ern genera have not appeared in the fossil record; they are grouped by Simpson (*5*) in a subfamily distinct from fossil genera.

Modern penguins live in sea temperatures ranging from 25°C at the Galápagos Islands to −1.8°C in Antarctica. Three species, including two of the smallest, live where mean annual sea temperatures exceed 16°C; five, including the largest, live where sea temperatures rarely exceed 0°C. Most species live in waters with mean annual temperatures between 3°C and 15°C, in situations where the difference between summer and winter mean sea temperatures does not usually exceed 5° to 8°C (*12*). The largest living penguins inhabit cold and the smallest warm water; but there is no correlation between environmental temperature and body size throughout the family. Chill and overheating are countered by fat, plumage thickness, and heat-regulating areas in the face, flippers, and feet (*12*). Present evidence indicates that the largest fossil forms, together with medium-size and smaller species, lived for long periods in environmental temperatures equal to the warmest in which modern penguins are found.

Origins of penguins are uncertain, but evolution from petrel-like, flying ancestors during the Cretaceous or early Tertiary seems probable (*5*); major adaptations of foot and wing are already complete in Eocene fossils. In other families of diving birds, flying and wing-swimming are compatible up to a body weight of about 1 kg; further increase in body size—which facilitates sustained diving (*14*)—involves loss of flight as weight outstrips permissible wing area. Thus flightlessness must have been forced on protopenguins which were approximately the size of the smallest modern forms (*Eudyptula* of New Zealand and southern Australia), with subsequent diversification during the late Cretaceous or early Eocene that produced the variety of larger forms capable of exploiting deeper layers of pelagic water. The absence of a polar ice cap throughout this period allowed cool temperate conditions to extend south to the polar continent, with only a moderate zonal temperature gradient in high latitudes. Thus penguin evolution up to the mid-Miocene must have occurred in cool temperate or warmer conditions, with the diversity of size related to diving depth rather than environmental temperature. Disappearance of the larger penguins from the fossil record may be due either to predation or to competition from toothed whales and seals which diversified and spread during the mid-Tertiary.

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Viscosity of Argon at High Temperatures

Abstract. *New data for the viscosity of argon at high temperatures indicate that the accepted data are substantially too low at temperatures above 600°K.*

Recent work (*1*) has emphasized the need for a systematic redetermination of the viscosities of the inert gases. Despite the large quantity of data on the viscosities of these gases, considerable doubt has been expressed about the accuracy, particularly at high temperatures (*2*). In the course of investigations of the intermolecular potential energy of argon atoms, Barker and Pompe (*3*) suggested, as did earlier workers (*4*), that the experimentally determined viscosity coefficient might be too low by as much as 10 percent at 1500°K. Barker and Pompe ascribed this discrepancy to an incorrect esti-

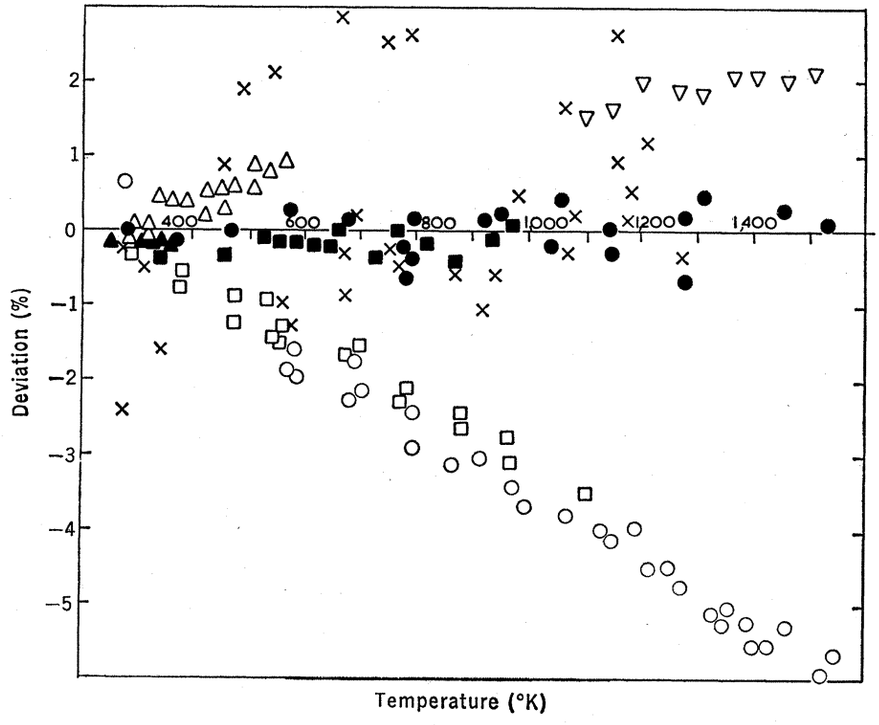

Fig. 1. The deviations of the viscosity of argon from Eq. 2. Solid circle, this work; solid square, Rigby and Smith (*14*) (corrected to the standard nitrogen viscosities of Dawe); solid triangle, Clarke and Smith (*5*); open circle, Vasilesco (*8*); open square, Trautz and Zink (*7*); open triangle, Kestin and Whitelaw (*10*) and DiPippo (*11*); inverted triangle, Guevara *et al.* (*12*); X, thermal conductivity data (*13*).

mate of the so-called slip correction, which arises from the fact that molecules of a gas flowing through a capillary tube do not have zero tangential velocity at the walls.

