In contrast to existing works on stochastic averaging on finite intervals, we establish an averaging principle on the whole real axis, i.e. the so-called second Bogolyubov theorem, for semilinear stochastic ordinary differential equations in Hilbert space with Poisson stable (in particular, periodic, quasi-periodic, almost periodic, almost automorphic etc) coefficients. Under some appropriate conditions we prove that there exists a unique recurrent solution to the original equation, which possesses the same recurrence property as the coefficients, in a small neighborhood of the stationary solution to the averaged equation, and this recurrent solution converges to the stationary solution of averaged equation uniformly on the whole real axis when the time scale approaches zero.