The base was a colourless liquid, soluble in water, with an odour similar to that of pyridine, but less pungent. The platinumchloride is very sparingly soluble in alcohol, crystallising in fine golden scales of the orthorhombic system. M.pt. 208° C. with decomposition. It contained 32.73 per cent. of platinum; $(C_6H_7N)_2H_2PtCl_6$ requires 32.72 per cent. When prepared from aqueous solution the platinum compound formed red crystals of the orthorhombic

soluble in alcohol and fairly easily in water. A quantity obtained from a heated aqueous solution appeared exactly the same in all respects. The compound contained 43.98 per cent. of gold ($C_7H_7N.HCl.AuCl_3$ requires 44.13 per cent.).

The picrate forms pale yellow crystals, easily soluble in water of alcohol, m.pt. 178° C. without decomposition.

The density of the base is 0.9378 at 14° C.; the index of refraction (sodium light)=1.5033 at 14° C.; the specific refraction=0.3154; and the molecular refraction =33.75. On oxidation with potassium permanganate, the base was converted into lutidinic acid, of m.pt. 235° C.

Below is a table comparing the values obtained for the melting points of the platinum and gold compounds of the above bases with those quoted by other workers.

Platinum Compounds.

Base.	Brühl.	Calm and Buchka.	Garrett and Smythe.	Author's Values.	
				From alcohol.	From water.
Pyridine ..	240°—242° C.	228°—220° C.	228°—220° C.	228° C.	241° C—242° C.
α -Picoline ..	195° C.	178° C.	194° C.	178° C.	194° C.
γ -Picoline ..	231° C.	231° C.	—	208° C.	208° C.
α - γ -Lutidine ..	230° C.	219°—220° C.	216° C.	209° C.	216° C.

Gold Compounds.

Base.	Brühl.	Calm and Buchka.	Garrett and Smythe.	Author's Values.	
				From alcohol.	From water.
Pyridine ..	unchanged	at 285° C.	—	323° C.	320° C.
α -Picoline ..	167°—168° C.	167°—168° C.	—	175° C.	175° C.
γ -Picoline ..	205° C.	205° C.	—	203° C.	205° C.
α - γ -Lutidine ..	—	—	94°	77° C.	77° C.

system, of m.pt. 208° C., and containing 32.71 per cent. of platinum. The aurichloride, obtained from alcoholic solution, gave easily soluble bright-yellow needles, of m.pt. 203° C. without decomposition, and containing 45.22 per cent. of gold.

Prepared from a heated aqueous solution, the gold compound gave bright-yellow needles of m.pt. 205° C. without decomposition, and containing 45.46 per cent. of gold ($C_6H_7NHCl.AuCl_3$ requires 45.33 per cent.). The picrate forms small crystals of pale lemon-yellow colour easily soluble in water or alcohol, of m.pt. 160° C. without decomposition. The density of the base is 0.9603 at 12.5° C. The index of refraction (sodium light) =1.5065 at 12.5° C., the specific refraction is 0.3097, and the molecular refraction=28.80. This is practically the same as the value for α -picoline. On oxidation of the base with potassium permanganate, isonicotinic acid was obtained, m.pt. 312° C. in a sealed tube.

2.4. *Dimethylpyridine*. (α - γ . lutidine). From the fraction boiling at 155°—160° C. a mercury compound was obtained in the form of white, hair-like needles, of m.pt. 128.5° C., containing 58.49 per cent. of mercury. $C_7H_9N.HCl.2HgCl_2$ requires 58.35 per cent.

The base was a colourless liquid, more soluble in cold water than in hot, and having a rather pleasant odour. The platinumchloride was obtained from alcoholic solution as minute prisms with pyramidal ends, and of the monoclinic system; they melted at 209° C. with decomposition, and contained 31.13 per cent. of platinum

($C_7H_9N)_2H_2PtCl_6$ requires 31.25 per cent. The platinum compound separated from aqueous solution as orange-red crystals of the monoclinic system, containing 31.15 per cent. of platinum m.pt. 216° C. with decomposition. The gold compound, prepared from alcoholic solution, formed a yellow oil, which crystallised on standing. The crystals melted at 77° C. without decomposition, and are easily

The author has pleasure in acknowledging his indebtedness to Messrs. Priestmans, Ltd., for their kindness in providing the raw material required, and to Prof. P. Phillips Bedson, in whose laboratory the work was carried out. The investigation is being continued.

