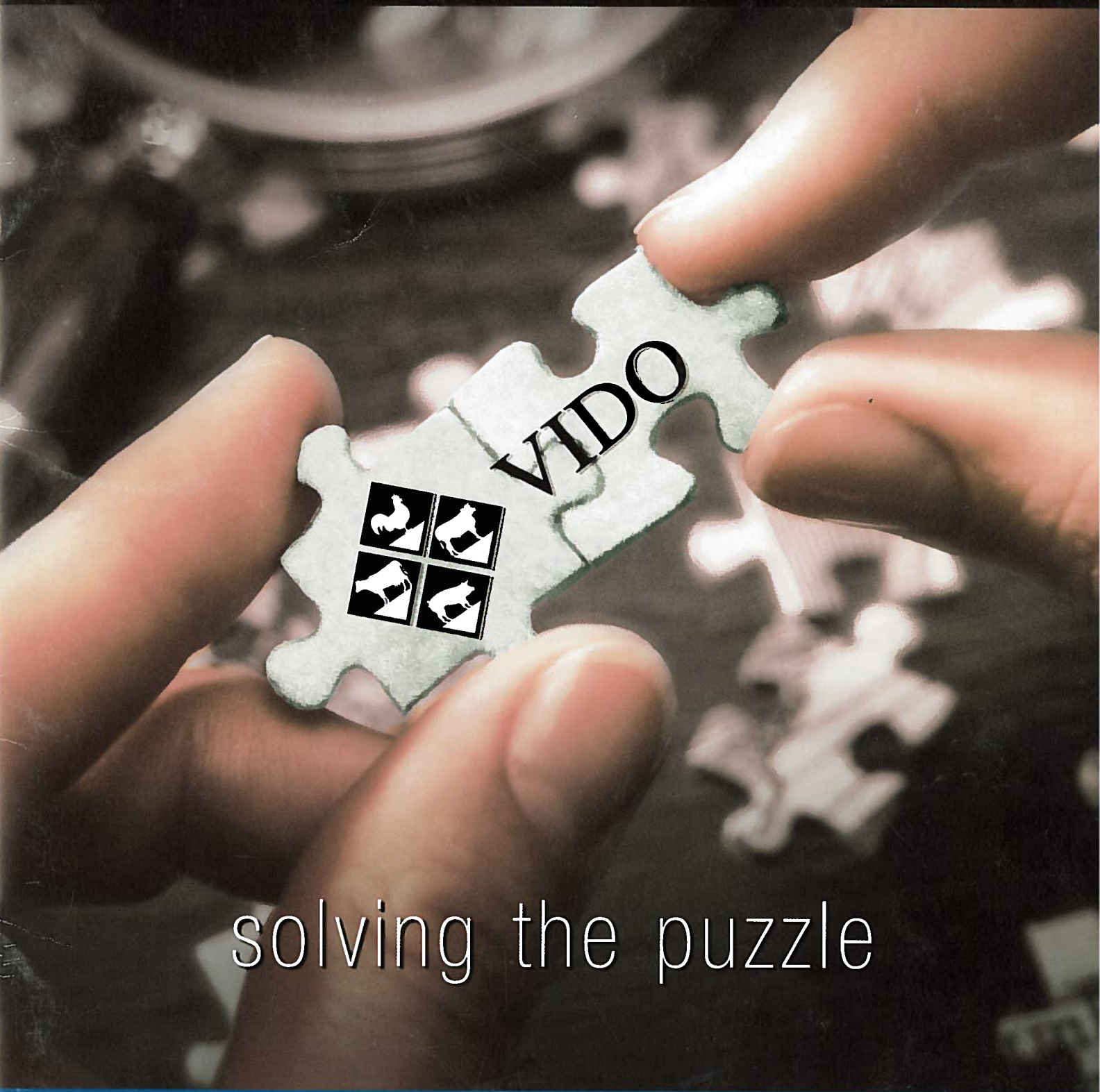
2000/2001 Annual Report



solving the puzzle

VIDO

VIDO

MANDATE

To Serve the Canadian Livestock and Poultry Industry by:

