V I D O

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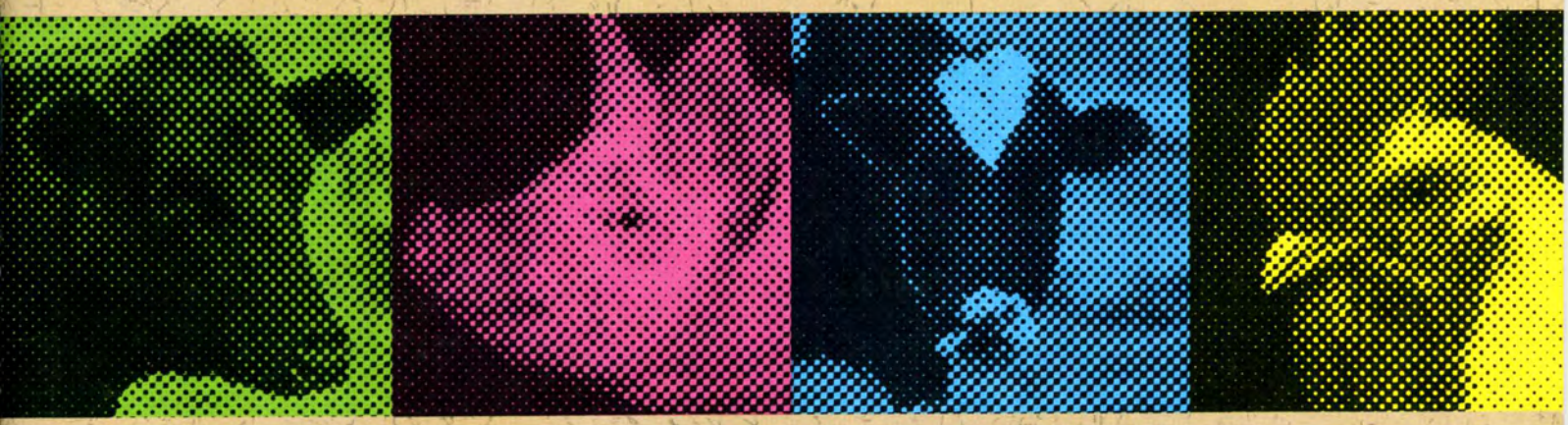

Origins

In 1975, VIDO was established at the University of Saskatchewan in Saskatoon with a grant provided by the Devonian Group of Charitable Foundations of Calgary. The Foundation was joined by the Provinces of Saskatchewan and Alberta, and the University which supported the original development of the Organization. As a financially self-reliant national Organization of the University, it receives on-going funding from governments, charitable foundations, the livestock and poultry industries, federal and provincial granting agencies, contracts and other private sources. The Provinces of Saskatchewan and Alberta, and the University of Saskatchewan continue to be important supporters of VIDO.

Mandate

VIDO's mandate is to serve livestock and poultry producers and consumers by developing safe and effective animal health and performance products, preventive medicine programs and improved livestock management techniques and information.

Goals of VIDO

1) To serve the livestock industry through research on the common infectious diseases of farm animals and poultry.

2) To help provide higher quality food to consumers through research on safe and effective animal health and performance products, preventive medicine programs and improved livestock management.

3) To fill the gap between scientific discoveries in the laboratory and their practical application on the farm.

4) To use science, technology and innovation to improve the economic well-being of the agri-food system.

5) To reduce the suffering and wastage of animals caused by disease.

6) To improve human health by encouraging the application of results from animal health research to the development of human health products and by reducing diseases that are directly transmissible from animals to man.

Report from the Chairman

Bob Hunsberger
Chairman

Dr. Ed Moss
Vice-Chairman

As we approach 20 years of history at VIDO, the Organization continues to evolve. It has been a difficult year in some ways. The recession affected the availability of funding support as livestock producers and granting agencies sought to be more effective with their funds. Our Organization is entirely dependent on the financial support of producer organizations, companies, governments and granting agencies. Each year that support must be earned. Because of funding constraints, VIDO, like many organizations, went through a downsizing and adjustment process. This always involves some painful and difficult decisions. The Board, however, is very proud of how the Organization handled these changes and appreciative of the continued funding support that was received. VIDO continued to be successful in its goal of "results oriented" research. Through the concerted efforts of the staff, the budget has been met and funding support is constantly being earned.

The developments in biotechnology are proceeding at a frantic pace, and VIDO continues to be at the forefront of this technology. The recognition of VIDO's competence in this area is particularly gratifying. New opportunities continue to be presented, and VIDO's staff is meeting those challenges. The changes and plans that have been set in place at VIDO are enabling it to maintain its position as a leading centre for biotechnology in Canada and the world.

I wish to express my personal thanks to my fellow Board members for their insight and direction. Most importantly, the Board wishes to express thanks to all the staff members at VIDO for their contributions to VIDO's strategic planning process and the Organization's ongoing commitment to quality research for the livestock industry. The work at VIDO is contributing to Canada's global competitiveness.

Bob Hunsberger

Back row: Paul Hodgman, Deborah Whale, Dr. Lorne Babiuk, Dr. Dennis Johnson, Bob Byle, Dr. Alex Livingston, Don Taylor, Dr. Ralph Christian, George Schoepp, Fred Van Ingen.
Front row: Dr. Lorne Hepworth, Bob Hunsberger, Dr. Ed Moss, Al Hingston.

Report from the Director

Lorne Babiuk
Director

Richard Harland

Andy Potter

Carol Martel

The advent of biotechnology has made the 1990s an extremely exciting era to be involved in biological and veterinary research. VIDO has been able to capitalize on these recent developments to establish itself as an international Center of Excellence in Animal Health. This success has occurred primarily through the commitment and dedication of its staff and management team. Without such individuals, VIDO would be unable to carry out its multi-disciplinary team approach to research in animal health and to transfer the technology to the end user. However, even with international recognition as a Center of Excellence in Animal Health, VIDO is not immune to the economic pressures of maintaining the infrastructure of the Organization in the face of reduced funding for research. During the past year, VIDO had to reduce its staff by 13 individuals due to its inability to generate sufficient core funding to maintain these positions. Although this was a traumatic experience for all involved, the Organization has refocused its efforts and continues to address the most critical areas of research that have been identified by the producers. Today, following the down-sizing, VIDO has a staff of 56 individuals including management, scientific staff, trainees and support staff. The scientific and management staff includes 18 individuals with advanced degrees in various specialities of molecular biology, virology, bacteriology, immunology, chemistry and veterinary clinical medicine. Individuals from all of these disciplines interact in teams to address each of the complex areas of investigation.

Unlike academic institutions where individuals decide the direction of their own research, VIDO plans its research activities in conjunction with all of its scientists, producer groups and industry members. As a result of these interactions, VIDO assembles teams with the required expertise to complete the project in the most expeditious manner after approval of specific research direction by VIDO's Board of Directors.