Yorkshire Section.

Meeting held at Hull on Monday, January 18, 1909.

MR. F. W. BRANSON IN THE CHAIR.

A RAPID METHOD FOR DETERMINING CARBON DIOXIDE IN THE ATMOSPHERE.

BY S. H. DAVIES AND B. G. McLELLAN.

A rapid method of determining the condition of the atmosphere in schools, factories, and other places where people congregate, is of great importance. To do this with any certainty it is necessary within a brief interval of time to test the proportion of carbon dioxide at several points in the room. Given the number of people in the room and the area, it is then easy to calculate the rate of exchange of air for the room as a whole and to observe if the exchange is uniform, or whether there are any stagnant areas.

It is generally felt that Government regulations merely defining the cubic feet of space allotted to each worker in a factory, or each child in a school, must be replaced by regulations demanding a minimum exchange of air per head, supplied at a reasonable temperature.

In the First Report of the Departmental Committee appointed by the Home Office to inquire into the venti-

lation of factories and workshops (1902), the Commissioners concluded from their own observations that it is reasonable to expect under ordinary circumstances that 10 volumes of carbon dioxide per 10,000 should not be exceeded in factories or workshops unless gas is burning in the room. Their chief recommendation was that a standard of ventilation should be prescribed for all classes of factories and workshops not otherwise specially dealt with. This standard they defined as follows:—The proportion of carbon dioxide in the air at about the breathing level and away from the immediate influence of any special source of contamination (such as a person or light) shall not rise beyond twelve volumes of carbon dioxide per 10,000 of air, and that when gas or oil is used for lighting, the proportion shall not exceed twenty volumes after dark or before the first hour after daylight. Our experience, including many hundreds of tests on the air of workrooms, confirms that of the Commissioners, that it is possible to secure sufficient ventilation in workrooms to maintain this standard, and we regard any larger proportion of carbon dioxide than ten volumes per 10,000 to indicate unsatisfactory ventilation, and more than twelve volumes an excessive contamination. It is, however, useless for a Government Department to impose any such regulations unless the percentage of carbon dioxide can be determined rapidly and with sufficient accuracy. It is desirable that an accuracy of at least one unit of carbon dioxide per 10,000 shall be secured, and that the result shall be obtained within three to four minutes.

Pettenkofer's method, in which a large volume of air, varying from two to five litres, is collected and the carbon dioxide absorbed by baryta water, the excess of baryta being titrated back with oxalic acid, can be performed with great accuracy (as modified by Letts and Blake and others). Under industrial conditions, however, it is obviously impossible to collect a large number of samples by this method.

A gas volumetric method, in which the decrease in volume due to the absorption of carbon dioxide is directly measured, has been worked out by Haldane. His neat and portable form of apparatus is well known. Judging from our experience, however, of the difficulty in obtaining strictly consistent results with this apparatus, we fear that in the hands of men with the usual training of Medical Officers of Health or Sanitary Inspectors, it would give misleading results.

A third method, known as the minimetric method, was suggested by Dr. Angus Smith and has been developed by Lunge and Zeckendorf. In this the quantity of air is determined which is necessary to saturate the reagent used for the absorption of carbon dioxide. The apparatus used by Lunge and Zeckendorf consists simply of a bottle and a rubber bulb fitted with valves so as to allow the passage of air to take place only in one direction. A known volume of standardised baryta or sodium carbonate solution tinted with phenolphthalein is introduced into the bottle, and the volume of air required

