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The Science of Science in the Theatre, A Scientist as Reader and Critic

I have some slightly scattered remarks to make this morning, but I do so in the hopes that they will generate discussion.

First let me say something about why this meeting and why this sort of work is so important. For that I am going to use a bit of history.

In 1633 Galileo was excommunicated and sentenced to house arrest by the Catholic church over a disagreement about whether the earth went around the sun or vice versa. Or so we have all been taught this well known story in school. The real story is somewhat different. In fact the learned men of the priesthood were largely in agreement with Galileo; they were after all the most educated men of their day and it had for some time become obvious to them that the apparent movement of the sun across the sky was really due to the earth's rotation and that the movement of the sun through the stellar zodiac during the course of the year was really due to the earth's orbiting the sun. So what was the problem?

The trouble was that Galileo had published his findings in a huge book called *Dialogue Concerning the Two Chief World Systems*, and the book was written in Italian. Not Latin. In the sprit of the Renaissance, then well under way, Galileo published in a vernacular language making his work accessible to the populace. And this revolutionary act was what brought on the wrath of the church powers.

With this book Galileo began a tradition of publishing science in common languages – Descartes in French, Leibniz in German, Hooke in English, and ushered in an era of public interest in science and its empirical approach to the world. Indeed one could make the case that his popularly available publications, even more than the scientific discoveries contained in them, were Galileo's most important contribution. It was the public dissemination of science that led to the decline of magical and mysterian explanations that characterized life in the middle ages, that reinvigorated the Renaissance and lead to the Enlightenment spirit that eventually gave rise to our American constitution and many other ideas about man's role in the universe and towards each other that we continue to hold in high esteem.

Back to the present and we find ourselves perhaps shockingly again in an era where science is in danger of being absent from the individual citizen's life, where it seems as remote as if it were being communicated in Latin and as exceptional as if it were being performed by a priesthood. And indeed we see a public that is all too ready to embrace magical explanations of the world, seeing things like natural disasters, epidemics and even political acts it in the light of mystical forces rather than empirical data.

How do we meet the Galilean challenge of bringing science back into the public discourse, and indeed back to the public, who rightfully own it. You pay for it, you use it in your daily lives, you rely on it in thousands of ways, it effects the way you think about things from the weather to ethics.

Some years ago Professor Richard A. Muller at UC Berkeley began a class that has now become the most popular class on the Berkeley campus, with a yearly enrollment of over 250 students, with another 200 on the waiting list. The class is called Physics for Future Presidents. It is intended to provide the critical level of scientific thinking that any leader in the modern world should know to make informed decisions about policies ranging from climate to health to security – from why the climate is warming to how bombs work. What is remarkable about this course is its popularity which I take to reflect a strong desire for this knowledge. I suggest we need a movement that is even larger – a Science for Citizens, because if we live in a democracy it is not only critical for an elite leadership to be informed, the citizenry must be as well.

This is where the theatre comes in – as it always has. In the mid 60's and 70's we had political theatre – with its roots in Bertolt Brecht, The Living Theatre of Beck and Malina, The San Francisco Mime Troupe, and even popular commercial productions of pieces such as The Catonsville Nine and MacBird. Of course there is a long history of political theatre but I am only concentrating here on a contemporary movement that is fresh in our minds. Political issues are fodder for the theatre as are psychological ones. More than any of the other arts the theatre speaks directly to a public, it works by a curious dynamic of informing and entertaining, of being immediate and contemporary while also mythic and classical.

In our age I would like to suggest that science, like radical politics has been, can be a powerful new subject for the theatre.

So now, what am I doing here?
About 5 years ago I got involved with the Sloan Foundation and their program at EST, that you have already heard about from Graeme. This happened through the machinations of my colleague at Columbia Darcy Kelley who happened to know that before I got into this science business I had a nearly 20 year career in the theatre. I don't want to go into any detail about that except to say that I did many things in the theatre, just about everything except costumes because I cannot sew a stitch without letting blood, and was fortunate to have been able at one time or another to

work with directors like Andre Gregory, Jerzy Grotowski and Peter Brook. Grotowski especially was a particularly strong influence on me – not just for the kind of theatre that his company produced but for his inquiring approach to the theatre as an activity – his group was called the Polish **Laboratory** Theatre and his approach was experimental in the truest sense of the word. Eventually I found that directing was my particular talent, or perhaps capability would be the more modest and correct word.

Now almost 25 years since my last production in the theatre I find myself reviewing play proposals for the Sloan/EST program aimed at developing theatrical fare with science themes. I also, by another coincidence, have been given the opportunity by Sherman Suter, book and arts editor of Science magazine, and here today, to write an occasional review of science oriented performances for the journal.

So is there anything I can tell you that I have learned from this curious and interesting vantage point?

Reviewing pieces for Science has been especially rewarding. Now I am not a professional critic and don't pretend to be. I wouldn't write a "bad" review for Science, and they wouldn't want one. If the piece is not interesting or is flawed then we just don't write about it. But every so often a work comes along that should be bought to the attention of the scientific community for its aesthetics and its relevance, for the way it brings science in from the cold, if you will, making it accessible without thinning it out, for the way it integrates science into the culture, where it belongs. This is a tremendous accomplishment and a great service. Examples that come to mind are the recent film Agora, Philip Glass's opera Kepler, and Theatre Complicite's Disappearing Number. I have not mentioned several productions at EST that have also met this standard, but I never review them since I am on the selection committee.

What about reviewing play proposals? How does a scientist assess an idea for a play?
I have spent several years reviewing scientific grant proposals for the National Institutes of Health, NIH. There we have a mandated system for selecting applications for funding. It doesn't really work that well but its supposed to be somehow standardized. There are five criteria that grants are to be evaluated on:

Significance
Innovation
Environment
Investigator
Research Plan

These each have a counterpart in evaluating plays:

Significance = meaning, importance

Innovation = novelty, aesthetics, original, creative
Environment = producer
Investigator = writer, director, actors
Research Plan = narrative

But how does one finally decide what is likely to be a great play about science?

Since I am the token scientist on this panel I would like to conclude with an instructive story that has a little bit of math in it – but that I am sure you will all nonetheless appreciate.

The story, possibly apocryphal but no less instructive, revolves around a conversation between General Leslie Grove, military head of the Manhattan Project and the physicist Enrick Fermi, scientific co-director of the Project. Fermi was having some difficulty making decisions about which scientists to recruit to the project and was discussing, over evening cocktails on the veranda of Grove's house in the desert, how hard it was to determine greatness in a scientist. Grove claimed that the military had a simple rule for this when it came to determining who was a great general: a great general is any general who wins five battles in a row. Fermi asked how many Generals met this standard and Grove replied that about 3% of the Generals achieved this status.

Now the math part. Fermi, thinking on his feet, and with perhaps half a martini already downed, makes the following calculation. Any general worth anything at all would never get into a battle that he didn't think he had at least a 50-50 chance of winning. In other words winning the battles, at its worst, is simply a binary probability. So winning 5 in a row is 2^5 which equals 32 and the probability of winning them all is 1/32 which is about 3/100 or the magical 3%.

So from the scientific perspective, it's a crapshoot.