- Conducting animal health-related research
- Communicating livestock management techniques and information
- Facilitating the transfer of technology for international commercial development

VIDO'S GOALS

- To serve and assist the economic competitiveness of the livestock industry through research on the common infectious diseases of animals and poultry.
- To provide information leading to safe and effective animal health preventative medicine programs which enhance animal care through improved management and performance of livestock.
- To identify opportunities to utilize VIDO's livestock research to improve human and companion animal health.
- To maximize funding by enhanced visibility and development of innovative communication programs with all organizations that provide support to VIDO.
- To transfer technology to the biological industry to enhance its commercial application for the benefit of the Canadian livestock producers and to provide financial stability to VIDO.
- To manage its financial, educational, and human resource efforts to ensure long-term benefits to the organization's stakeholders.

Financial Contributors

Agriculture & Agri-Food Canada

Agriculture Canada

Agri-Food Innovation Fund

Alberta Agriculture Research Institute

Alberta Cattle Commission

Alberta Pork

Alberta Science and Research Authority

Beef Cattle Industry Development Fund

British Columbia Investment Agriculture Foundation

Canada-Alberta Beef Industry Development Fund

Canadian Bacterial Diseases Network

Canada Foundation for Innovation

Canadian Institutes of Health Research

Canvac

Dairy Farmers of Canada

Province of British Columbia

Province of Manitoba

Health Services Utilization and Research Commission

Kamloops Stockmen's Association

Livestock Environmental Initiative

Manitoba Pork Council

Natural Sciences & Engineering Research Council of Canada

Ontario Cattlemen's Association

Poultry Industry Council

Sask Pork

Saskatchewan Agriculture Development Fund

Saskatchewan Beef Development Fund

Saskatchewan Cattle Marketing Deductions Fund

Saskatchewan Council for Community Development

Saskatchewan Health Research Board Fellowship

Saskatchewan Horned Cattle Trust Fund

South Coastal Dairy Education Association

Swine Improvement Services Cooperative

World Health Organization

2000-2001
Chair's Report

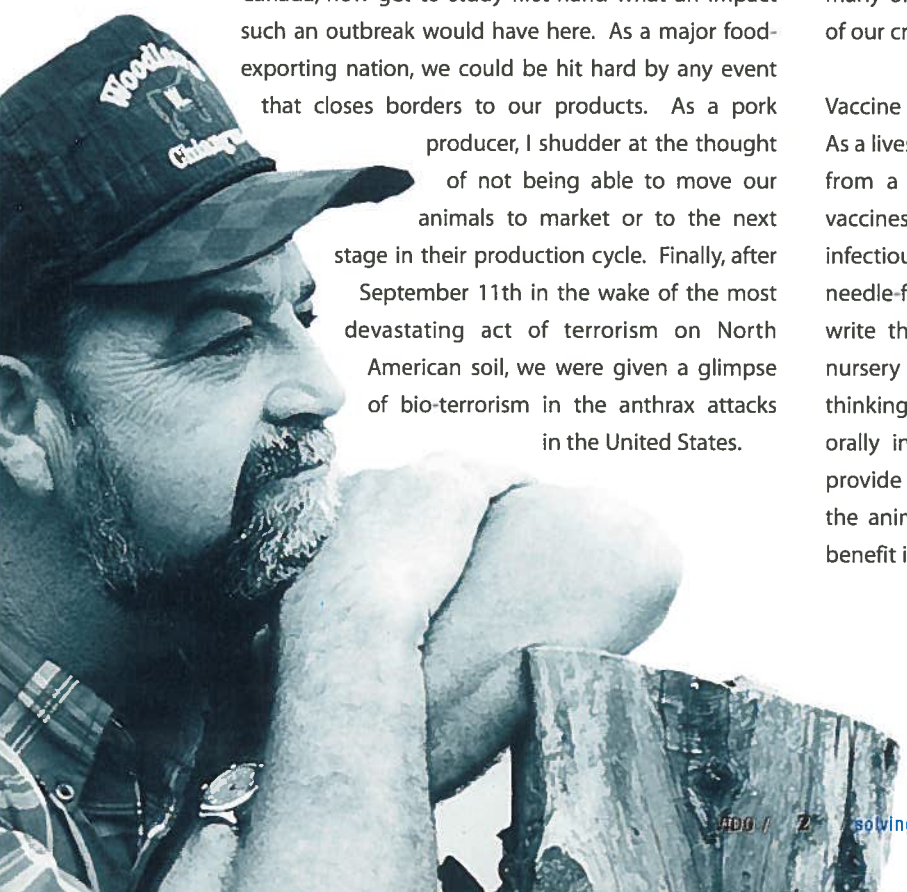
Don Winslow
Chair

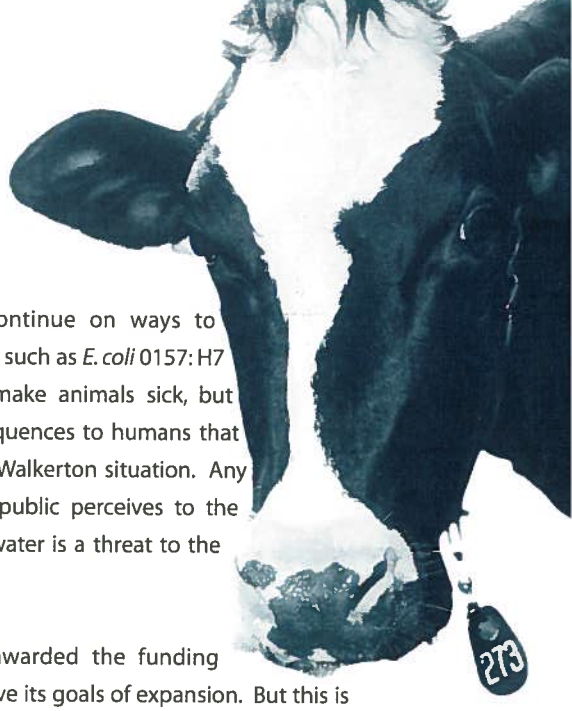
Brad Wildeman
Vice Chair