Board of Directors

Since VIDO's inception, its research activities have been guided by a 13-member Board representing various livestock and poultry industries, the agri-business community, the University of Saskatchewan, and representatives from the Federal and Provincial Governments. This blend of expertise has been instrumental in guiding the Organization through each new era of growth and transition. This year, as previously, the Board has provided Management with both encouragement and direction to help the Organization through these economically difficult times. I especially thank Bob Hunsberger for his leadership as Chairman of the Board and Dr. Ed Moss as Vice-Chairman of the Board. I also thank George Schoepp and Al Hingston, both of whom are retiring Board Members. Their four-year term on the Board will be remembered for the significant contribution each made, not only to VIDO but to me personally. I would also like to welcome to the Board the following new Directors: Dr. Peter Rempel, from Regina, Saskatchewan, representing the Government of Saskatchewan, and Mr. Ian Thompson, from Carnduff, Saskatchewan, representing the beef livestock industry. The Management Team looks forward to working with the new Board of Directors and especially with Mr. Bob Hunsberger and Dr. Ed Moss who remain as Chairman and Vice-Chairman of the Board of Directors respectively. This Board structure provides Management, and especially me as Director, with extremely valuable direction with respect to addressing industry needs in a rapidly changing environment.

Funding

Since its inception in 1975, VIDO has never had any long term guaranteed funding. As a result, VIDO needed to be responsive to the needs of the various constituencies which provided it with its operating funds. As seen in the financial statements which make up part of this Annual Report, VIDO has been able to assemble a great mosaic of private and public funding sources. Over the past five years, approximately 42% of our funding was from private sources, 36% from federal government competitive grants and 22% from various provincial government competitive grants. Since most of these funds are provided for anywhere between one and five years in duration, VIDO must continue to address the needs of its potential funders and maintain its leading edge technologies so that industry sees VIDO as "the place" to funnel their limited resources. However, with the deterioration of funding for biological research in general across North America and the increased cost of conducting research, VIDO is under severe pressure to do more with less funding. Unlike most academic organizations, VIDO does not have guaranteed salary support for its scientists. Since most granting agencies do not provide salary support for scientists, VIDO's greatest challenge is to obtain core funding for scientists' salaries. It is these scientists who maintain VIDO's vitality and competitive edge. They can attract additional funding from peer-reviewed national and international funding agencies to cover the direct costs of the research and the transfer of technology to the commercial sector and the livestock industry. Core funding is also required for protection of intellectual property, which will in turn generate more core funding for VIDO in the future.

Strategic Planning

Although VIDO continuously analyzes its research strategies and identifies the most appropriate research programs, teams and strategic alliances, the Organization has undertaken a major strategic planning process to ensure that it remains successful over the next decade. We anticipate that the strategic plan will be complete within the next six months and will ensure the viability of VIDO into the 21st century. I am happy to report that the strategic plan has reaffirmed VIDO's mandate and the majority of its goals. VIDO staff are now in the process of developing action plans to implement the strategic plan.

VIDO appoints new Board Members

SASKATOON SK – At the recent VIDO Board of Directors Meeting, the Board appointed Dr. Peter Rempel from Regina, Saskatchewan and Ian Thompson from Carnduff, Saskatchewan to replace Al Hingston as the Government of Saskatchewan representative and George Schoepp as the Beef Cattle representative respectively.

New Vaccines

A World First in Calf Scours

VIDO's philosophy has always been to provide the Canadian livestock producer with innovative and better vaccines as management systems to make livestock production more economical and reduce animal suffering. In this way, we not only benefit the animal but also make Canadian livestock production more competitive globally. This philosophy resulted in VIDO's first vaccine, VICOGEN, which was a world first for controlling calf scours. Subsequent *E. coli* vaccines developed for calf scours were based on this early success. The philosophy continued when VIDO developed the world's first genetically engineered subunit vaccine, *P. haemolytica*, for any animal species. It is a vaccine to control bacteria which is involved in the bovine respiratory disease complex.

Preventing Chronic and Acute Disease in Pigs

Over the past year, VIDO has continued to make significant progress in developing new vaccines for a number of bacterial and viral diseases and in transferring the research findings to commercial companies. Using a similar approach to that used to develop the subunit vaccine for *P. haemolytica*, we have identified the important protective components of other agents which cause significant economic losses in livestock. One of these diseases, *Actinobacillus pleuropneumoniae*, can cause both chronic and acute disease in pigs. Since there are a number of different types (serotypes) of *A. pleuropneumoniae*, it was important to identify individual proteins that would protect pigs against all of the different serotypes of bacteria that cause disease. Researchers at VIDO were able to identify five specific proteins from different serotypes that, when produced by genetic engineering technology, could protect against all serotypes. This five-component vaccine has proven to be effective in very young pigs as well as in older pigs. Furthermore, we have been able to identify a formulation that will not cause adverse effects at the injection site and stimulate protective immunity in the piglets. This data has been compiled and submitted to Agriculture Canada for licensure of the vaccine. The technology has also been transferred to BIOSTAR Inc. for field testing and commercialization of the vaccine in Canada. Thus, VIDO has completed all of its responsibilities in the research and demonstrated the efficacy of a vaccine for this important disease. We await approval from Agriculture Canada and the successful marketing of this vaccine by BIOSTAR.

Controlling Bovine Herpesvirus

VIDO has also completed the research required for the development of a second subunit vaccine, one to control bovine herpesvirus-1 in cattle. As with *Actinobacillus pleuropneumoniae* we identified the critical components of the virus which, when introduced into animals, induces very high levels of protective immunity. In addition, we have demonstrated that the duration of immunity following immunization with this subunit vaccine is significantly longer than that induced by presently available commercial vaccines. Based on our research findings, we have transferred all of this technology to BIOSTAR for commercialization and registration of this vaccine. One of BIOSTAR's strategic allies is testing this vaccine in the Netherlands. Presently, over 75,000 doses have been injected into dairy cattle and the vaccine has proven to be safe. This trial is designed not only to test the safety of the vaccine, but also to test its ability to reduce the spread of latent virus from infected animals in the hopes of breaking the cycle of reactivation and spread. Furthermore, since this vaccine contains only a single component of the virus, we are developing a diagnostic test to differentiate vaccinated animals from latent carriers of the disease. Such a test would be very useful in the export of live and breeding stock animals. This vaccine, in combination with the test, will provide an opportunity to eradicate bovine herpesvirus from our national herd over time. This will be possible since vaccinated animals would not only be protected from disease, but would also hopefully prevent

Vaccine Saves Canadian Livestock Producers $5 million annually

CANADA – Further evidence supporting the value of research is the $1.8 million invested to develop a vaccine that controls calf scours. The research was conducted by the Veterinary Infectious Disease Organization (VIDO) in Saskatoon. Javed says. The vaccine saves Canadian livestock producers about $5 million annually.

establishment of latent infections. VIDO is collaborating with a commercial company to develop and market this test.

