A Rabies-induced Serum Factor Inhibiting Rous Sarcoma Virus in Chicks*

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SUMMARY

Chicks inoculated in the wing web with fixed rabies virus (RV) were protected against subsequent challenge injections of Rous sarcoma virus (RSV). The protection was transient, generalized and was not elicited in birds treated with actinomycin D or hydrocortisone. Chick serum was shown to possess a factor induced by RV, which inhibited RSV in vivo, and its presence in the serum at different times after RV administration was closely correlated with the RV-RSV blockade. This serum factor (SF), probably protein in nature, was heat and pH-labile. The inhibition of RSV by RV or the serum factor was affected by flock changes in a manner suggesting the occasional presence of interfering contaminating agent(s).

INTRODUCTION

The inhibition of Rous sarcoma virus by non-oncogenic viruses, in different in vivo and in ovo systems, has been described (Oker-Blom & Strandström, 1956a, b; Strandström, Sandlin & Oker-Blom, 1962; Shirodkar, 1963a, b, 1965; Banerjee, 1965; Kravchenko, Voronin & Kosmiadi, 1967; Desai, 1970). Other oncogenic viruses such as the Shope fibroma virus, polyoma virus and Friend and Gross leukaemia viruses are inhibited in various systems (Andrewes, 1940; Selbie, 1946; Ginder & Friedewald, 1951; Barski, 1963; Wheelock, 1967a; Takehara, Makino & Hotta, 1969; Barski & Youn, 1971). Interferon has been implicated (Wheelock, 1967a, b; Gressor et al. 1967) in some of these systems as in the inhibition of Friend leukaemia virus in mice. Preliminary experiments by one of the present authors (Shirodkar, 1963a) failed to detect interferon in the blockade of RSV by West Nile virus. A recent report excluded interferon mediation in the inhibition of the Gross leukaemia virus in mice by a non-leukaemogenic C-type murine RNA virus (Barski & Youn, 1971). However, no definite conclusion has been reached regarding the mechanism of inhibition in most systems. It is necessary therefore to consider inhibitors other than interferon in the explanation of such findings.

This paper presents an analysis of the RV-RSV system in White Leghorn chickens (Kravchenko et al. 1967; Desai, 1970) leading to the hypothesis that the inhibition of RSV is mediated by a factor present in the sera of RV inoculated birds. This serum factor (SF) is

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probably a protein and appears to be distinct from interferon (J. Vilček, personal communication). Such factors may be involved in other interference systems involving oncogenic viruses.

**METHODS**

*Rous sarcoma virus.* The RSV stocks were derived from the Bryan Master Standard strain (CT 559 of 1965, University Laboratories Inc., New Jersey, U.S.A.). This was passaged serially as described earlier (Desai, 1970) through the wing webs of White Leghorn chicken as indicated in Table 1. Chilled sodium citrate buffer (0·05 M, pH 6·7) was used as diluent.

*Rabies virus.* The Paris strains of infective, fixed RV were used. RV1 was obtained from the Haffkine Institute, Bombay, India, and RV2 from Dr P. Atanasiu, the Pasteur Institute, Paris, France. These strains were passaged subsequently in our laboratory according to the Lépine (1966) technique. Chilled saline (0·9 %) was used as diluent.

*Normal rabbit brain (NRB).* This was obtained from control rabbits of the batches used for passage of RV. Suspensions (10 % w/v) were prepared in chilled saline (0·9 %).

*Chicks and embryonated eggs.* White Leghorn chickens from several flocks were used in the present study. Flocks Fa, b, c and d (Table 1) were HyLine Park strains maintained at the Haffkine Institute Farm, Pimpri, India; flock KPF was a similar strain from the Kuality Poultry Farm, Aundh, India; and flock RPF was an Australian strain from the Regional Poultry Farm, Bombay, India. Embryonated eggs or 1-day-old unvaccinated male chicks were obtained from the farms. Eggs were incubated (37·5 °C, and 86 % r.h.) in the laboratory until used or hatched. No information was available on the prevalence of leukosis in these flocks. These birds were highly susceptible to the RSV used.

*Mice.* These were the Swiss Kasauli, random bred, albino strain of mice maintained at the Haffkine Institute.

