

BOOK REVIEWS

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Applications of centre manifold theory, by J. Carr, Applied Mathematical Sciences, vol. 35, Springer-Verlag, New York, 1981, 142 pp., \$14.00. ISBN 0-3879-0557-4

Theory and applications of Hopf bifurcation, by B. D. Hassard, N. D. Kazarinoff and Y.-H. Wan, London Mathematical Society Lecture Notes Series, No. 41, Cambridge Univ. Press, Cambridge, England, 1981, vi + 311 pp., \$35.00. ISBN 0-5212-3158-2

Elementary stability and bifurcation theory, by Gerard Iooss and Daniel D. Joseph, Springer-Verlag, New York, 1980, xv + 286 pp., \$22.00. ISBN 0-3879-0526-X

Monsieur Jourdain: Par ma foi, il y a plus de quarante ans
que je dis de la prose, sans que j'en susse rien.

Molière, *Le Bourgeois Gentilhomme*, Act II, Scene 4.

Many of the questions now studied in bifurcation theory can be illustrated by means of the following pair of ordinary differential equations for θ and ϕ :

$$(1) \quad \begin{aligned} 2\ddot{\theta} + \ddot{\phi} \cos(\phi - \theta) - \dot{\phi}^2 \sin(\phi - \theta) + \beta_1 \dot{\theta} + \beta_2(\dot{\theta} - \dot{\phi}) \\ + 2\theta - \phi + \lambda \sin(\phi - \theta) = 0, \\ \ddot{\theta} \cos(\phi - \theta) + \ddot{\phi} + \dot{\theta}^2 \sin(\phi - \theta) + \beta_2(\dot{\phi} - \dot{\theta}) + \phi - \theta = 0. \end{aligned}$$

Here the superposed dot denotes the derivative with respect to t , interpreted as time. $\beta_1, \beta_2, \lambda$ are real parameters with $\beta_1 \geq 0, \beta_2 \geq 0, \lambda > 0$. This system of equations describes the motion of the double pendulum, shown in Figure 2, consisting of two weightless rigid shafts OA and AB of unit length capped by particles of unit mass at A and B under the action of a compressive force of constant magnitude λ acting along the line BA . The rotations of OA from OC and of AB from OA are opposed by torsional springs each with spring constant 1 and by torsional dampers with constants β_1 and β_2 . (The plane of this system is taken to be horizontal so that effects of gravity do not appear. Any problem for a pendulum like that of Figure 2 with equal masses, with shafts of equal lengths, and with springs of equal strengths can be reduced to (1) by a suitable scaling.)