Second Generation SomnuStar

Although VIDO has already licensed a vaccine designed to prevent *Haemophilus somnus* (SomnuStar) in cattle, VIDO scientists are developing a second generation vaccine using genetic engineering technology that will be even more effective than SomnuStar. Although the number of doses of *Haemophilus somnus* (SomnuStar) used by cattle producers has doubled in each of the last two years since its introduction into Canada, VIDO feels that the efficacy of this vaccine could be further improved using modern genetic engineering techniques. The reason for the potentially improved efficacy is that we can now identify the important protective components that are present in the bacterial extract of SomnuStar and, using genetic engineering techniques, produce the one or two protective components that are present in this extract. Since this disease is becoming a very important impediment to successful cattle production in Western Canada, this second generation vaccine has the potential to significantly reduce the economic losses and animal suffering due to *Haemophilus somnus*.

Genetically Engineered Live Vaccines

In addition to subunit vaccines, VIDO scientists are also developing genetically engineered live viral and bacterial vaccines. These vaccines are made by identifying specific genes which are responsible for the organism's ability to cause disease (virulence genes). These genes are then altered or deleted so that the organism's ability to infect an animal is not affected, but its ability to cause disease is completely removed. These crippled organisms can then be administered to the animal in such a way that they resemble the natural infection, but cannot under any circumstances revert back to virulence and cause disease, as is possible with conventional live vaccines, thereby providing a greater margin of safety. By using such an approach, animals can be infected by the natural route and establish the entire range of immune responses. A further advantage of this technology is the possibility of introducing genes coding for protective antigens from other disease causing organisms into the crippled organism. In this way, vaccination with the recombinant organism could induce protection not only to the vector (crippled organism), but also to the additional disease causing organism whose gene was added to the vector. Such an approach is being developed with bovine herpesvirus and bovine adenovirus. Thus, it is anticipated that we can incorporate genes from other bovine viruses into either of these two viruses to provide broad range protection against multiple disease causing organisms. In this way, it is anticipated that there will not be the interference often observed when multiple vaccines are administered simultaneously. In the case of bacteria, a similar approach is being used with *E. coli* in poultry. *E. coli septicemia* and *cellulitis* has become very prevalent in poultry populations, especially in those birds which are stressed or infected with different viruses. In fact, the results from Agriculture Canada indicate that the majority of condemnations at slaughter are due to *E. coli* infections. Thus, in addition to causing death *E. coli* infections cause significant economic losses at the end of the production cycle. During the past year, VIDO has been successful in identifying two specific genes in *E. coli* which can be removed or altered in such way that they will "cripple" the *E. coli* and prevent it from causing disease. We have also demonstrated that these crippled bacteria can be administered to the birds via the drinking water. These bacteria then replicate in the intestine of the bird and immunize the animal. This approach to immunization should prove extremely economical both in regards to production and the administration of the vaccine. Thus, although our primary focus at present is to develop a vaccine against *E. coli* infections in poultry, this technology will form the foundation for insertion of genes from other infectious agents of poultry including salmonella and mycoplasma, and provide protection against multiple disease with a single oral vaccination.

VIDO is probably best known for the development of VICOGEN.

TORONTO – The first project VIDO undertook, and probably the one they are best known for, was the development of VICOGEN, the first vaccine to prevent the bacterial form of *E. coli* diarrhoea in calves. That vaccine was licensed to Connaught Laboratories Ltd. of Toronto and marketed in Canada, the U.S. and other countries. Since that development eight other products have been brought to market of which four were world firsts.

Protection for Pigs and People

Although VIDO's mandate is to work on economically important infectious agents of livestock, VIDO has always looked for opportunities to assist society and human health where possible. One of these areas of special interest is in the area of *Streptococcus suis* infections in pigs. During the past year, VIDO has very successfully demonstrated that it is possible to immunize pigs against *Streptococcus suis*. Using the approach we used earlier with *Haemophilus somnus*, VIDO scientists developed an extract from the outer surface proteins of *Streptococcus suis* and immunized sows. Sows developed immunity against these proteins and transferred the immunity in their milk to their piglets. Under controlled conditions, this vaccine proved to be extremely efficacious in reducing the incidence of infection with *Streptococcus suis* in piglets. VIDO scientists are now using molecular biology approaches to identify the important protective proteins in the extract so that we can then develop a subunit vaccine to protect pigs against *Streptococcus suis*. Reduction of infection in pigs will also have a significant impact on the spread of this infection from pigs to humans.

Fighting Streptococcus Mastitis

Mastitis in dairy cattle continues to be the major factor responsible for economic losses, not only because of lost production but also due to treatment costs and early culling of some of the best genetic stock. Although this disease can be caused by a variety of infectious agents including *Staphlococcus* species, *E. coli* and *Streptococcus* species, VIDO has decided to focus on the *Streptococcus* species. The reason for this choice is because they are resistant to conventional treatments including antibiotics and teat dipping, and they make up the largest percentage of uncontrolled infections.

During the past year, VIDO scientists have identified a number of potential vaccine candidates from *Streptococcus uberis* and *dysgalactia*. Furthermore, a model has been developed to test the protective capacity of these potential vaccine candidates.

Effects of Infection

Our expertise in molecular biology and immunology and understanding of how infectious agents cause disease has allowed VIDO scientists to assess the specific events which occur in the animal following infection. These investigations have led to the discovery that following infection, white blood cells produce a family of molecules called cytokines. These cytokines are important in directing the immune response and influencing the animal's ability to recover from infection or respond to vaccination since these cytokines can either enhance or reduce the immune response. In addition, these cytokines can stimulate other cells in the body to produce additional proteins. At VIDO, we have been investigating the role of these cytokines in regulating immune responses and altering disease patterns in hopes of being able to predict the eventual outcome of the disease as well as to prevent disease. Recently, VIDO has identified a series of acute phase proteins that are induced by cytokines that are generated early in the infection process. Using specific tests for measuring these proteins, we were able to determine that a number of them correlate with the degree of illness. Using these tests, we have begun to develop sensitive assays to differentiate those animals that are suffering from a viral or bacterial infection as well as to predict what type of therapy they need. We anticipate that it should be possible to develop rapid diagnostic tests to determine treatment regimes. This should dramatically reduce treatment costs. In addition, we predict that we will be able to adopt these rapid diagnostic tests to abattoirs, where on-line testing could be implemented for disease monitoring. This should dramatically improve the quality of food since all diseased animals would be detected and eliminated from sale for human consumption.

VIDO Internationally Recognized

INTERNATIONAL – VIDO has become internationally recognized as a centre of excellence in vaccination of animals, genetic engineering and recombinant DNA. Because VIDO developed the world's first large animal vaccine produced by recombinant DNA methods, the future for new animal health products will be based on genetic engineering technology. VIDO is the only group in the country that can take an idea through all phases of research and development to commercial production — everything from DNA to the dinner plate.

