dioxide in the gas sample, since so little is present when the normal precautions are taken to exclude carbonate from the alkaline hypobromite solution; and the correction factor is small anyway. The presence of nitrous oxide in the gas sample is of interest in accounting for the appearance of a peak at mass number 30, which is much larger than would be expected from the $^{15}N^{15}N^{+}$ contribution. In the mass-spectrometer, the rupture of nitrous oxide gives NO^{+}, rather than N_2^{+}, and this completely masks the contribution of the $^{15}N^{15}N^{+}$ to the peak at mass number 30, even when the ^{15}N content of the nitrogen sample is quite large (15–18 atoms per cent).

The nitrous oxide may be eliminated, if it is so desired, by placing a liquid-air trap between the generator and the gas sample tube. However, there does not seem to be any way of avoiding the production of free oxygen during the preparation of the nitrogen sample. The small intensity of the peak at mass number 40 makes its accurate measurement difficult, and where the intensities of the peaks at mass numbers 32 and 40 correspond, then a correction for air, based on the size of the mass 32 peak, will be more accurate. However, in nearly all the results which we obtained, the use of the mass 40 peak gave a considerably smaller correction than that of the 32 peak, and was presumably more accurate.

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Aerodynamic Drag of Perforated Plates

WE have recently conducted wind-tunnel experiments to determine the aerodynamic drag of perforated plates at zero incidence by the wake transverse method. The plates have no protuberances, yet they are aerodynamically rough and give a drag comparable with that of plates covered with protruding roughness of the same size and spacing as the holes.

The non-dimensional quantities which could affect the drag are: (1) the Reynolds number of the chord of the plate; (2) the Reynolds number of the diameter of the holes; (3) the ratio of the area of the holes to the area of the plate; (4) the ratio of hole diameter to plate thickness. During the experiments, the airspeed, plate chord, plate thickness and total area of the holes remained constant, while the hole diameter was varied. Thus ratios (1) and (3) were constant, their values being $3 \cdot 5 \times 10^5$ and 0·355 respectively.

The plates were of a double thickness of 18-gauge perforated plate with the holes coinciding but with a sheet of tissue paper sandwiched between them. The leading edge of each was cut on a line through solid metal and was not sharpened. Therefore, the measured drag included surface drag and form drag due to the frontal area. To assess the latter, the drag coefficient of a smooth plate of the same size and thickness was measured and found to be 0·023, which is more than double the value 0·011 expected for a very thin smooth plate in turbulent flow[1]. The difference, 0·012, may be ascribed to the form drag, and may be subtracted from the drag coefficients of the other plates to obtain that part of the drag due to the surface itself.

Table 1. DRAG OF PERFORATED PLATES

Reynolds number of tests, $3 \cdot 5 \times 10^5$. Chord of plate, $6\frac{1}{4}$ in.

Hole diameter (in.)	Hole diameter/plate thickness	Hole Reynolds No.	Drag coefficient: With paper sandwiched, As measured	Drag coefficient: With paper sandwiched, Corrected for frontal area	Drag coefficient: Without paper, As measured	Drag coefficient: Without paper, Corrected for frontal area
No holes	—	—	0·023	0·011	0·023	0·011
0·125	2·27	7×10^3	0·033	0·021	0·071	0·059
1·125	21·6	$6 \cdot 3 \times 10^4$	0·033	0·021	0·038	0·026
4·5	84	$2 \cdot 5 \times 10^5$	0·025	0·013	0·028	0·016

The sandwiching of paper between the plates produces the effect of a flat plate covered with a number of cylindrical pits the depths of which equal the plate thickness. The results are summarized in Table 1, from which it is seen the drag considerably exceeds that of a smooth plate and provides evidence of vigorous interchange between the fluid in the hollows and the passing stream.

Further tests were made at the same Reynolds number, after removing the paper from between the plates, thus allowing turbulent transverse velocity components to transfer momentum deeper into the plates where it could build pressures on more of the forward facing surface of each perforation. From Table 1, it is seen that the drag is now greater than that when the paper is preventing through-flow.

Thus perforations or hollows can give rise to great aerodynamic drag, so that a surface entirely devoid of protrusions may behave as if extremely rough. This property may be useful in the design of energy dissipators.

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High-Efficiency Columns for the Analysis of Hydrocarbons by Gas-Liquid Chromatography

FOLLOWING the work of Keulemans and Kwantes[1], the factors affecting column efficiency have been examined further, and the conditions required to obtain optimum column-efficiency have been determined. Important factors affecting column efficiency are the correct grade of column support, the quantity of liquid phase on the support and the dimensions of the column. Column efficiencies[2] of 12,000 theoretical plates may be obtained using the following conditions: