They don't mention the "imaginary time" connection between SE and heat equation, seems odd. The web mentions it. So just as Chapter 11 was "the wave chapter" we might call this "the diffusion/heat/SE" chapter.

Chapter 12: Diffusion and Wave Mechanics.

12.1 *Solutions of the Diffusion Equation* 1584

Transient Surface Heating of a Slab. Green's Functions and Image Sources. Radiative Heating. Transient Internal Heating of a Slab. Diffusion and Absorption of Particles. Fission and Diffusion. Laplace Transform Solution. The Slowing-down of Particles. Fission, Diffusion, and Slowing-down. General Case, Diffusion Approximation. Heating of a Sphere.

Radiative heading refers to the Stak radiative boundary condition, I know about this at least. So we open here with heat problems, then switch to solutes and their diffusion. Then the fission section is an application to the diffusion of neutrons in a nuclear reactor (they are created too fast to sustain fusion and have to be slowed down). The last section concerns sunlight hitting a rotating earth! There is a heat source on one side (sun) and radiative heat loss on the other side. Right up my alley.

12.2 *Distribution Functions for Diffusion Problems* 1606

Uniform Space Distribution. Approximations for Forward Scattering. General Considerations, Steady-state Case. Integral Relations between the Variables. Calculating the Diffuse Scattering. Calculating the Diffuse Emission. Solution by Laplace Transforms. The Variational Calculation of Density. Loss of Energy on Collision. Uniform Space Distribution. Age Theory.

This seems to open with some "gas physics" where particles have a "distribution" of velocities. Maybe you want to scatter something off such a gas. Diffuse reflection from a statistical surface. This is an area of the canyon I have never visited. Stak did the simple heat equation. I think here you are doing approximations again and statistical averaging probably.

12.3 *Solutions of Schroedinger's Equation* 1638

Definitions. The Harmonic Oscillator. Short-range Forces. The Effect of a Perturbation. Approximate Formulas for General Perturbation. Momentum Wave Functions. Bound and Free States. Existence of Bound States. Reflection and Transmission. Penetration through a Potential Barrier. Central Force Fields, Angular Momentum. Central Force Fields, the Radial Equation. Coulomb Potential. Inverse Cube Force. Coulomb Field in Parabolic Coordinates. Rutherford Scattering. Other Soluble Central Force Systems. Perturbations of Degenerate Systems. The Stark Effect. Momentum Eigenfunctions. Scattering from Central Fields. Ramsauer and Other Resonance Effects. Approximate Calculations for Slow Incident Particles. The Born Approximation. Phase Angles by Born Approximation. The Variational Method. Variation-iteration Method. Variational Principles for Scattering. Variation-iteration Method for Scattering. Variational Principle for the Angle Distribution. Two Particles, One-dimensional Case. The Green's Function. Surface Waves. The Effects of Interaction between the Particles. Meaning of the Results. Coupled Harmonic Oscillators. Central Force Fields, Several Particles, Angular Momentum. Inversion and Parity. Symmetrizing for Two-particle Systems. Bound, Free, and "Surface" States. Green's Function for the Two-particle System. Bound States. Variational Calculation. Scattering of Electron from Hydrogen Atom. Elastic and Inelastic Scattering. Exchange of Particles. Recapitulation.

So this is the M&F "Quantum Mechanics" section. Recall that Morse wrote his own QM book at one time. I presume they are doing fairly advanced QM topics here. It seems non-relativistic.

Problems (1745) 12.1 to 12.32

A. **Jacobi Polynomials** (but they don't use the standard notation)

B. **Semicylindrical Functions** -- never even heard of these babies! Like $J_m^{(4)}(z)$. This is so obscure that basically M&F is the only hit on the web. Some book suggests Sonin used these. Here is the definition

$$J_m^{(n)}(z) = \frac{n}{\pi i^m} \int_0^{\pi/n} e^{iz\cos u} \cos(mu)\, du$$

Note that

$$\int_0^{\pi} e^{i\beta\cos x} \cos nx\, dx = i^n \pi\, J_n(\beta)$$

So I guess n = 2 would be "semi-cylindrical".

Bibliography (1758)

Bateman PDE book 1932, Bethe on neutron diffusion, Chand on stellar distribution stuff, Hopf has a whole book on radiative equilibrium stuff (the H of WH), a Blatt and Jackson paper 1949, hear of JDJ PhD at MIT.