Auditors' Report

To the Board of Directors
Veterinary Infectious Disease Organization (VIDO),
University of Saskatchewan

We have audited the combined balance sheet of the University of Saskatchewan - Veterinary Infectious Disease Organization as at September 30, 1994 and the statements of income, expenditure and fund balance (Research Trust, Capital Trust, and Technology Development Trust) and combined statement of changes in financial position for the year then ended. These financial statements are the responsibility of the Organization's management. Our responsibility is to express an opinion on these financial statements based on our audit.

We conducted our audit in accordance with generally accepted auditing standards. Those standards require that we plan and perform an audit to obtain reasonable assurance whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation.

In common with many non-profit organizations, the Organization derives part of its income in the form of donations and certain grants, the completeness of which is not susceptible to satisfactory audit verification. Accordingly, our verification of revenues from these sources was limited to the amounts recorded in the records of the Organization, and we were not able to determine whether any adjustments might be necessary to donations and grant revenue, excess of income over expenditure, assets and fund balance.

In our opinion, except for the effect of adjustments, if any, which we might have determined to be necessary had we been able to satisfy ourselves concerning the completeness of donations and certain grants referred to in the preceding paragraph, these financial statements present fairly, in all material respects, the financial position of the Organization as at September 30, 1994, and the results of its operations and the changes in its financial position for the year then ended in accordance with generally accepted accounting principles.

Deloitte & Touche

Chartered Accountants
December 15, 1994

University of Saskatchewan
Veterinary Infectious Disease Organization (VIDO)

Research Trust – Statement of Income, Expenditure and Fund Balance

Year ended September 30, 1994

	1994	1993
INCOME		
Donations and unconditional grants (Schedule 1)		
Livestock and poultry industries – beef	$ 127,200	$ 150,700
– dairy	71,000	–
– swine	73,913	105,198
– turkey	–	12,000
Provincial governments	65,500	27,388
Other contributors	100,240	190,000
	437,853	485,286
Conditional grants (Schedule 2)	2,267,802	1,930,435
Contract research – Commercial	374,928	388,439
– Government of the Province of Saskatchewan	300,000	300,000
Contract services	214,535	235,765
Royalties	63,083	79,778
Interest	22,984	55,530
Animal sales	87,747	123,812
Technology Access Agreements	228,300	–
	3,997,232	3,599,045
EXPENDITURE		
Salaries and fringe benefits	2,539,644	2,389,590
Materials and supplies	732,226	767,884
Animal services	337,268	220,518
Equipment and service agreements	138,109	57,228
Travel and recruiting	106,415	176,163
Patents and legal fees	5,707	46,467
Other expenditures (Note 7)	122,152	352,082
	3,981,521	4,009,932
EXCESS OF INCOME OVER EXPENDITURE	15,711	(410,887)
FUND BALANCE, BEGINNING OF YEAR	769,720	1,180,607
	785,431	769,720
TRANSFER TO CAPITAL TRUST	–	–
FUND BALANCE, END OF YEAR	$ 785,431	$ 769,720

University of Saskatchewan
Veterinary Infectious Disease Organization (VIDO)

Capital Trust – Statement of Income, Expenditure and Fund Balance

Year ended September 30, 1994

	1994	1993
FUND BALANCE, BEGINNING OF YEAR	$ 30,000	$ 30,000
TRANSFER FROM RESEARCH TRUST	–	–
FUND BALANCE, END OF YEAR	$ 30,000	$ 30,000

University of Saskatchewan
Veterinary Infectious Disease Organization (VIDO)

Technology Development Trust – Statement of Income, Expenditure and Fund Balance

Year ended September 30, 1994

	1994	1993
FUND BALANCE, BEGINNING OF YEAR	$4,699,876	$ –
INCOME FROM TECHNOLOGY ACCESS AGREEMENTS	–	4,699,876
FUND BALANCE, END OF YEAR	$4,699,876	$4,699,876

University of Saskatchewan
Veterinary Infectious Disease Organization (VIDO)

Combined Balance Sheet

As at September 30, 1994

	1994	1993
ASSETS		
Current Assets		
Cash on hand	$ 212,575	$ 22,240
Funds held (claim on cash) – University of Saskatchewan	(331,764)	(252,236)
Due from University of Saskatchewan – operating fund	960,205	836,749
Accounts receivable (Note 3)	708,551	852,612
Inventories (Note 4)	64,633	112,157
	1,614,200	1,571,522
Investments (quoted market value, 1993 – $211,420)	–	200,676
Note Receivable (Note 5)	4,699,876	4,699,876
Capital Assets		
Site and improvements	146,503	146,503
Furnishings, fixtures and equipment	459,752	459,752
Buildings and facilities	5,036,996	5,036,996
	5,643,251	5,643,251
	$11,957,327	$12,115,325
LIABILITIES		
Current Liabilities		
Accounts payable	$ 8,303	$ 9,606
Unearned revenue (Note 6)	790,466	962,872
	798,769	972,478
EQUITY		
Capital Assets	5,643,251	5,643,251
Research Trust	785,431	769,720
Capital Trust	30,000	30,000
Technology Development Trust	4,699,876	4,699,876
	11,158,558	11,142,847
	$11,957,327	$12,115,325

APPROVED BY THE BOARD:

Director

Trustee

University of Saskatchewan
Veterinary Infectious Disease Organization (VIDO)

Combined Statement of Changes in Financial Position

Year ended September 30, 1994

	1994	1993
OPERATING ACTIVITIES		
Working capital from operations		
Research Trust – Excess of income over expenditure	$ 15,711	$ (410,887)
Technology Development Trust – Income	–	4,699,876
	15,711	4,288,989
Changes in non-cash operating working capital		
Due from University of Saskatchewan	(123,456)	(410,473)
Accounts receivable	144,061	8,736
Inventories	47,524	(69,970)
Accounts payable	(1,303)	(7,296)
Unearned revenue	(172,406)	404,682
Cash used in operating activities	(89,869)	4,214,668
INVESTING ACTIVITIES		
Increase in debenture	–	(4,699,876)
Reductions in investments	200,676	51,437
	200,676	(4,648,439)
FINANCING ACTIVITIES		
Repayment of loan payable	–	(25,000)
INCREASE (DECREASE) IN CASH	110,807	(458,771)
CASH (DEFICIENCY), BEGINNING OF YEAR	(229,996)	228,775
CASH (DEFICIENCY), END OF YEAR	$ (119,189)	$ (229,996)
Cash (Deficiency) consists of:		
Cash on hand	$ 212,575	$ 22,240
Funds held (claim on cash) – University of Saskatchewan	(331,764)	(252,236)
	$ (119,189)	$ (229,996)

Notes to the Financial Statements

September 30, 1994

1. ESTABLISHING AGREEMENT

The Organization was established by an Agreement dated August 11, 1975, between the Devonian Foundation of Calgary, Alberta, the Province of Alberta, the Province of Saskatchewan and the University of Saskatchewan to conduct research on indigenous infectious diseases of food producing animals.