During my two years as Chair of VIDO, I've seen an unprecedented change in the way we perceive our world. The Walkerton water tragedy in Ontario has heightened and intensified the scrutiny of the public toward all aspects of water safety and quality. We, who are part of the livestock industry, feel "under a microscope" as never before. In Britain, the economic impact of the foot-and-mouth epidemic coming on the heels of bovine spongiform encephalopathy (mad cow disease) has been devastating to the livestock industry, the food industry, tourism, and many other aspects of British life and their economy. We, in Canada, now get to study first-hand what an impact such an outbreak would have here. As a major food-exporting nation, we could be hit hard by any event that closes borders to our products. As a pork producer, I shudder at the thought of not being able to move our animals to market or to the next stage in their production cycle. Finally, after September 11th in the wake of the most devastating act of terrorism on North American soil, we were given a glimpse of bio-terrorism in the anthrax attacks in the United States.

Add all of these additional threats to the more mundane ones we already face – the maintenance of herd health and the food safety and quality of our products, and we, as livestock producers, need VIDO more than ever. The expansion of VIDO's facilities and staff will maintain its position as the premiere research facility of its kind in the world. VIDO is already a multi-cultural scientific "all-star team" with the recruitment of staff from many parts of the world. Armed with the latest in technology and an interdisciplinary mix of creative intellect, VIDO will continue to produce quality science – science that will offer solutions to many of our challenges and a defense against many of our critics.

Vaccine development remains the #1 priority at VIDO. As a livestock producer, I'm already seeing a shift away from a reliance on antibiotics toward the use of vaccines to protect my animals from the assaults of infectious organisms. I'm excited by the possibilities of needle-free delivery of immunity to my animals. As I write this, I am preparing for the vaccination of a nursery barn of 2000 pigs. My back already hurts just thinking about it! When vaccines can be administered orally in feed or water and can be engineered to provide birth to death protection for an animal, both the animals and the people who care for them will benefit in both health and welfare.





