tial and specific membrane resistance, have also been noted when primary cultures of muscle cells are compared to the clonal cell line (*17*). These differences may reflect a departure from normal development in the clonal cell line. In conclusion, our data demonstrate that in primary cultures of chick myotubes, ACh hot spots can form on muscle fibers that have never been contacted by nerve processes. This suggests that neural induction of ACh hot spots may not be an essential step in neuromuscular synapse formation.

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Evolving Strategic Arms and the Technologist

Gustavson (*1*) does not go far enough in his descriptive example of strategies in a nuclear battle. Carrying the example to its conclusion suggests a simple model that leads to some interesting observations regarding disarmament.

The results discussed below indicate that participants in disarmament talks, such as the SALT talks, should concentrate not only on reduction or equalization in total reentry bodies, but that they also direct their attention to the multiplicative MIRV factors that tend to destabilize the system, to the effectiveness of their missiles, and to the perceived quality of information.

The model shows that escalation is more likely (or occurs at a faster rate) if the perceived quality of information is lower, if P, the single kill probability of a reentry body, is higher, or if the number of reentry bodies per missile is higher. Since the interchange associated with SALT would tend to improve the perceived quality of information, it is encouraging to find that this will act as a damper on escalation. It is not clear whether SALT will have the desired effect on P or the MIRV factors.

Although P can be reduced in several ways, its reduction is unlikely. Reducing P of one's own missiles is antithesis to the technologist, and it is dangerous as a unilateral policy. Reducing P of the opponent's missiles can be accomplished with ABM's or through the hardening of silos. Curiously, both of these alternatives have been precluded to a large extent by SALT.

Gustavson's example purports to show that the dynamic analysis he proposes will yield results different from and more realistic than the more traditional analysis which compares static capabilities. Whereas such a traditional analysis may show that the side (A) with the first strike in a nuclear battle has the advantage, Gustavson's dynamic analysis shows that the other side (B) can gain the advantage if it is able to determine which of its silos are threatened and launch those ICBM's before they are destroyed.

However, Gustavson permits each side only one strike. Since A does not use all of its missiles in the first strike, some of its remaining missiles will be threatened by B's retaliation, and the same logic that caused B to retaliate with threatened missiles will now cause A to launch those missiles threatened by B's retaliation.

The example is carried to its completion in Table 1. As in Gustavson's example, the table is based on a single-kill probability of .8, a perceived quality of information of 8/9, and an assumption that missiles cannot be retargeted.

In Gustavson's scenario, the second strike is unanswered by A, and B ends up with the advantage because its missiles destroy most of A's remaining force. In my extension of the example, the exchange is terminated when one side runs out of missiles, and here A has the final advantage from at least two points of view.

By "street fighting" standards, A is the winner, having delivered both the first and the last punches, although the last punch is somewhat meaningless since it was initiated after all target silos were empty.

The final tally also favors A, with 17 remaining missiles, although neither side destroyed any primary targets (missiles). In terms of secondary targets (silos), A comes out ahead, retaining an expected 40 of its silos unscathed. B retains only an expected 1.15 of a silo. Note that A's advantage in remaining missiles and silos (given that both sides must initially have the same number of reentry bodies) is due to its lower MIRV factor, giving it more silos. A's advantage does *not* result from the fact that it executed the first strike.

Below is presented a simple model that incorporates the dynamics of

Table 1. Missile exchange carried to completion.

Strike	Initial status			
	Missiles		Reentry bodies	
	A: 1000	B: 500	A: 2000	B: 2000
1 Used by A	250		500	
2 Launched by B in return to strike 1		450		1800
3 Launched by A in return to strike 2	729		1458	
4 Launched by B in return to strike 3		50		200
5 Launched by A in return to strike 4	4		8	
Remaining	17	0	34	0

MIRVing. Let N_i represent the number of missiles in the ith launch regardless of the side responsible. Let M_i be the MIRV factor associated with the ith launch, that is, the number of reentry bodies per missile, and let P be the single-kill probability of a reentry body. (I assume it is the same for all launches.) Then a policy of launching only threatened missiles for all launches after the first can be stated as

$$N_{i+1} = M_i N_i P \quad (1)$$

I have made three simplifying assumptions by ignoring that: (i) The number of missiles launched is limited by the number remaining to the side in question. (ii) After the first two launches and if missiles cannot be retargeted, some reentry bodies will be aimed at empty silos and hence will not evoke a subsequent launch. (iii) Multiple reentry bodies may be targeted for the same silo on a single launch.