*Virus titration.* RSV was titrated on the chorioallantoic membranes of 10- to 12-day-old embryonated eggs from the respective passage flocks. Various stocks showed infectivities between $10^{5.1}$ and $10^{6.2}$ pk.f.u./ml. Rabies virus (RV) was titrated by inoculating mice intracerebrally with 0·03 ml of the virus dilutions. The infectivities ranged between $10^{6.5}$ and $10^{7.2}$ adult mouse LD$_{50}$/0·03 ml (Reed & Muench, 1938).

*Blockade procedure.* This was as described by Desai (1970) and utilized, as control material, the same normal rabbit brain (NRB) homogenate. All experiments were performed with 3- to 15-day-old chicks. Birds were examined daily for tumours after the fifth day following RSV challenge. Results were expressed as $100 \frac{c}{a-b}$ tumour-free birds where ‘a’ is the total number of birds in a group, ‘b’ the number of tumour-free birds dying prior to the time of recording and ‘c’ the number of tumour-free birds at the time of recording.

*Preparation of serum factor (SF).* Between $10^4.8$ and $10^5.8$ adult mouse LD$_{50}$/0·1 ml of RV was inoculated bilaterally into 5-day-old chicks (0·05 ml/web) and the birds were bled by cardiac puncture after 24 or 72 h. The blood was allowed to clot at 4 °C and the sera separated 2 to 24 h later, when the sera from several birds were pooled. The pool was clarified by centrifuging at 1000 g (4 °C) for 5 min (RV serum). The absence of infective RV in the sera was tested by inoculating these intracerebrally into adult mice. Control NRB-sera were prepared similarly by bleeding chicks inoculated with 0·1 ml of a 1/100 dilution of a 10 % (w/v) suspension of normal rabbit brains (NRB).

*Assay of serum factor.* Equal vol. of the serum and an appropriate dilution of RSV, strain P-2/1 (RPF), of $10^8$ to $10^4$ pk.f.u./ml were mixed at 4 °C. Three- to ten-day-old chicks were inoculated bilaterally, within 15 to 30 min, with 0·05 ml/wing-web of the mixture and the birds checked daily for 21 days for occurrence of tumours.
RV–RSV blockade in chicks: serum factor

Table I. Rous sarcoma virus stocks (BRYAN strain)

<table>
<thead>
<tr>
<th>Origin</th>
<th>Serial passages*</th>
<th>Flock</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT 559</td>
<td>P-1 to 5, 6'</td>
<td>Fa, b, c</td>
</tr>
<tr>
<td>P-5</td>
<td>P-6 to 8</td>
<td>Fd</td>
</tr>
<tr>
<td>P-2</td>
<td>P-2/1 to 3 (KPF)</td>
<td>KPF</td>
</tr>
<tr>
<td>P-2</td>
<td>P-2/1 to 3 (RPF)</td>
<td>RPF</td>
</tr>
<tr>
<td>P-2</td>
<td>P-2/1 (Fd)</td>
<td>Fd</td>
</tr>
</tbody>
</table>

* Wing web passage in 3- to 15-day-old chicks.

Heat and pH lability of serum factor. RV serum containing SF was purified partially by passing through a DEAE-cellulose column and the peak fraction (determined by $E_{280}$) dialysed overnight against distilled water in the cold. Samples of 0.5 ml of the active preparation were kept at 37 and 56 °C for 0.5 h in a water bath. One sample was acidified with 1 N-hydrochloric acid to pH 2.0 at 10 °C for 0.5 h before neutralization by 1 N-sodium hydroxide. All three samples were then assayed for SF. Two controls were used: (a) a low protein fraction from the same RV serum run (fraction 11) and (b) the peak protein fraction obtained from NRB serum in a DEAE-cellulose column.

Drugs. Actinomycin D ('Lyovac Cosmegen Dactinomycin', Merck, Sharpe and Dohme, U.S.A.) was used at a concentration of 100 μg/ml. The groups of test birds were given 0.1 ml of the solution by the intracardiac route just prior to the infection of RV or NRB.