Vaccine development is often a long and painstaking process ending with years of field testing in order to ensure the safety of the vaccine for both the animals and the consumer. In meeting this type of challenge, VIDO's scientists and staff don't work in isolation, but often collaborate with other institutions and companies pursuing similar goals. Partnerships and collaborations are an ever-increasing aspect of how VIDO researchers pursue their goals. VIDO's location at the University of Saskatchewan gives its scientists close proximity to an increasing number of collaborators: the Western College of Veterinary Medicine to name one, and soon a new player on the scene with the launch of the Canadian Light Source Institute, practically next door to VIDO. The Canadian Light Source (CLS) is one of the largest scientific projects in Canada, and one of the most advanced synchrotrons in the world. Costing $173.5 million, it will be commissioned in 2003 with at least six beam lines and eventually at least thirty. As scientists from across Canada and around the world come to Saskatoon to make use of the CLS, VIDO's researchers are exposed to even greater possibilities for exchange of ideas and eventual partnerships. The vast potential of the CLS to allow probing of the actual atomic structures of molecules and to study molecular surfaces at the interface between cell structures and the agents that invade them or protect them may provide VIDO's scientists with a vital piece of information needed to develop an effective vaccine.

As a livestock producer, I'm excited about the work which will be accomplished at VIDO over the next 25 years. Use of the vast array of data being compiled on the genetic sequencing within chromosomes of humans and animals allows scientists an important tool in the understanding of how infectious agents work and how to protect against them. I also know that work will continue on ways to combat organisms such as *E. coli* 0157: H7 which does not make animals sick, but has serious consequences to humans that ingest it as in the Walkerton situation. Any threat which the public perceives to the safety of food or water is a threat to the livestock industry.

VIDO has been awarded the funding necessary to achieve its goals of expansion. But this is just the capital to put in place the bricks and mortar and to acquire the vital pieces of equipment. As we go forward, VIDO must achieve the ongoing support from government in order to cover what are called the indirect costs of research, mainly scientist's salaries. Nothing inspires more confidence in government officials than when the primary producers support for research is able to be seen in the dollars they commit to it. I would urge producers across the country to look at increasing their support for vaccine research by grants to VIDO. Make an investment in a brighter future for livestock production.

Finally, with my time as Chair coming to end, I extend sincere thanks to the Board Members, past and present, who have given their time and expertise in support of VIDO. With terms of appointment ending, we have said goodbye to several valuable people. It is gratifying, however, to see the contributions of new Board Members who bring enormous experience and talents to the table. To our Director, Dr. Lorne Babiuk, let me say how pleased and relieved our Board felt when you agreed to another term with VIDO. You bring honor to VIDO with your profile and reputation, and during this exciting time of growth and change, your guiding hand will keep us on course.

Lorne Babiuk
Director

Director's Report

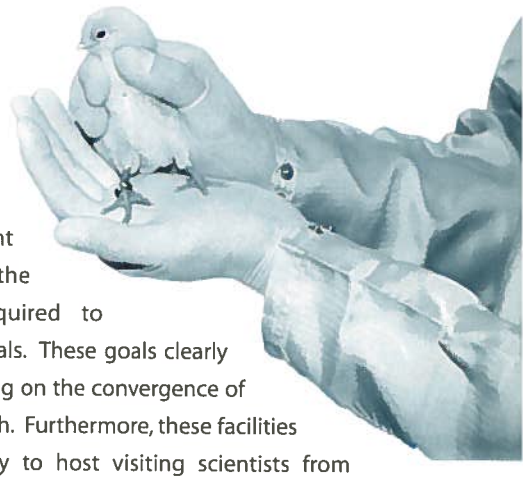
The original founders of VIDO had great expectations for the Organization and anticipated that the research at VIDO would assist the livestock industry in meeting the challenges associated with the control of major infectious diseases which were economic barriers to livestock production. However, even the most optimistic founders of VIDO could not imagine the success we would eventually achieve. This success was made possible by the philosophy and culture that was established by this original founding group. They insisted on using a focused team approach to problem solving. This approach continues today, although in a much expanded manner.