The corresponding effects of these assumptions on the model and the results relating to escalation are: (i) No effect. (ii) Overstates the rate of escalation for larger values of i. (iii) Understates the rate of escalation for large values of N_i. Since escalation implies that N_i gets larger as i increases, the effects of the assumptions will partially cancel.

Equation 1 also assumes perfect information. To restate Eq. 1 for imperfect information, let Q_i be the perceived quality of information regarding the ith launch ($0 \leq Q_i \leq 1$). Then,

$$N_{i+1} = \frac{1}{Q_i} M_i N_i P \quad (1')$$

Escalation is simply the condition that

$$N_{i+1} > N_i \text{ for all } i \quad (2)$$

From Eqs. 1′ and 2, it can be concluded that escalation will occur if

$$1 < \frac{1}{Q_i} M_i P$$

$$P > \frac{Q_i}{M_i} \quad (3)$$

I have no knowledge of actual values of P, but Gustavson suggests that values are fairly high and uses .8 in his example. In any case, as long as $P > .5$ escalation will occur in any MIRV system because $M_i \geq 2$ for all i. Since the perceived quality of information is likely to decrease during a battle, it is more likely for Eq. 3 to hold for larger values of i.

It is disturbing that the MIRV factors, M_i, have an inverse effect on the escalation threshold (Eq. 3). Only in a non-MIRV system ($M_i = 1$) is it theoretically possible to increase the threshold to 1 (thereby eliminating the possibility of escalation) by increasing the perceived quality of information, Q_i.

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Gerritsen's conclusions (*1*) are founded on my "extreme example," which was intentionally and carefully provided with the warning: "This illustration is meant to be heuristic only. It assumes an extreme and simplified situation which is much less complex than that likely to occur."

Gerritsen also has introduced an assumption that entirely changes the character of this extreme example. In my article, having examined a case in which A strikes and B simply suffers attrition, I postulated a special innovation in giving B, the side attacked, the capability to discern which of its missiles was threatened and also the ability to launch these missiles quickly enough to avoid their destruction. The example served to illustrate the potentially profound impact of one side having introduced such an innovation in its posture. Gerritsen changes this example in a very significant way by attributing this same innovation in capability to side A. However, if both sides have such a capability and particularly if both sides also realize this in advance, then A's use of one-quarter of its forces in a countermissile, disarming strike is quite unreasonable. Analysis readily demonstrates that such a decision would, in fact, be far from A's optimum strategy for what is now a minimax type situation.

Finally, my heuristic example included, for the sake of simplicity, only a very few of the innovations suggested in the article. All or many of these innovations may be implemented at the same time and at varying performance levels in future force postures. A fully adequate analytic procedure would accommodate quantitative measures of performance for all of the suggested innovations. Such a comprehensive treatment would provide a foundation on which predictions could be more confidently based.

I feel that, as Gerritsen suggests, the perceived quality of information will play an important role. It would, in fact, be desirable if one were able to include explicitly all of the aspects of the "information war" identified by Rona (*2*). Precisely defining the components out of which this quality of information function is composited and incorporating this function into a comprehensive analytic scheme would be a major achievement. It is one of the numerous outstanding challenges facing the technologist in coping with the evolution of strategic arms.

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Breast Lobules

Jensen *et al.* (*1*) report a continuum of atypical lobules through carcinoma in human breasts in patients with associated malignant disease of ipsilateral or contralateral breast. Unfortunately, their report provides no evidence to substantiate their claims. The histologic pictures labeled figure 4 and figure 5 represent papillary intraductal carcinoma and not atypia. This is a well-known neoplasm which, according to McDivitt *et al.* (*2*, p. 46), "is least frequently recognized by those sending us slides in consultation."

Furthermore, the terminology of Jensen *et al.* serves to confuse a relatively recently clarified concept. Lobular carcinoma of the breast is a well-defined entity and differs considerably, both in appearance and prognostic implications, from intraductal carcinoma. Whether or not so-called intraductal carcinoma originates from breast lobules appears to be irrelevant. Finally, papillary hyperplasia with cytologic atypia is a term that was once used to describe what we now recognize as papillary carcinoma; thus it is not at all surprising that this lesion is "more frequent in cancerous breasts."

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