

arms control (that is, weapons limitation and reduction), Dunay analyses the accomplishments of various forums over the past half-century: control over West Germany, the Mutual and Balanced Force Reduction talks, the verification regime for the Treaty on Conventional Armed Forces in Europe and the regional approach in the Balkans.

Today, arms control arrangements are increasingly focused on regional contexts and have less to do with weapons limitation than with confidence and security-building measures, transparency (such as clarification of the military information provided, information on the methodology of defence planning, high-level military doctrine seminars), risk reduction and stabilization. This may mean that the stringency of verification will gradually give way to broader, less binding regimes within the cooperative security system in Europe.

We cannot yet tell how history will judge the efforts to eliminate Iraq's arsenals of non-conventional weapons following its eviction from Kuwait in 1991. The UN Security Council ordered the destruction of Iraq's chemical and biological weapons as part of the cease-fire resolution 687 (1991) and to this end created a Special Commission — UNSCOM. Stephen Black, who was attached to UNSCOM as a historian, neatly describes the establishment of the verification regime, its expansion and successes, and the political difficulties and compromises that eventually led to the dissolution of UNSCOM in 1999 and its replacement with the still inactive UN Monitoring, Verification and Inspection Commission (UNMOVIC).

Although Iraq represents a case of coercive disarmament in an extremely hostile environment, several valuable lessons can be learned. Most importantly, as the author notes, parties to arms control and disarmament treaties must understand the need for continued active involvement in the treaties. Indeed, the UNSCOM saga also tells us that the UN Security Council is unable or unwilling to uphold its own resolutions despite blatant violations by Iraq, and that certain permanent members easily succumb to short-term self-interest. As the UN Security Council is the ultimate arbiter for material breaches of disarmament treaties, this is a serious cause for concern.

The *Yearbook* represents a serious and concerted effort to introduce the reader to the evolving and multifaceted world of verification. We recommend it to practitioners, academics, and the less technical reader alike. ■

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Science in culture

Dramatizing science

Oxygen, a play by Carl Djerassi and Roald Hoffmann

Phillip Ball

Conveying the language of any specialized profession in a dramatic context is never easy. But can that alone explain why it is so hard to portray scientists realistically on the stage and screen?

On the printed page we can somehow accept much more: Alice in Jeanette Winterson's *Gut Symmetries* or Thelma Darke in Ian McEwan's *The Child in Time*, both theoretical physicists, don't sound gauche as they hold forth on relativity. But put scientific characters on stage and their words become, in the ears of professional scientists, stilted and false.

Only the finest playwrights seem able to avoid this trap — and then by sacrificing all but the appearance. Tom Stoppard's *Valentine Coverly in Arcadia* gives us an elegant and convincing exposition on chaos, but, like Jeff Goldblum in the film *Jurassic Park*, you know he has never really spent hours plotting Poincaré maps. Bertolt Brecht's Galileo works so well as a character because he seldom has to speak as a scientist.

When playwrights do try to show us scientists speaking to one another, we never hear the rhythms of lab speech, but instead an awkward counterfeit — even when the writer is as well informed as Stephen Poliakoff, whose *Blinded by the Sun* was inspired by the cold fusion episode and who is the brother of a chemist.

Oxygen, a play by Carl Djerassi and Roald Hoffmann premiered in San Diego last month at the meeting of the American Chemical Society, is interesting because it reveals the professional scientist's attempt to bring off this dramatic sleight-of-hand. Here, at least, we know that the chemistry will be impeccable:

Ulf Svanholm: You remember the Stanford group's paper on new catalysts for oxygenated polymers?

Bengt Hjalmarsson: Didn't you have some similar catalysts up your sleeve?

Ulf Svanholm: Identical. Except that the American paper came out several months earlier.

Let no one underestimate the preparation needed for an actor to say "oxygenated polymers" and sound as though he not only knows what they are but has been working on them for the past five years. Playwrights take a great risk when they use language like this — not Stoppard-style explanations to outsiders, but chat between peers.

But that is part of the game for Djerassi, who confesses to the aim of using theatre to 'smuggle' some science into people's field of view. His concept of 'science in theatre' is explicitly pedagogical — the audience will leave not only entertained, but also better informed.

At face value, this sounds akin to Brecht's didactic theatre. But Brecht's motives were moral and political: he set out to persuade us of a certain stance or argument, not to deepen our



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historical knowledge of, say, the Thirty Years' War. *The Life of Galileo* does not seek to teach us heliocentric astronomy, but to question the relationship between person and state, between enquiry and ideology.

This is why Djerassi's 'science in theatre' has one foot firmly in science education. That is a valuable role, and *Oxygen* should be an effective emissary. But we should not mistake the play for something else. It entertains, it informs, it has the clever device of marshalling the evidence (the question is: who discovered oxygen?) and letting the audience reach their own conclusions. But at times, for example when discussing the phlogiston theory, the characters are clearly providing explanations more for the audience's sake than for one another's. And in terms of probing, say, the counterpoint of truth and ambition, the play reaches no further than *Blinded by the Sun* (which is not far).

The story rests on the premise that the Nobel Committee of 2001 are awarding 'retro-Nobels' for great discoveries made before the prizes began. In chemistry, the first is to go to oxygen's discoverer — but should that be Carl Wilhelm Scheele, Joseph Priestley (both of whom made it but were avowed phlogistonists) or Antoine Lavoisier, whose experiments came last but who reached the correct interpretation? The action jumps back and forth between the chemistry committee's deliberations and a meeting between the three protagonists in Stockholm in 1777.

Perhaps it is to other scientists that the play will be most educative, as it shows how little the squabbles of Priestley, Scheele and Lavoisier matter for chemistry today, and how arbitrary is any final attribution. One hopes that scientific audiences will not respond like the fictional Nobel Committee, grudgingly acknowledging this truth and then, by each advocating his own candidate until the bitter end, proceeding to ignore it. ■

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Oxygen is published by Wiley-VCH. It will be performed (in German) at the Stadttheater in Würzburg from 23 September and in London (in English) in November at the Royal Institution.