Hydrocortisone sodium succinate (brand ‘Efcorlin’ of the Glaxo Laboratories India Ltd., Bombay, India) was inoculated intraperitoneally with 2 mg (in 0.1 ml)/bird prior to infection of RV or NRB. The drug was repeated (1 mg in 0.1 ml/bird) 48, 72 and 120 h after injection of RV or NRB.

Storage and bacteriological sterility of materials. All biological samples except RV were stored in an ice-chest containing dry ice (−70 °C). RV was stored at 4 °C in a refrigerator. Only samples shown to be sterile under aerobic and anaerobic conditions were used in experiments.

RESULTS

The inhibition of Rous sarcoma viruses by rabies viruses

The pooled results in Fig. I show the inhibition-time curves produced in two different strains of White Leghorn chicks (Fb, c, and RPF) by two different preparations of both rabies (RV1 and RV2) and Rous sarcoma viruses (P-4, 5 and P-2/1 (RPF)). Each curve refers to constant doses of each virus. Though differing in detail, the pattern of the curves is similar. The protection due to inhibition of RSV developed rapidly within 24 h of RV inoculation but persisted for only 96 to 144 h. The reduction in the effect at 24 (Fb, c) to 48 (RPF) h was demonstrated repeatedly, and was consistent for each flock. The blockade was observed to be a generalized effect. When rabies virus (RV1) was inoculated into the left wing web, and the right web was challenged with RSV, (P-6') after 0, 48 or 96 h the tumour induction was inhibited.

In attempts to determine whether the blockade of tumour induction due to RSV required the elaboration of an interferon-like substance we tested the effects of pretreatment with actinomycin D and hydrocortisone since these drugs are inhibitors of interferon synthesis and action (Kilbourne, Smart & Pokorny, 1961; Heller, 1963; Wagner, 1963; Smart & Kilbourne, 1966). Chicks (Fc) treated with actinomycin D or hydrocortisone (see Methods) were inoculated with RV1 (13 and 20 chicks, respectively) or NRB (5 and 7 chicks, respectively) and challenged 48 h later with RSV (passages 4 and 5, respectively). The results
Fig. 1. Temporal pattern of RV-RSV blockade. Fifteen to 20 or 5 to 10 birds inoculated with rabies virus or a normal rabbit brain homogenate respectively and challenged with Rous sarcoma virus at various times with respect to the first inoculum. Each point consists of such a test, each at least in duplicate. Zero-hour inocula mixed together prior to injection. ● —●, flock Fb; c; RV₁ (10⁴.₅ adult mouse LD₅₀/0·₁ ml) and RSV-P₂₁, 5 (10⁶ pk.f.u./ml) and ○ —○, flock RPF; RV₄ (10⁴.₅ adult mouse LD₅₀/0·₁ ml) and RSV-P₂₁ (RPF) (10⁴.₄ pk.f.u./ml). NRB groups had no tumour-free chicks.

indicated that treatment with these two drugs completely prevented the inhibition by rabies virus of tumour induction, whereas the simultaneous control experiments without the drugs showed about 30% tumour-free birds at 21 days after challenge with RSV.

Serum inhibitory activity

If the generalization of the inhibition by rabies virus was due to factors circulating in the blood, then the sera of the birds inoculated with rabies virus would inhibit tumour induction by RSV. Such activity in inhibition was detected in the sera of 5- to 7-day-old chicks (flock RPF) inoculated with RV and bled 72 h later (experiment 1, Table 2). An in vitro inactivation of RSV during this procedure, such as that due to neutralizing antibody, was excluded by the next experiment (experiment 2, Table 2) in which RSV was not inhibited by RV serum when assayed in the blockade 'resistant' flock Fd (see below).

In a further experiment on the role of a serum factor, three sets of chicks (RPF) were inoculated with RV₂ and NRB. These were bled at 24, 48 and 72 h after RV inoculation. The three serum pools were then assayed for inhibitory activity (SF) using RSV (P-2/1 RPF). The results (Fig. 2) show a similarity between the inhibition of tumour induction by either rabies virus or serum and show again the 'dip' of Fig. 1.