Effective April 1, 1980, the above Agreement was replaced by a Constitution which provides for a Board of Directors to assume the responsibilities formerly performed by the Board of Advisors and the Governing Committee.

2. SIGNIFICANT ACCOUNTING POLICIES

These financial statements have been prepared in accordance with the following policies:

Fund accounting

Transactions of the Organization are accounted for by fund accounting principles which require classification of resources into funds to reflect the various designated uses. The Research Trust fund consists of those revenues and expenses used in the general operations of the Organization. The Capital Trust fund consists of grants, interest and authorized transfers from the Research Trust for the purpose of acquiring capital assets. Funds are transferred from the Research Trust to operations and to the Capital Trust as approved by the Board of Directors. The Technology Development Trust fund consists of income generated from Technology Access Agreements and will be used for the future development of technology under patent or license. The balance sheet and statement of changes in financial position have been presented on a combined basis reflecting the activities of all funds.

Capital assets

Capital assets are recorded as Capital Trust expenditures when purchased. The same assets are included in the balance sheet as Capital assets offset by the Capital Assets equity account. No depreciation is recorded on the capital assets.

Equipment purchased with Research Trust monies is expensed as purchased, and is not included in the balance sheet as assets.

The Constitution referred to in Note 1 states that all buildings and facilities constructed for the Organization shall be used by it in accordance with the Constitution and upon termination of the Organization, the buildings, facilities and equipment therein shall remain the absolute property of the University of Saskatchewan.

Inventories

Inventories of materials and supplies are valued at the lower of cost and net realizable value. Animal inventory is valued at cost.

Investments

Investments are recorded at cost. The difference between cost and par value of bonds is not amortized but is treated as income or expense in the year of disposal.

Grants and donations

Grants and donations are recognized in these financial statements in the period defined in the terms or conditions of the respective grants or donations.

Grants and donations received without terms or conditions as to the period in which the grant or donation is to be used are recognized in the financial statements when received.

Unearned revenue consists of unexpended funds relating to specific grants and donations and is determined on the percentage of completion basis.

License Fees and Royalties

License fees and royalties are recognized as they are received or earned under the terms of the agreements with licensees.

3. ACCOUNTS RECEIVABLE

	1994	1993
Donations and unconditional grants	$ 15,000	$ –
Conditional grants (Schedule 2)	77,294	47,566
Contract research	480,994	208,485
Contract services	97,787	189,732
Recoverable patent costs	–	308,256
Royalties	37,476	87,756
Accrued Interest	–	10,817
	$ 708,551	$ 852,612

4. INVENTORIES

	1994	1993
Animals	$ 16,093	$ 68,550
Materials and supplies	48,540	43,607
	$ 64,633	$ 112,157

5. NOTE RECEIVABLE

As of December 15, 1993, the University of Saskatchewan, as represented by VIDO signed a Debenture/Debt Transfer Agreement with 598707 Saskatchewan Ltd., the trustee of the BIOSTAR Trust. This agreement transfers the debt obligation including related interest as evidenced by the Debenture made between BIOSTAR Inc. and the University of Saskatchewan, effective December 11, 1991, to 598707 Saskatchewan Ltd. Consideration for the transfer is a Promissory Note of $4,699,876 bearing no interest and due on demand.

6. UNEARNED REVENUE

	1994	1993
Donations and unconditional grants	$ 16,033	$ 25,000
Conditional grants (Schedule 2)	749,933	828,665
Contract research	24,500	109,207
	$ 790,466	$ 962,872

7. OTHER EXPENDITURES

Other expenditures consist of VIDO operating accounts which include repairs and maintenance, equipment rental, annual report and technical bulletins, professional fees and Board expenses.

8. INCOME TAXES

The Organization is not subject to either federal or provincial income taxes.

9. RELATED PARTY TRANSACTIONS

a) VIDO is a research affiliate of the University of Saskatchewan. The University of Saskatchewan maintains, as part of its normal operations, various financial and administrative functions relating to VIDO. The financial statements do not include expenditures for administrative and ancillary services, or in-kind support provided by the University of Saskatchewan.

b) The University of Saskatchewan is the beneficiary of a Trust which owns 100% of BIOSTAR Inc., a research and development company which assists VIDO in the development of its products and technologies. During the year VIDO had the following transactions with BIOSTAR Inc.:

	1994	1993
Income from BIOSTAR Inc. to VIDO		
Contract research	$ 372,020	$ 120,283
Contract services and leases	59,574	71,743
Royalties	63,083	79,778
Sponsorship of an industrial research chair at VIDO in conjunction with NSERC	110,332	122,410
Expenditures by VIDO to BIOSTAR Inc.		
Management service fees	–	25,979
Research and veterinary services	–	9,140
Equipment lease	–	28,409
Expenditures made by VIDO on BIOSTAR Inc.'s behalf	72,203	164,021

At September 30, 1994, the Organization has a receivable from BIOSTAR Inc. of $406,257 (1993 – $624,181).

c) In 1993, VIDO entered into technology access agreements relating to specific products with BIOSTAR Inc. Income generated from these agreements was $4,699,876. Consideration for this income is a Note Receivable (Note 5).

University of Saskatchewan
Veterinary Infectious Disease Organization (VIDO)

Schedule 1

Schedule of Donations and Unconditional Grants

Year ended September 30, 1994

		1994	1993
LIVESTOCK AND POULTRY INDUSTRIES			
Beef	Manitoba Cattle Producer's Association	$ 1,500	$ –
	British Columbia Cattlemen's Association	5,000	5,000
	Kamloops Stockmen's Association	700	700
	Saskatchewan Cattle Marketing Deductions Fund	75,000	75,000
	Saskatchewan Wheat Pool	–	5,000
	Nechako Regional Cattlemen's Association	–	1,000
	Ontario Cattlemen's Association	5,000	4,000
	Canadian Association of Animal Breeders	15,000	10,000
	Saskatchewan Horned Cattle Trust Fund	25,000	50,000
		127,200	150,700
Dairy	Alberta Milk Producers' Society	25,000	–
	Manitoba Milk Producers' Marketing Board	25,000	–
	Ontario Milk Marketing Board	20,000	–
	Agrifoods International Cooperative Ltd.	1,000	–
		71,000	–
Swine	Alberta Pork Producers Development Corporation	39,956	44,430
	B.C. Hog Marketing Commission	5,102	5,483
	Manitoba Pork est.	8,826	34,863
	Ontario Pork Producers	–	–
	SPI Marketing Group	19,214	19,334
	Swine Improvement Services Co-operative (SISCO)	815	1,088
		73,913	105,198
Turkey	Canadian Turkey Marketing Agency	–	12,000
PROVINCIAL GOVERNMENTS			
	Alberta	35,000	–
	British Columbia	15,000	11,888
	Manitoba	15,500	15,500
		65,500	27,388
OTHER CONTRIBUTORS			
	The W. Garfield Weston Foundation	–	100,000
	Max Bell Foundation	100,000	90,000
	Individuals	240	–
		100,240	190,000
		$ 437,853	$ 485,286