We here report data on the viscosity of argon at high temperatures. [Values for the viscosity of argon below room temperature have been reported (*5*).] The capillary-flow technique was used with provision for varying the mean pressure of the gas in the capillary from 10 to 100 cm of mercury. In this pressure range the correction for slip is of the form (*6*)

$$\eta = \eta_0 (1 + 4\kappa\lambda/r) \quad (1)$$

where η is the corrected viscosity, η_0 is the uncorrected viscosity, λ is the mean free path, r is the radius of the capillary tube, and κ is a constant. Thus the slip correction depends inversely on pressure. Therefore, extrapolation of the apparent viscosities of the gas to the limit of pressure $1/p \rightarrow 0$ permits the effects of slip to be eliminated from the calculation without the introduction of theoretically estimated correction factors. The latter are unreliable, especially at high temperatures, as it is not possible to gauge the extent to which the collisions of molecules with the wall of the capillary are specular (that is, the angle of incidence is equal to the angle of reflection). A number of different helical capillaries made of platinum, platinum-rhodium alloy, and silica were used. These were placed in furnaces which were regulated to an accuracy of ± 1°K. Apart from the slip effect, the results were corrected for curved pipe flow (*6*) and gas imperfection. The viscosity of argon from 300° to 1600°K was determined relative to the viscosity of argon at 293°K with a precision of about 0.3 percent. These data were fitted, by the method of least squares, to give the equation

$$\log [\eta(T)/\eta(293)] = 0.63842 \log T - 6.9365/T - 3374.72/T^2 - 1.51196 \quad (2)$$

Data calculated from this equation are given in Table 1. The ratio of the viscosity of argon to that of nitrogen over this temperature range was measured with a precision of better than 0.2 percent.

The results for argon are compared with those of other workers in Fig. 1. The widely accepted results of Trautz and Zink (*7*) and Vasilesco (*8*), though mutually consistent, are too low at temperatures above 500°K (*9*). The discrepancy between these workers and the results reported here reaches 6 percent at 1500°K. Only part of this discrepancy would appear to be attributable to errors in their slip corrections. Our data lie about 0.5 to 1 percent below those of Kestin and Whitelaw (*10*) and DiPippo (*11*) from 300° to 600°K and are about 2 percent below the results of Guevara *et al.* (*12*) from 1100° to 1500°K. However, because these results (*11, 12*) are subject to variations of ± 1 percent, we are unable to confirm that this difference is significant, particularly since the accuracy of our results is probably about ± 1 percent.

Table 1. Viscosity of argon. Smoothed values of viscosity are derived from Eq. 2 based on the standard η (293°K) = 222.8 × 10^{-6} poise. The original measurements are illustrated in Fig. 1.

Temperature (°K)	Viscosity ($\eta \times 10^6$ poise)
(293	222.8)
300	227.4
500	340.1
700	432.0
900	513.0
1100	586.9
1300	655.6
1500	720.3

The viscosities calculated from thermal conductivity data (*13*) (Fig. 1) are in broad agreement with our data. The new data are more consistent with intermolecular potential functions calculated with measurements based on molecular beam experiments and second virial coefficients.

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Antigenic Streptococcal Components in Acute Glomerulonephritis

Abstract. *Fluorescein-labeled immunoglobulin G fractions from serums of patients with acute glomerulonephritis and from many normal serums stained the glomerular basement membrane and mesangium of renal tissue from patients with early acute glomerulonephritis; these serums did not stain the corresponding tissues from patients with any other kidney disease. Previous absorption of the serum fraction with frozen and thawed nephritogenic beta hemolytic streptococci abolished all staining. Other bacteria studied did not abolish the staining. Only the plasma membrane of the streptococcus absorbed the immunoglobulin G fraction; such absorption eliminated staining. Fluorescein-labeled antiserums against streptococcal plasma membrane had staining properties similar to patients' serums.*

The fact that immunoglobulin (IgG) and complement (β_{1c}-β_{1a}) labeled with fluorescein isothiocyanate become localized on the glomeruli of patients with acute glomerulonephritis suggests a complement-consuming antigen-antibody reaction (*1, 2*). A causative relation between β-hemolytic streptococcal infections and acute glomerulonephritis can be established in most instances, but the presence of streptococcal components as antigens and their specific antibodies on the glomeruli have not been demonstrated consistently (*2, 3*).

We studied 16 children with acute poststreptococcal glomerulonephritis, as manifested by hematuria, proteinuria, low serum complement activity, and elevated antistreptolysin O titers. Renal tissue was obtained by biopsy within 3 days after clinical onset of the disease. As judged by light microscopy, such tissue had the typical glomerular changes. The glomerular basement membrane and, to a moderate extent, the mesangium stained in a beaded fashion characteristic of the early phase of the disease when antiserums against human IgG and complement (β_{1c}) were used. Serums from these patients and from normal individuals were obtained; IgG fractions were prepared (*4*) and labeled with fluorescein isothiocyanate (*5*).

The labeled IgG fractions from patients with acute nephritis stained, in a segmental pattern, the glomerular basement membrane and the mesangium