We thank our founders for not only taking the bold initiative to establish VIDO as an unique organization, but also for establishing the governance model. The Board of Directors continues to provide valuable guidance and set direction for VIDO. Throughout the years, VIDO has been blessed with an extraordinarily dedicated Board who volunteer their time to VIDO and go beyond the call of duty. Thus, I would like to acknowledge them all, past and present, and especially the current Board of Directors that has provided tremendous support to VIDO over the past year as we embark on an extremely ambitious phase of growth. These bold endeavors are beginning to pay off not only to the Organization and the University, but also for all of Canadian citizens and society in general.

When VIDO started, we were using conventional technologies to address the important issues of disease diagnosis and vaccine production. Today, the technology has clearly changed to embrace biotechnology and genomics, but the initial mandate – to respond to stakeholder's needs, has not changed. This has been one of the hallmarks of VIDO's success. In addition to changing technology, there have also been significant changes in our geopolitical landscape. The recent events involving bioterrorism has significantly changed our society. Clearly, agro-terrorism has the potential to dramatically impact our livestock producers' livelihood both in lost production and altering our export markets. The recent foot-and-mouth disease outbreak in the United Kingdom is a clear example of how devastating an exotic disease outbreak can be to the economy of a country. The technology being developed at VIDO will clearly be beneficial should any of these unfortunate events occur in Canada. VIDO is prepared to assist in this battle against infectious agents whether they be directed against livestock or humans.

To enhance VIDO's profile and ability to achieve its mission, we have begun expanding our research facilities. The recent ground-breaking for a $14 million expansion involved representatives from the Canada Foundation for Innovation and the Governments of Saskatchewan and Alberta who are partners in the expansion. Since the ground-breaking, we have received funding from Western Diversification to complete the partnership for the construction of a new wing of laboratories. This addition will clearly enhance our partnership with commercial companies and help expedite the development of the research emanating out of VIDO's laboratories. We especially thank the University of Saskatchewan's Facilities Management personnel for their assistance in getting the project to the tender and construction phase. We are grateful to Stantec Architecture, especially Allan Duddridge and Rory Picklyk for their architectural ingenuity. The new facility will not only be extremely functional, but will also be esthetically pleasing and ensure the most efficient use of space. This should improve the productivity of our staff for years to come. Our staff is delighted with your design and your willingness to work with us to accommodate all of our needs.

The new addition will allow us to expand our interdisciplinary teams and provide the necessary equipment required to embrace the new technologies required to achieve our research goals.



The new addition will allow us to expand our interdisciplinary teams and provide the necessary equipment required to embrace the new technologies required to achieve our research goals. These goals clearly are focused at capitalizing on the convergence of human and animal health. Furthermore, these facilities will enhance our ability to host visiting scientists from around the world to expedite our research and product development activities. This expansion will also improve our ability to recruit and retain the world's top researchers. This is critical in today's competitive research environment.

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In addition to the current expansion of our research laboratories, VIDO is also pursuing funding to expand our animal isolation facilities. The Canada Foundation for Innovation requested letters of intent for unique facilities that would aid Canadian scientists to establish innovative links with the international community. VIDO was successful in the letter of intent and has now submitted a full proposal to establish a level III animal facility. This facility will further enhance opportunities to interact with world leaders in vaccine development and aid the country in responding to bioterrorism attacks, as well as working on chronic wasting diseases. This facility will also enhance our interactions with Canada's National Centers of Excellence in Vaccines (CANVAC) and with the Canadian Bacterial Disease Network Centres of Excellence (CBDN). These developments will ensure VIDO remains successful, but, more importantly, will be positioned to assist Canada and Canadian industry to achieve international success. VIDO is committed to ensuring Canada achieves global prominence in research, development, and commercialization of research.