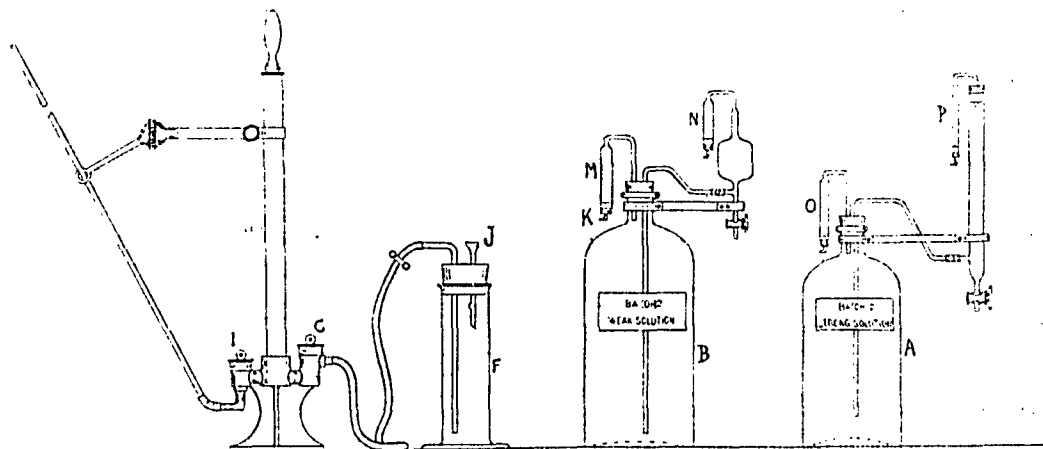
to decolorise the solution is obtained by counting the number of compressions of the ball. This gives a measure of the proportion of carbon dioxide in the air. It is evident that this process is capable of considerable refinement, and by our modifications we have secured a rapid and sufficiently reliable process. Our apparatus is illustrated in the accompanying diagram.*

The pump for measuring the air is fitted with inlet and outlet valves, I and C, and delivers 50 c.c. of air at each full stroke. The inlet side is connected to a long glass tube supported by a clamp so that the air may be taken at a distance from the operator. The outlet is connected by a piece of rubber tubing to the absorption vessel, F.

Many experimenters have dwelt on the difficulty of titrating very weak solutions of baryta such as are required for this process, and on account of this difficulty we have abandoned the titration method, and, previous to making a series of tests, we standardise the solution against fresh air. The results of the most reliable investigators give proportions of carbon dioxide in fresh air varying from 3 to 3.5 parts per 10,000. The proportion seldom rises above 3.5, even in town air, except during foggy weather. As the variation is so slight, and as the majority of these tests will be made in a town atmosphere, we have adopted 3.5 parts per 10,000 as a standard.

Two solutions are required; the stronger stock solution is made as follows:—25 grms. of pure crystallised barium hydroxide (powdered) is placed in the bottle, A, and 1 litre of distilled water added. After corking, the contents are thoroughly shaken, until the baryta is dissolved. The cork is then replaced by a rubber stopper fitted with the tubes shown in the diagram. To one of these a measuring burette is attached, and the solution is protected by two soda-lime tubes. The weak solution which is used in the apparatus is prepared in bottle, B. Two litres of distilled water are placed in this bottle and a few c.c. of alcoholic phenolphthalein added. Strong baryta solution is added a few drops at a time and the bottle well shaken after each addition until the pink colour is just permanent. We have now precipitated the carbon dioxide present in the water. A further addition of 3.3 c.c. of baryta is now made and the solution, after shaking, is ready for standardisation. The bottle is fitted with a measuring pipette and protection tubes similar to those shown on bottle A. To standardise this solution the whole apparatus is placed on a table in front of an open window on the windward side of the room, the open end of the inlet tube projecting some feet out of the window. The apparatus is now completely washed out with fresh air by working the pump several times. A drop or two of phenolphthalein solution is placed in F, followed by a measured 25 c.c. of baryta solution run through tube J. A small hand blower, attached to K, is convenient for transferring the solution from the bottle to the pipette. The vessel, F, is now

* The apparatus is now being made by Messrs. J. J. Griffin and Sons, Ltd., Kingsway, London, W.C.



thoroughly shaken for 15 seconds and this is counted as one volume of air. 50 c.c. of air is then discharged, by means of the pump, into the vessel, F, which is again shaken for the same length of time. This is followed by another 50 c.c. and so on, until the solution is just decolorised; the number of strokes of the pump being counted. During the shaking it is an advantage to have a spring clip on the rubber tube, close to vessel F, to prevent the liquid from leaving the bottle. The solution should be of such a strength that 25 c.c. is exactly decolorised by 15 strokes (14 discharges from the pump and one for the air originally present in the bottle). If the solution is either too weak or too strong it is better not to attempt to modify it, but to start afresh, varying the quantity of strong baryta accordingly. Having standardised the solution against fresh air, the apparatus can be used to test the air of a room. The inlet tube should be placed at some distance from the operator, at least 3 ft. from any person in the room, and 3 ft. away from any wall. In an ordinary test of a workroom the sample should be taken at about the breathing level.

