remains influential. However, in 1984, he branched out into popular science and in this he was and continues to be extraordinarily successful.

In summary, this book is engaging and informative. It gives a parallel chronological account of his life simultaneously with the development of his contributions to physics. The physics should be comprehensible to an intelligent layperson, and certainly to a scientist from a different field — four appendices provide more detailed (although still non-technical) background to some of the areas under discussion. I recommend this book to anyone who is curious about Stephen Hawking and his contributions to science.

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THEATRE

Entangled stage

The grand old *enfant terrible* of the British theatre, Tom Stoppard, has a penchant for peppering his plays with abstruse themes grubbed from herbaceous borders of science. *Arcadia* (1993) is the best-known example — a farrago of fractals and Fermat, thermodynamics, newtonian mechanics and population dynamics that plays in an English country house simultaneously two centuries apart.

If that sounds like a recipe for chaos — and Stoppard was inspired to write the play after reading James Gleick's book of the same name — the deft interweaving of the science and society of the two eras led to *Arcadia*'s wide acclamation as a masterpiece. *Hapgood*, another comedy that predates *Arcadia* by five years, is a less clear-cut case. The science is more focused, but less subtly embedded. Its conceit is quantum mechanics as a metaphor for the fuzzy loyalties and entangled webs of international espionage.

The seed of that idea, once planted, grows on you; and Stoppard certainly leaves no stone unturned in exposing its ramifications. In both worlds, uncertainty rules. In *Hapgood*, that uncertainty revolves around the different possible interpretations of a bewildering, wordless opening scene played out on a half-darkened stage. The scene is dimly recognizable as the changing rooms of a public swimming baths. The genre is unmistakeably a (parodic take on a) cold-war spy thriller *à la* John le Carré. Shadows enter, shadows leave; towels are hung portentously over cubicle doors; briefcases are slipped under doors; briefcases are retrieved.

The scene, it turns out later, is an experiment staged to test the doubted loyalty of a double agent. True secrets have been turning up in Moscow where only true lies were planted on Kerner, the Russian particle physicist whom the British spymistress Hapgood thinks is working for her. Has the turned worm re-turned? Single or double agent — or some higher multiple?

ROBERT DAY

Kerner (John Hodgkinson) explains to Hapgood (Josie Lawrence) the mystery of the quantum–classical transition.

Alternatively (let's make the duality explicit here, as Kerner does) wave or particle?

The answer to that last question of course depends on how one chooses to look at things. And so it proves. Kerner is clean (we think, by the end): with the abstracted innocence of the eccentric scientist, he seems to be the only person who consistently has not been dissimulating. Not so the agent engaged to test Kerner, by swapping the briefcase he is to hand over to the Russians. The observer, by choosing to observe at all, has changed the observed.

But it's not even that simple. As Kerner — with the kind of offhand brilliance natural to scientists of book, stage or screen — proves, the topology of the manipulated briefcase exchange is analogous to Leonhard Euler's notorious Seven Bridges of Königsberg. Euler proved that no one could cross all the bridges over the river in his (also Kerner's) home city just once and end up in the same place. In the process, he kick-started graph theory. By the same token, Kerner concludes that the shadowy observed paths we see in the swimming baths could not possibly have been covered by one person.

In fact, there must be two of them. The bent British agents are those darlings of the spy novel, identical twins; those central characters of quantum physics, indistinguishable particles. Thus endeth the quantum-mechanical lesson.

There is perhaps only so much quantum physics that a civilian audience can stomach before indigestion sets in. And that was indeed the tenor of *Hapgood*'s reception when it was premiered in London in 1988. The *Daily Telegraph*, resolutely anti-intellectual in the solid British tradition, harrumphed words to the effect that Mr Stoppard was far too clever for his own good. Audiences seemed to agree: by the time the play was finally produced on Broadway in 1994, it had gone through a series of transmogrifications designed to make its physics less — well, entangled.

Hapgood has just been revived at two theatres in England, the Repertory in Birmingham and the West Yorkshire Playhouse in Leeds, with Josie Lawrence (pictured) in the title role. It still takes a lot of concentration to follow what's going on. I cheated; I read the play before seeing it. Even so, I lost the plot at times — not that that necessarily spoilt the enjoyment. In that way, it occurred to me, *Hapgood* establishes perhaps the best metaphor for quantum physics of all: to paraphrase Richard Feynman, we've read the script, but none of us has a clue what it's about. And that's the fun.

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