Joyce Sander
Manager, Human Resources

This year, as in all previous years, our success could not have been achieved without the combined support of many individuals and organizations. These individuals include the staff of VIDO who have devoted much more time to the Organization than is expected. This is a reflection of the commitment of our staff to VIDO's mission and in embracing the Organization as their own. Ownership, teamwork, and pride in an organization is the culture that has been developed at VIDO. This culture is allowing us to achieve successes that most can only dream of. However, the staff could not achieve this scientific success without support of others outside of VIDO. The other partners have provided funds for research through various grant programs. We thank the livestock producers for providing funds through their check-off programs and other support programs. We especially thank those organizations that have provided "core" funding to VIDO for our infrastructure costs. Research in today's environment is extremely expensive. Without your financial support, the successes that VIDO has achieved in the past and continues to achieve today, would not be possible. However, in addition to the financial support, we are also appreciative of the constructive criticisms which you have provided over the past year that have strengthened our Organization. We firmly believe that we cannot address the needs of our constituency if we do not have interactions with the constituency and receive feedback as to both the things that we are doing right and areas where we can improve.

We have worked extremely hard over the past year in negotiating with the Province of Saskatchewan to obtain a portion of our funding to assist in defraying the indirect costs of research. Although the Province has appeared favorable to our request and has begun to recognize that research institutes like VIDO, who do research for the public good, cannot survive without such funding, they have not yet made a commitment as to the level of support VIDO will receive from the Province of Saskatchewan. We continue to be hopeful that during this year, we will come to an agreement as to the importance of VIDO, not only to the research infrastructure of the Province of Saskatchewan, especially to the livestock industry, but also to the rural vitality of Saskatchewan and Western Canada.

As stated in my comments, VIDO has had a very full and exciting year. This was possible through the dedication of VIDO's staff and management teams. Each of the members of our team have worked countless hours to finish the specific task that they were either assigned or initiated on their own. Without their dedication, VIDO could not have begun to achieve the dreams that we have dreamed this past year. Our dreams for next year are even more ambitious.

However, with the partnerships between our staff and all of our funders and collaborators, we are confident that these dreams will become a reality. As the Annual Report cover implies, the issues surrounding development of effective vaccines requires multiple pieces. All of us have been challenged with puzzles where either a piece was missing or does not fit. We need all the pieces not only to be available, but to interact effectively to ensure a complete picture is presented. We look forward to working with all of you since you are the pieces that fit together making us successful and allowing us to understand the complexities of infectious diseases. Understanding will help us achieve the success we are striving for.

Nothing succeeds like success. This saying is most appropriate here at VIDO. The culmination of 26 years of research into the infectious diseases and food safety of livestock and poultry has born fruit many times. Our reputation as a vaccine institute of "world class" proportions is firmly established. Our not for profit status and more particularly our reputation internationally as a vaccine institute of renown makes us very attractive to animal health corporations around the world. The funding we receive from various sources including contract work continues to grow significantly every year.

We are to the point now that our present facility can no longer accommodate all the work we are asked to do. Fortunately construction on our new building will start in March of 2002 with a completion date the following year. All the money is in place for this 14 million dollar expansion and our Director and Associate Director, Research are aggressively looking for new staff to expand our capabilities primarily in genomics which will be the major thrust of the expanded area.

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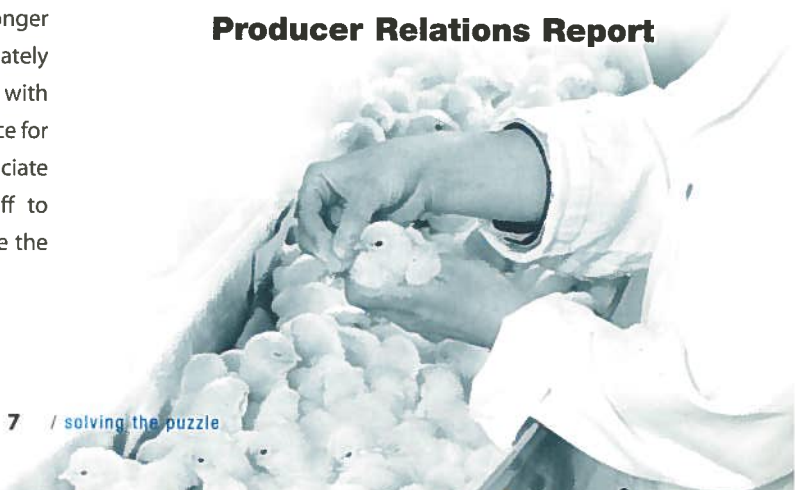
Stuart Bond
Associate Director