In further tests the levels of serum inhibitory activity (SF) fell in parallel with the rabies virus by which it was induced. Tenfold dilutions of virus strain RV₂ were inoculated into groups of chicks, which were bled after 24 h when the group sera were pooled and assayed for SF activity. Serum prepared with 10⁶₉, 10⁵₉ and 10⁴₉ adult mouse LD₅₀/0·₁ ml/bird of RV₂ inhibited tumour induction by RSV in 50%, 33% and 0% of birds respectively. A parallel dependence of the RSV blockade on the dose of rabies virus, including its disappearance when about 10⁴₉ adult mouse LD₅₀/0·₁ ml/bird was inoculated, was noted in preliminary experiments.
Table 2. Inhibition of tumour induction by crude serum

<table>
<thead>
<tr>
<th>Expt no.</th>
<th>Assay flock</th>
<th>No. of chicks</th>
<th>Serum from RPF chicks following injection of</th>
<th>Tumour-free chicks on day post-RSV* challenge (% in parentheses)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RPF</td>
<td>12</td>
<td>RV†</td>
<td>12 (100) 7 (58) 7 (58) 5 (42)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10</td>
<td>NRB‡</td>
<td>2 (20) 0 (0) 0 (0) 0 (0)</td>
</tr>
<tr>
<td>2</td>
<td>Fd</td>
<td>10</td>
<td>RV</td>
<td>5 (50) 2 (22)§ 2 (22) 2 (22)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
<td>NRB</td>
<td>4 (67) 1 (17) 1 (17) 1 (17)</td>
</tr>
</tbody>
</table>

* Rous sarcoma virus (P-2/1 (RPF)) $10^5$ pk.f.u./ml at final concentration, $10^3$ pk.f.u./bird.
† Serum prepared 72 h after injection of rabies virus (RV2) $10^5$ adult mouse LD$_{so}$/o·1 ml/bird.
‡ Serum prepared 72 h after injection of normal rabbit brain (NRB) homogenate, $10^{-2}$ dilution, o·1 ml/bird.
§ One tumour-free chick died on day 7.

Heat- and pH-lability of SF

In an attempt to establish the nature of SF, its heat- and pH-lability were studied. As chick interferon is known to be sensitive to heat (56 °C for 1 h) and pH (pH 2·0 for 1 h) (Finter, 1966; Vilček, 1969) it was believed that these two tests would assist the comparison of SF with interferon. A partially purified preparation of SF was used in the experiments described. The results (Table 3) show that SF was heat- (37 or 56 °C for 0·5 h) and pH- (pH 2·0 for 0·5 h) labile. These experiments therefore suggest that SF was distinct from interferon.

A limitation of the RV-RSV blockade

As indicated earlier, a flock of White Leghorn (Fd) chickens was encountered in which the blockade of tumour induction could not be produced. This effect was analysed and appeared to be due to contaminating agent(s), probably the Rous-associated virus(es) (Rubin & Vogt, 1962; Hanafusa & Hanafusa, 1966) present in this flock.

Table 4 summarizes the results on the blockade by rabies virus of tumour induction by
Table 3. Heat- and pH-lability of the anti-RSV activity of 24 h serum (partially purified)*

<table>
<thead>
<tr>
<th>Experiment no.</th>
<th>Treatment for 30 min</th>
<th>Serum group</th>
<th>No. of chicks of flock RPF</th>
<th>Tumour-free chicks on day post-RSV† (% in parentheses)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nil</td>
<td>RV†</td>
<td>8</td>
<td>8 (100) 5 (63) 3 (43)§</td>
</tr>
<tr>
<td></td>
<td>Nil</td>
<td>Fr.11</td>
<td>8</td>
<td>0 (0) 0 (0) 0 (0)</td>
</tr>
<tr>
<td></td>
<td>Nil</td>
<td>NRB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>pH 2</td>
<td>RV</td>
<td>8</td>
<td>3 (38) 1 (12) 0 (0)</td>
</tr>
<tr>
<td></td>
<td>pH 2</td>
<td>NRB</td>
<td>9</td>
<td>2 (22) 1 (11) 1 (11)</td>
</tr>
<tr>
<td>3</td>
<td>37 °C</td>
<td>RV</td>
<td>10</td>
<td>4 (40) 1 (10) 1 (10)</td>
</tr>
<tr>
<td></td>
<td>37 °C</td>
<td>NRB</td>
<td>10</td>
<td>4 (40) 2 (20) 1 (10)</td>
</tr>
<tr>
<td>4</td>
<td>56 °C</td>
<td>RV</td>
<td>8</td>
<td>3 (38) 2 (25) 2 (25)</td>
</tr>
<tr>
<td></td>
<td>56 °C</td>
<td>NRB</td>
<td>9</td>
<td>1 (11) 0 (0) 0 (0)</td>
</tr>
</tbody>
</table>