The accompanying table was constructed from a series of parallel determinations with Pettenkofer's method. It indicates the proportion of carbon dioxide per 10,000 corresponding to any given number of strokes.

Strokes of pump.	Parts carbon dioxide per 10,000.
15	3.6
14	4.0
13	4.5
12	5.0
11	5.6
10½	5.9
10	6.3
9½	6.7
9	7.2
8½	7.7
8	8.2
7½	8.7
7	9.3
6½	10.1
6	10.9
5½	11.7
5	12.7
4½	13.8
4	15.0
3½	16.4
3	18.0
2½	19.8

A note of the general condition and temperature of the atmosphere; of the air space available; the number of people present; the presence or absence of gas jets and of any open windows should accompany the result of this test.

The apparatus is handy to manipulate, and once the solution is standardised against fresh air, a youth can rapidly perform the tests *in situ*. The strength of the solution should be checked after each series of experiments. The apparatus involves the following modifications: (a) the accurate delivery of known volumes of air; (b) sampling at a distance from the operator; (c) standardisation of the solution against fresh air instead of titration; (d) special precautions for preventing access of carbon dioxide to the solutions.

DISCUSSION.

Mr. W. GATHORNE YOUNG thought that slight modification of the author's method, to secure accurate standardisation of the absorbent solution, and increase in capacity of the air pump, might be advantageous.

Mr. S. H. DAVIES said that the authors' method was sufficiently accurate for practical purposes. The highest proportion of carbon dioxide that he had seen recorded in a living room was 81 parts per 10,000 in a Glasgow lodging-house. It had been shown that 200 to 300 parts per 10,000 of pure carbon dioxide were necessary to give any marked physiological effect.

Mr. A. R. TANKARD thought that enlargement of the shaking cylinder, resulting in larger volumes of air and solution used, would probably be an improvement from the point of view of accuracy. Ammonia and obscure organic compounds often accompanied carbon dioxide, producing undesirable effects.

Dr. H. T. CALVERT pointed out that if a half-stroke of the pump was the limit of delicacy of manipulation this meant an error of 2 per 10,000 in the atmosphere they were then breathing. Another probable defect was that rapidity of movement of the piston might cause leakage.

Mr. B. G. McLELLAN said that for most ventilation problems where the carbon dioxide was between 7 and 10 parts per 10,000 the apparatus was quite sufficiently accurate. The volume of air and solution used had been arrived at after many experiments, and the apparatus as described combined portability with accuracy.

Journal and Patent Literature.

PATENT SPECIFICATIONS may be obtained by post by remitting as follows:—

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I.—PLANT, APPARATUS, AND MACHINERY.

PATENTS.

Drying machines; Continuous — for drying grain, peat, hops, salt, sand, cement, manures, chemicals, small coal, ores, and other analogous wet or moist materials. J. Black and A. H., H., and A. B. Lennox, Newcastle-on-Tyne. Eng. Pat. 1455, Jan. 21, 1908.

THE dryer is formed of a number of superposed, vertical, flanged cylinders, bolted together and having a plate, forming a shelf bolted between each pair of flanges. A central shaft or centrally disposed cylinder attached to a shaft and rotated from below, has scrapers attached to it corresponding with each shelf. The material is introduced above the top shelf, and after completing the circle of the shelf, is discharged by the scrapers, through an opening, on to the shelf below. The drying medium enters above

the lowest shelf and circulates upwards, being forced to travel in the opposite direction to that taken by the material, by partitions or flaps depending from the shelf above and situated behind the openings.—W. H. C.

Drying, roasting, or otherwise treating pulverulent or granular materials. J. and C. McNeil, Govan, North Britain. Eng. Pat. 4491, Feb. 28, 1908.

THE material to be treated is fed into one end of a horizontal, rectangular, metal vessel mounted on a hollow, perforated shaft and rotated by gearing. A number of inclined blades project inwards from each side of the vessel and form what is practically a screw or helix, which as the vessel is rotated, lifts up the material, drops it again and at the same time moves it forward through the vessel to the other end, from which it is discharged. Hot air or any other suitable drying or treating medium is introduced through the hollow, perforated shaft.—W. H. C.