Producer Relations Report



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What does this all mean to producers? The use of antibiotics continues to be heavily criticized by the consuming public. Vaccines are very much in favour. Food safety concerns also remain at the top of the list in consumers minds and while one can easily argue that Canada's food supply has never been safer this in no way has diminished the demand for continued scientific advances in this area.

Producers want to know that their commodity will continue to be in high demand. They clearly understand that they must endorse food safety issues and be actively involved in the search for product improvements. VIDO, as their national institution of excellence in this area, continues to receive support from producer groups at the provincial level and also their national organizations. They also understand that some of the "platform technologies" we are working on may in the long run have a greater influence on their ability to operate profitably than anything else we do. In particular I am thinking of the research that is ongoing in our "Needle-Free" program. Findings to date continue to be very exciting. The prospect of administering a vaccine or better yet a multiple vaccine for several diseases and/or food safety issues without the use of needles is real. The end result would be a less expensive, more effective and easier to administer process. Our work continues to expand our knowledge in this field.

Technology transfer back to producers is increasingly important to VIDO. We have now had the benefit of nine months working with a professional communications firm - Meristem Communications. The reaction to this improvement to our communication strategy has been excellent. They bring two major factors to the table that we could not possibly hope to have in house.The ability to adapt research papers for nonscientific consumption and perhaps even more important is to have the database of media outlets so that our story gets out to the right media/people that make up our major stakeholders. Our news releases now go out to approximately 1400 media outlets, senior bureaucrats and federal and provincial politicians as well as all the producer commodity groups. VIDO continually gets calls for more information from interested parties all over the world as a result of this new initiative. We are also producing three newsletters each year with a mailing list of approximately 2000. In addition to the above our new website (vido.org) has been completely redone and is the anchor for all our communication efforts whether they are researcher focused or for the interest of producers and the public at large.

The VIDO Swine Tech Group now has a sister body in the VIDO Beef Tech Group. Both groups made up primarily of industry volunteers with participation from VIDO scientists meet three times each year. Their purpose is to address nonpolitical issues of interest/concern and supply credible information back to producers that can make a difference on the profitability of the operation. Partial funding for their activities comes from provincial commodity organizations that see value in the activities of the groups.

Finally, I spend the majority of my time meeting personally with both national and provincial beef, dairy, pork, and poultry producer groups throughout Canada. The message is always the same. We want producers to have a "Sense of Ownership" in VIDO. A feeling of trust and a basic understanding of what we do for food animals and poultry as it relates to infectious disease and food safety are our "stock in trade".

Funding from producer groups is modest in comparison to our overall budget this fiscal year which was $7 million but very important to VIDO for two reasons. Producer funding sends clear signals to other federal and provincial granting agencies that what we are pursuing has value to and endorsement by producers. In turn this means that VIDO can match producer dollars an average of 3:1. Suddenly those modest producer dollars are significant indeed!

Andrew Potter
Associate Director

RESEARCH REPORT

Infectious diseases continue to be a leading cause of animal suffering and economic losses to producers worldwide. Such losses can be devastating, as was seen with the foot and mouth disease outbreak in the United Kingdom last year and underscores the need for improved diagnostic and prophylactic technologies. Vaccination has proven to be the single-most effective method of preventing suffering due to infectious diseases in humans and animals, and phenomenal progress has been made over the past two decades on the development of a new generation of effective vaccines. However, most vaccines used today and many under development utilize invasive delivery procedures (injection), which is centuries-old technology. We believe that further advances in vaccine development are dependent on the development and optimization of new formulations which can be delivered via non invasive routes (oral, nasal, transcutaneous, etc.).