University of Saskatchewan
Veterinary Infectious Disease Organization (VIDO)

Schedule 2

Schedule of Conditional Grants and Contracts

Year ended September 30, 1994

	September 30, 1993		1994	September 30, 1994			
	Accounts Receivable	Unearned Revenue	Funds Received	Accounts Receivable	Unearned Revenue	1994 Income	1993 Income
Natural Sciences and Engineering Research Council of Canada (NSERC)							
– Co-operative Research Development	$ –	$ 188,750	$ 100,000	$ –	$ –	$ 288,750	$ 188,750
– Industrial Research Chairs	–	6,740	5,391	–	2,696	9,435	25,150
– Operating, Strategic and Equipment	–	119,458	543,683	–	111,291	551,850	533,050
– Industry Matching	–	–	47,200	–	23,600	23,600	77,735
– President's Award	–	3,438	13,750	–	1,146	16,042	10,312
BIOSTAR Inc. - NSERC Industrial Research	–	–	157,532	–	23,600	133,932	122,410
Canadian Bacterial Diseases Network (CBDN)	–	68,904	320,222	–	89,756	299,370	326,900
Agriculture Canada/NSERC Research Partnership Grants	–	99,000	162,000	–	114,000	147,000	132,000
Medical Research Council	–	102,850	155,700	–	116,775	141,775	86,950
Alberta Agriculture Research Institute (AARI)							
– Matching Grants Program	13,695	99,767	166,057	3,648	89,546	166,231	126,937
– Farming for the Future Program	3,595	31,000	121,172	–	12,802	135,775	147,844
Alberta Cattle Commission	–	42,856	36,250	–	63,866	15,240	24,766
Saskatchewan Agriculture Development Fund	–	–	43,600	43,600	43,600	43,600	–
Province of Ontario (OMAF) and Agriculture Research Institute of Ontario	15,138	–	94,082	–	–	78,944	25,663
National Agricultural Biotechnology Initiative	15,138	–	64,036	30,046	–	78,944	25,663
Health Services Utilization and Research Commission	–	–	67,400	–	50,550	16,850	–
Saskatchewan Health Research Board Fellowship	–	43,020	53,640	–	6,705	89,955	54,665
Medical Research Council Fellowship	–	22,882	7,627	–	–	30,509	21,640
	$ 47,566	$ 828,665	$2,159,342	$ 77,294	$ 749,933	$2,267,802	$1,930,435

Patents Issued on Which VIDO Staff are Inventors

United States Patent No 5298244
- Title - Assembled Viral Particles and Their Use in a Vaccine to Rotaviral Disease
- Date - March 29, 1994
- Inventors - M. Redmond, M. Ijaz, and M. Parker
- Assignee - University of Saskatchewan

European Patent No 0478609B1
- Title - SRIF-Related Peptides and Uses Thereof
- Date - September 7, 1994
- Inventors - B. Laarveld, R. Kirkwood, P. Thacker, L. Sordillo, and M. Redmond
- Assignee - University of Saskatchewan

Research Publications in Scientific Journals

Cox, G., Zamb, T., and Babiuk, L.A. 1993. Bovine herpesvirus 1: Immune responses in mice and cattle injected with plasmid DNA. J. Virol. 67:5664-5667.

Dixon, L.G., Albritton, W.L., and Willson, P.J. 1994. An analysis of the complete nucleotide sequence of the *Haemophilus ducreyi* broad-host-range plasmid pLS88. Plasmid. 32:228-232.

Hughes, H.P.A., Rossow, S., Campos, M., Rossi-Campos, A., Janssen, S., Godson, D.L., Daflon, B., Voirol, M.J., Gerber, C., and Babiuk, L.A. 1994. A slow release formulation for recombinant bovine interferon α_1-1. Antiviral Research. 23:33-44.

Hughes, H.P.A., Campos, M., McDougall, L., Beskorwayne, T.K., Potter, A.A., and Babiuk, L.A. 1994. Regulation of major histocompatibility complex class II expression by *Pasteurella haemolytica* leukotoxin. Infect. Immun. 62:1609-1615.

Ijaz, M.K, Sabara, M.I., Alkarmi, T., Frenchick, P.J., Ready, K.F., Dar, F.K. and Babiuk, L.A. 1994. Molecular determinants of rotavirus virulence - localization of a potential virulence site in a murine rotavirus VP4. Comp. Immunol. Microbiol. & Infectious Disease. 17: 99-110.

Kwaga, J.K.P., Allan, B.J., van den Hurk, J.V., Seida, H., and Potter, A.A. 1994. A *car*AB mutant of avian pathogenic *Escherichia coli* serotype O2 is attenuated and effective as a live oral vaccine against colibacillosis in turkeys. Infect. and Immun. 62:3766-3772.

Pellerin, C., van den Hurk, J., Lecomte, J., and Tijssen, P. 1994. Identification of a new group of bovine viral diarrhea virus (BVDV) strains associated with severe outbreaks and high mortalities. Virol. 203:260-268.

Taylor, L.F., Van Donkersgoed, J., Radostits, O.M., Booker, C.W., van den Hurk, J.V., Dobovi, E.J., and Janzen, E.D. 1994. Investigation of an outbreak of mucosal disease in a beef cattle herd in South-Western Saskatchewan. Can. Vet. J. 35:425-432.

Van Donkersgoed, J., Janzen, E., Potter, A., and Harland. R. 1994. The occurrence of *Haemophilus somnus* in feedlot calves and its control by post-arrival prophylactic mass medication. Can. Vet. J. 35:573-580.

Van Donkersgoed, J., Potter, A.A., Mollison, B. and Harland, R.J. 1994. The effect of a combined *Pasteurella haemolytica* and *Haemophilus somnus* vaccine and a modified-live bovine respiratory syncytial virus vaccine against enzootic pneumonia in young beef calves. Can. Vet. J. 35:239-241.

Van Donkersgoed, J., Schumann, F.J., Harland, R.J., Potter, A.A., and Janzen, E.D. 1993. The effect of route and dosage of immunization on the serological response to a *Pasteurella haemolytica* and *Haemophilus somnus* vaccine in feedlot calves. Can. Vet. J. 34:731-735.

Van Donkersgoed, J., Ribble, C., Boyer, L., and Townsend, H. 1993. Epidemiological study of enzootic pneumonia in dairy calves in Saskatchewan. Can. Vet. J. of Res. 57:247-254.