* Sera adsorbed at 0.05 M-potassium phosphate buffer (0.002 M-EDTA, 0.006 M-β-mercaptoethanol, 20 % ethylene glycol, pH 7.2) on to a DEAE-cellulose column, washed with 0.125 M buffer and eluted with 0.4 M buffer. Peak fraction dialysed against distilled water overnight in the cold. Fr.11: low protein fraction of RV serum chromatogram.

† Rous sarcoma virus (P-2/1 (RPF)) 10⁶ pk.f.u./ml at final concentration, 10⁵ pk.f.u./bird.
‡ Serum prepared 24 h after injection of rabies virus (RV2) 10⁶ # adult mouse LD₅₀/0.1 ml/bird.
§ One tumour-free chick died on day 11.
|| Serum prepared 24 h after injection of normal rabbit brain homogenate, 10⁻⁸ dilution, 0.1 ml/bird.

Table 4. The blockade by rabies virus of tumours induced by RSV*

<table>
<thead>
<tr>
<th>Experiment no.</th>
<th>Passage of rous sarcoma virus</th>
<th>Strain of rabies virus (see methods)</th>
<th>Assay flock</th>
<th>Detection of blockade</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>P-1 to 5</td>
<td>RV₁</td>
<td>Fa, b, c</td>
<td>+</td>
</tr>
<tr>
<td>2</td>
<td>P-6 to 8</td>
<td>RV₁</td>
<td>Fd</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>P-6</td>
<td>RV₂</td>
<td>Fd</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>P-3</td>
<td>RV₂</td>
<td>Fd</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>P-2/1 (KPF)</td>
<td>RV₂</td>
<td>KPF</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>P-2/1 (Fd)</td>
<td>RV₂</td>
<td>KPF</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>P-2/1 (RPF)</td>
<td>RV₂</td>
<td>RPF</td>
<td>+</td>
</tr>
<tr>
<td>8</td>
<td>P-2/1 (Fd)</td>
<td>RV₂</td>
<td>RPF</td>
<td>-</td>
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<tr>
<td>9</td>
<td>P-2/1 (KPF)</td>
<td>RV₂</td>
<td>RPF</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>P-2/1 (RPF)</td>
<td>RV₂</td>
<td>KPF</td>
<td>-</td>
</tr>
</tbody>
</table>

* Each test with 15 to 20 chicks in RV and 5 to 10 in NRB control groups.

RSV. Experiments 1 and 2 shows that RV₁ inhibited the earlier passages of RSV but that the later passages (P-6, 7, 8) were not inhibited. The failure of blockade was determined to be due to a variation in the chicks (experiments 3 and 4). This was confirmed by experiments in two new flocks. The challenge RSV was prepared by passing a 'susceptible' stock (P-2) through the two flocks (KPF and RPF). Two experiments were performed in each flock: for one RSV was prepared in the resistant flock (P-2/1 (Fd)) and for the other RSV was prepared in the same flock as used for the experiment. Experiments 5 and 6 show that no blockade was observed in KPF birds using either RSV, but experiments 7 and 8 show that a blockade was produced in RPF birds using a corresponding RSV (P-2/1 (RPF)) but not with RSV from the 'resistant' flock (P-2/1 (Fd)). As this 'resistant' stock was made by passaging (P-2) through the original flock (Fd) we conclude that the latter contained a contaminating agent which blocked the blockade activity of rabies virus, and further, that this agent was passed with the RSV and then continued to interfere with the blockade in the RPF flock.
Table 5. Dependence of serum factor activity on RSV passage and assay flock

