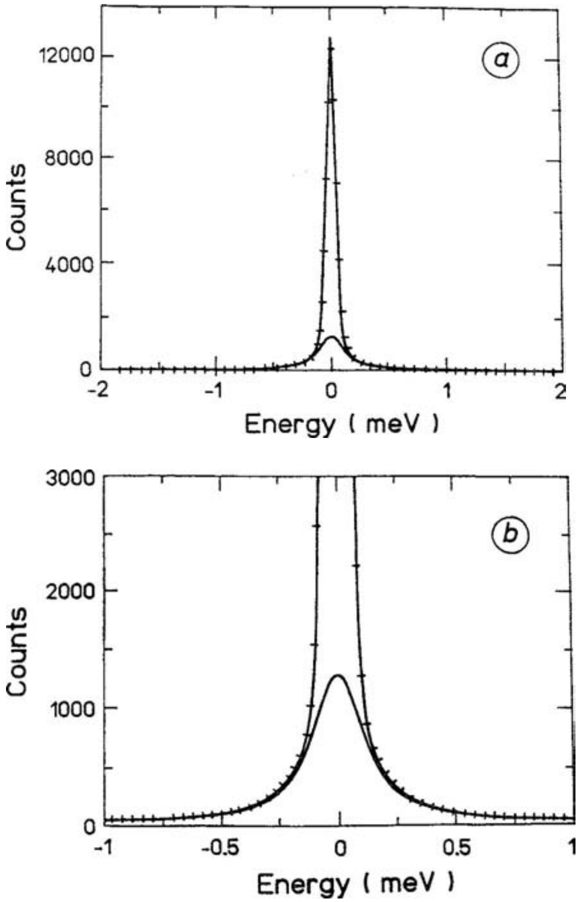

FIGURE 7 A typical quasielastic spectrum for the fully hydrated C-phycocyanin (h = 0.5 g water/g protein) at a scattering angle $\theta = 65.4$ K and for $T = 293$ K. Symbols "+" are experimental points and the full line is the fit using equation (2). *Source*: From Ref. 58.

water molecules is small at room temperature but, in contrast, that only at very low temperature (typically at -50°C) are their motions totally frozen. The curve shown in Figure 8B depicts the line width of the Lorentzian $L(\omega)$ versus the square of the momentum transfer Q. It shows that, at low values of Q, that is, when one investigates the system at large scales, the molecules appear confined. This is evident from the plateau seen below $Q = 1$ Å^{-1}. The resulting confinement yields a volume of confinement of molecular size ($a \approx 3$ Å). This is in contrast with the behavior of bulk water at the same temperature. The same figure shows that, in the case of bulk water, diffusive motions take place at all scales, as expected for a liquid. Indeed, the line width corresponding to bulk water goes to zero at small values of Q, following the Fick's law, $\Gamma = DQ^2$, where D is the self-diffusion coefficient. At intermediate values of Q, the slope of $\Gamma(Q^2)$ is smaller for confined water than for bulk water. This means that, within the small volume of confinement, the dynamics is hindered.

A numerical analysis of the data obtained at different temperatures shows that the dynamics of confined water molecules is analogous to that of bulk water at temperatures typically 30° lower (84). This can be understood in the following