Van Drunen Littel-van den Hurk, S., Van Donkersgoed, J., Kowalski, J., van den Hurk, J.V., Harland, R., Babiuk, L.A., Zamb, T.J. 1994. A subunit gIV vaccine, produced by transfected mammalian cells in culture, induces mucosal immunity against bovine herpesvirus-1 in cattle. Vaccine. 12:1295-1302.

Zhang, Y., Barber, E.M., Martin, W.T., and Willson, P. 1994. Dynamics of aerosol deposition rates in commercial swine buildings: A pilot study. Amer. Soc. Heat. Refrig. Air Cond. Engr. 100(1):906-912.

Research Presentations, Posters, and Abstracts Presented at Meetings

Allan, B., Kwaga, J., Ngeleka, M., van den Hurk, J., and Potter, A.A. 1994. Live attenuated *E. coli* vaccines for poultry and their use as vectors for delivery of heterologous antigens. CBDN Annual Meeting. Vancouver, British Columbia. June.

Babiuk, L.A. 1994. Do vaccines work? 3rd Congress of the European Society of Veterinary Virology. Interlaken, Switzerland. September.

Babiuk, L.A., Morsey, M., Campos, M., and Harland, R. 1994. Viral-Bacterial Synergy. 3rd International Conference on Haemophilus, Actinobacillus and Pasteurella. Edinburgh, Scotland. August.

Baca-Estrada, M.E., Yoo, D., Liang, X., and Babiuk, L.A. 1993. Mucosal immunization of cotton rats induces humoral and cellular immunity to a recombinant adenovirus. Novel Vaccine Strategies. Bethesda, Maryland. October.

Baranowski, E., Dubuisson, J., van Drunen Littel-van den Hurk, S., Babiuk, L.A., Michel, A., Pastoret, P.-P. and Thiry, E. 1994. Synthesis and processing of bovine herpesvirus-1 glycoprotein gH. The 19th International Herpesvirus Workshop. Vancouver, British Columbia. July.

Godson, D.L., Harland, R.J., Cordeiro, D., Attah-Poku, S.K., and Babiuk, L.A. 1993. Measurement of serum haptoglobin in cattle with bovine respiratory disease or *Haemophilus somnus* infection. 74th Annual Meeting of the Conference of Research Workers in Animal Disease. Chicago, Illinois. November.

Gomis, S., Godson, D.L., Hughes, H., Wobeser, G., and Potter, A.A. 1994. *H. somnus*-bovine mononuclear cell interactions at the cellular level: Analysis of bacteria-phagocyte interactions by flow cytometry. Canadian Association of Veterinary Pathologists Annual Meeting. Quebec City, Quebec. July.

Gomis, S., Chen, W., Godson, D., Hughes, H., and Potter, A.A. 1994. Intracellular survival of *H. somnus* in bovine blood monocytes: Effects of cytokine and LPS treatment. 3rd International Conference on Haemophilus, Actinobacillus and Pasteurella. Edinburgh, Scotland. August.

Gomis, S., Van Donkersgoed, J., Harland, R., Potter, A., and Heins, D. 1993. Immunohistochemical demonstration of the distribution of *Haemophilus somnus* in feedlot calves after an experimental infection. Proceedings of the American College of Veterinary Pathologists. December.

Guichon, P.T., Harland, R., Booker, C.W., and Jim, G.K. 1994. Seroepidemiology of undifferentiated fever in feedlot calves. 3rd International Conference on Haemophilus, Actinobacillus and Pasteurella. Edinburgh, Scotland. August.

Harland, R.J. 1994. Immunizing against bovine respiratory disease. Formation Continue, Corporation Professionnelle Des Médicine Vétérinaires du Quebec. Université de Montréal, Faculté de Médicine Vétérinaire. Saint-Hyacinthe, Quebec. February.

Harland, R.J. 1994. Advances in dairy technology. Proceedings of the 1994 Western Canadian Dairy Seminar. Red Deer, Alberta. February.

Jucker, M.T., van den Hurk, J.V., Boyle, S.M., Pierson, F.W. 1994. Characterization of the hemorrhagic enteritis virus (A) penton base gene. Southern Conference of Avian Diseases. Baton Rouge, Louisiana. March.

Li, Y., van Drunen Littel-van den Hurk, S., Babiuk, L.A., and Liang, X. 1994. Study of interaction of bovine herpesvirus-1 gC, gB and gD with permissive cells. The 19th International Herpesvirus Workshop. Vancouver, British Columbia. July.

Liang, X., Pyne, C., Babiuk, L.A., and Kowalski, J. A cell line expressing bovine herpesvirus 1 gD protein with a glycolipid membrane anchor supports growth of gD gene-deletion mutant. The 19th International Herpesvirus Workshop. Vancouver, British Columbia. July.

Mittal, S.K., Prevec, L., Graham, F.L., and Babiuk, L.A. 1994. Development of a bovine adenovirus-based expression vector. 13th Annual Meeting of American Society for Virology. Madison, Wisconsin. July.

Pellerin, C., van den Hurk, J.V., Lecomte, J., and Tijssen, P. 1994. Identification of a new group of BVDV associated with high mortalities in calves. ESVV Congress. Interlaken, Switzerland. September.

Pellerin, C., van den Hurk, J., Lecomte, J., and Tijssen, P. 1994. New bovine viral diarrhea virus (BVDV) strains associated with high mortalities in North America. Symposium of acute bovine diarrhea. Guelph, Ontario. March.

Pontarollo, R.A., Rioux, C.R., and Potter, A.A. 1994. Cloning and characterization of a bacteriophage lysozyme gene from *Haemophilus somnus*. 3rd International Conference on Haemophilus, Actinobacillus and Pasteurella. Edinburgh, Scotland. August.

Pontarollo, R.A., Rioux, C.R., and Potter, A.A. 1994. Bacteriophage genes from *Haemophilus somnus*: Homology to genes from bacteriophage P2 and HP1. 3rd International Conference on Haemophilus, Actinobacillus and Pasteurella. Edinburgh, Scotland. August.

Rioux, C.R., Rawlyk, N., Crockford, G., and Potter, A.A. 1994. Cloning and characterization of *Haemophilus somnus* genes coding for proteins involved in iron metabolism. CBDN Annual Meeting. Vancouver, British Columbia. June.

Rioux, C.R., Harland, R.J., Theisen, M., Rawlyk, N.A., and Potter, A.A. 1994. Protective capacity of the antigenic 40-kilodalton LppB lipoprotein of *Haemophilus somnus* against experimental infection in cattle. 3rd International Conference on Haemophilus, Actinobacillus and Pasteurella. Edinburgh, Scotland. August.

Sorden, S.D., Watts, T.C., and Lees, J. 1994. Spontaneous cardiomyopathy in inbred cotton rats *(Sigmodon hispidus)*. American College of Veterinary Pathologists, Veterinary Pathology Annual Meeting. Montreal, Quebec.