<table>
<thead>
<tr>
<th>Experiment no.</th>
<th>Passage of rous sarcoma virus</th>
<th>Serum* prepared in flock</th>
<th>Assay flock†</th>
<th>Blockade</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>P-2/1 (RPF)</td>
<td>RPF</td>
<td>RPF</td>
<td>+</td>
</tr>
<tr>
<td>2</td>
<td>P-2/1 (RPF)</td>
<td>RPF</td>
<td>Fd</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>P-2/1 (RPF)</td>
<td>Fd</td>
<td>RPF</td>
<td>+</td>
</tr>
<tr>
<td>4</td>
<td>P-2/1 (KPF)</td>
<td>RPF</td>
<td>RPF</td>
<td>-</td>
</tr>
</tbody>
</table>

* Rabies virus (RV2) serum prepared (24 h, see Methods) and assayed in indicated flocks.
† Each assay with 10 to 15 experimental and 5 to 10 control chicks.

On this basis it was predicted that P-2/1 (KPF) and P-2/1 (RPF) would not be blocked in RPF and KPF flocks respectively. Experiments 9 and 10 (Table 4) confirm this prediction.

Extrapolating these findings to the tumour-inhibitory activity of serum we may predict a series of results using different passage stocks of RSV, RV sera from different flocks and different assay flocks. Table 5 shows that the results of these experiments tallied with the predictions based on the hypothesis that the serum factor could be induced by RV even in flocks which probably carry the contaminating agent(s) but that no blockade could be produced when tissues of such resistant flocks were utilised either as RSV source, or as the in vivo host.

A preliminary experiment using a ‘high potency’ 24 h rabies serum (10^6.8 adult mouse LD₅₀/0.1 ml/bird) to test for inhibition with P-2/1 (KPF) in RPF chicks showed a 25% protection of the birds as against 50% protection when P-2/1 (RPF) was used. This indicated that the effect of the contaminating agent(s) was essentially a quantitative change in the RSV and not a qualitative alteration in its properties.

DISCUSSION

The injection of rabies virus inhibited tumour induction by RSV in chicks. This inhibition was rapid in onset, was biphasic and of short duration, the effect declining gradually after 72 h (Fig. 1). That this inhibition could be elicited at a site remote from the site of rabies inoculation suggested the activity of a generalized or circulating agent. Experiments with sera drawn from rabies-treated birds demonstrated the presence of an inhibitory activity in such sera (Table 2) which showed a close parallel with the inhibition of RSV tumour by rabies virus as evidenced by the pattern of blockade activity with time after administration of RV (Fig. 2). Further, the inhibitory activity of serum was not observed in a flock (Fd) in which rabies virus failed to inhibit tumour induction by RSV (Tables 4, 5).

These observations support the conclusion that the serum of rabies-inoculated birds contains a factor (SF) responsible for the major part, if not all, of the tumour blocking activity of rabies virus.

The nature of this serum factor has been studied. Prevention of the interviral blockade by pretreatment with actinomycin D or by hydrocortisone (which inhibit protein synthesis) suggests that the blockade is mediated by a protein substance. The maximum inhibition of tumour induction by RSV was observed at the protein peak of a DEAE-cellulose column run with serum from rabies injected birds, thus favouring the above possibility. These observations together with the transient and generalized nature of SF activity suggest the presence of an interferon-like substance. However, a biphasic nature of the time-effect curve
has not yet been described for an in vivo interferon mediated inhibitory system. The RSV stock and chick flock specificity of the phenomenon (Tables 4, 5) would be unusual for an interferon mediated system. The acid and thermal lability of the activity both in crude and partially purified preparations (Table 3) confirms the hypothesis that it is not the usual interferon (Finter, 1966; Vilček, 1969). This activity was lost even at 4°C (pH 7.2) in less than 1 week.

The mode of action of SF at the cellular and/or the molecular level remains to be explained. Experiments are in progress to determine whether it can interfere with reverse transcriptase activity (Baltimore, 1970; Temin & Mizutani, 1970) of RSV. The reported inhibition of the DNA polymerase of feline sarcoma virus by an inhibitor in feline sera (Roy-Burman, Pal & Gardner, 1972) gives credence to this hypothesis.

The experiments described in Tables 4 and 5 highlight a common problem encountered in avian leukosis virus work (Pontén, 1971). Could these data be interpreted as an in vivo rescue of RSV?

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REFERENCES
RV–RSV blockade in chicks: serum factor


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