Van Donkersgoed, J. 1994. Using drugs properly. "Vet Advice". Canadian Cattlemen. September.

Van Donkersgoed, J. 1994. VIDO Fact Sheet on Hemophilosis. Canadian Cattlemen. March.

Van Drunen Littel-van den Hurk, S., Van Donkersgoed, J., Kowalski, J., Tikoo, S.K., van den Hurk, J.V., Godson, D., and Babiuk, L.A. 1994. A subunit gIV vaccine, produced in transfected mammalian cells in culture, induces protection against BHV-1 in cattle. Eighth Annual Bovine Herpesvirus Workshop. Vancouver, British Columbia. July.

Van Drunen Littel-van den Hurk, S., Baranowski, E., Plainchamp, D., Thiry, E., and Babiuk, L.A. 1994. Glycoprotein gII (gp108) of bovine herpesvirus-1 is the homologue of herpes simplex virus gH and plays a role in penetration, but not in attachment of BHV-1. The 19th International Herpesvirus Workshop, Vancouver, British Columbia. July.

Van Drunen Littel-van den Hurk, S., Van Donkersgoed, J., Kowalski, J., van den Hurk, J.V., Godson, D., and Babiuk, L.A. 1994. A subunit gIV vaccine, produced in transfected mammalian cells in culture, induces protection against BHV-1 in cattle. Eighth Annual Bovine Herpesvirus Workshop. Vancouver, British Columbia. July.

Watts, T.C. 1994. Humane Endpoints. Canadian Council on Animal Care Western Regional Workshop. Vancouver, British Columbia. April.

Willson, P.J. 1994. Application of molecular biology to the production of new vaccines for swine. 1994. Banff Pork Seminar. 5:59-65.

Willson, P.J., Potter, A.A., Harland, R., and Klashinsky, S. 1994. Vaccination with subunit bacterin reduces mortality due to *Streptococcus suis* in an endemically infected herd. C.V.M.A. 46th Annual Convention (Abst 46:420).

Yoo, D., Parker, M.D., Cox, G.J., and Babiuk, L.A. 1994. Primary structure of the second open reading frame ORF1b and characterization of the metal binding domain of the RNA polymerase gene of bovine coronavirus. 6th International Meeting on Corona- and Related Viruses. Quebec City, Quebec. August-September.

Yoo, D., Baca-Estrada, M., Liang, X., and Babiuk, L.A. 1994. Induction of mucosal and systemic immunity to hemagglutinin-esterase glycoprotein of bovine coronavirus by a recombinant adenovirus in cotton rats. 13th Annual Meeting of the American Society for Virology. Madison, Wisconsin. July.

Yoo, D., Breker-Klassen, M., Roberts, T.E., Sorden, S., and Babiuk, L.A. 1994. Replication and pathogenesis of bovine parainfluenza virus type 3 in *Sigmodon hispidus* cotton rats. American Society for Virology 13th Annual Meeting. Madison, Wisconsin. July.

Reports and Presentations to the Livestock Industry, External Groups, and Organizations

Harland, R.J. 1994. Feedlot health, vaccination and management update. Extension Series for Saskatchewan Agriculture and Food. Porcupine Plain and Burr, Saskatchewan. February.

Rioux, C.R. 1993. Antigenic lipoproteins of *Haemophilus somnus:* A bovine respiratory pathogen. Department of Biology, University of Regina. Regina, Saskatchewan. October.

Van Donkersgoed, J. 1994. Enzootic calf pneumonia and handling animal health products. PFRA Community Pasture, Lanigan, Saskatchewan. June 23.

Van Donkersgoed, J. 1994. Meta-analysis. Health Sciences Epidemiology Class, University of Saskatchewan. Saskatoon, Saskatchewan. March 19.

Van Donkersgoed, J. 1994. Trichonomiasis. PFRA Community Pastures. Glenside (February 22), Watrous (April 19), Nokomis (April 20), Saskatchewan.

Van Donkersgoed, J. 1994. Feedlot health and management. Producer meetings at Porcupine Plain (February 14) and Burr (February 15), Saskatchewan.

Van Donkersgoed, J. 1994. BVD - The Saskatchewan Experience. Western Canadian Association of Bovine Practitioners Conference. Saskatoon, Saskatchewan. January 20.

Chapters in Books, Expository, and Review Articles

Althouse, E., Froese, C., Gelderman, J., Haan, D., Hagen, M., Hodgkinson, D., Heuser, W., Stilborn, S., Vermette, W., Vielfaure, P., Waddington, J., Willson, P., and Whittington, L. 1994. *Depopulating and Repopulating a Swine Herd.*

Babiuk, L.A., and Potter, A.A. 1994. Veterinary Vaccines. Biotechnol. Adv. 12:489-523.

Campos, M., Godson, D.L., Hughes, H.P.A., and Babiuk, L.A. 1994. Cytokine applications in infectious diseases. In: *Cell Mediated Immunity in Ruminants.* pp. 229-240. Eds: B. Goddeeris and I. Morrison. CRC Press, Boca Raton.

Denis, M., Thiry, E., Pastoret, P.P., Splitter, G., and Babiuk, L.A. 1994. Infectious bovine rhinotracheitis (bovine herpesvirus-1): Cytotoxic T cells and NK cells. In: *Cell Mediated Immunity in Ruminants.* pp. 157-172. Eds: B. Goddeeris and I. Morrison. CRC Press, Boca Raton.

Hughes, H., and Babiuk, L.A. 1994. Potentiation of vaccines through effective adjuvant formulations and manipulation of the immune response. In: *Modern Vaccinology.* pp. 87-118. Ed: E. Kurstak.

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Canadian Bacterial Diseases Network Personnel - At Various Centres Throughout Canada

A network of over 50 investigators from seven Canadian universities, a number of industrial companies, and government laboratories interested in bacterial diseases of humans, animals, and fish.

VIDO Financial Supporters

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Alberta Cattle Commission

Alberta Milk Producers' Society

Alberta Pork Producers Development Corporation

American Cyanamid Company

BIOSTAR Inc.

British Columbia Cattlemen's Association

B.C. Hog Marketing Commission

Canadian Bacterial Diseases Network

Canadian Association of Animal Breeders

Cyanamid Canada Inc.

Egyptian Cultural and Educational Bureau

Government of Canada - Department of Western Economic Diversification

Government of Saskatchewan - Saskatchewan Agriculture Development Fund

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Province of Alberta - Alberta Agriculture

Province of British Columbia - Ministry of Agriculture, Fisheries and Food

Province of Manitoba - Manitoba Agriculture

Province of Ontario - Ontario Ministry of Agriculture, Food and Rural Affairs and Agriculture Research Institute of Ontario

Saskatchewan Cattle Marketing Deductions Fund

Saskatchewan Horned Cattle Trust Fund

S.P.I. Marketing Group

Swine Improvement Services Cooperative Ltd.

The Ontario Milk Marketing Board