VIDO is exploring multiple vaccine delivery technologies and their potential applicability to different routes of vaccination. These investigations are motivated by two major concerns. First, the livestock industry and consumers have identified meat quality as a major concern and many of the present day vaccines are injected intramuscularly, which can cause injection site lesions which reduce meat quality. A second major concern during vaccine development is to ensure that the vaccine provides optimal induction of protective immunity. Over 90% of human and animal pathogens enter and colonize mucosal sites such as the lung and intestine. Vaccines delivered to these sites will induce local immunity more efficiently than conventional intramuscular injection but this has been hampered by the lack of suitable delivery vehicles. Recent advances in vaccine formulation provide potential solutions to these problems. The Immunology group at VIDO is working in collaboration with Dr. Mariana Foldvari at the University of Saskatchewan to explore the use of novel lipid-based delivery systems for intranasal immunization of swine and other species of livestock. The ability of these novel formulations to induce mucosal immune responses is highly dependent on the interaction between the lipid delivery system and cells at the mucosal surface. Therefore, our research is focused on screening liposome formulations that provide optimal immune responses following intranasal delivery in young pigs. In addition, the local immune responses can be further enhanced by the addition of immunostimulatory molecules to the vaccine formulation. In collaboration with Qiagen/PECURA and Coley Pharmaceuticals we have identified specific oligodeoxynucleotides (ODN) that function as potent mucosal adjuvants and we are now combining lipid-based vaccine formulations with ODNs to optimize protection against disease.

Oral vaccines also provide a potentially effective approach to achieving herd immunity in animals without handling them individually. There are several barriers to the development of oral vaccines, including vaccine ingestion and safe passage of the vaccine through the stomach. The identification of

vaccine formulations that can overcome these barriers is extremely difficult. During the past year, the Immunology group has developed a novel animal model that facilitates the rapid screening of oral vaccine candidates. This model system is based upon the surgical preparation of multiple intestinal "loops" within young calves or lambs. Each "loop" thereby provides an independent site for the controlled delivery of known amounts of vaccine or different vaccine formulations. It is therefore possible within a single animal to compare multiple preparations and determine the optimal dose or formulation for the induction of local mucosal immune responses. This system is currently being used at VIDO to screen potential vaccine antigens, mucosal adjuvants and oral vaccine delivery systems. VIDO scientists are also searching for novel approaches to enhance mucosal immune responses through the study of developmental immunology. During the last year, they confirmed that the mucosal immune system is fully developed in the fetus. This knowledge has significant implications for both human and animal health and may create new opportunities for using vaccines to prevent neonatal infections. For example, it might be possible to use in utero vaccination to prevent the vertical transmission of various viruses and bacteria in humans. Furthermore, the pre-natal development of the mucosal immune system also means that oral vaccination might be one of the most effective routes of immunization for the newborn of all species of animals, including humans. This is significant since one of the greatest risk periods for infectious diseases is the time just following birth.

Exciting alternatives to conventional vaccines have now been clearly identified and the challenge remains to determine which of these technologies can be developed into effective tools that meet the needs of both the livestock industry and consumers. Since it takes considerable time to develop and commercialize new vaccine technologies, VIDO scientists are also addressing methods for the improvement of existing vaccines. One promising approach to achieve this is to add ODNs to existing vaccines. This novel adjuvant acts as a natural "danger" signal and immunologists at VIDO have shown that the addition of ODNs to conventional vaccines significantly enhances the amplitude of immune responses. Furthermore, ODNs do not appear to cause tissue damage at injection sites, making it possible to improve both safety and efficacy of existing vaccines.

ODN's also have potential to be used for the control of infectious diseases without vaccinating. VIDO scientists have demonstrated that treatment of poultry with these molecules can effectively block the ability of *Escherichia coli* to colonize birds following experimental infection. While it has been reported in the literature that ODN's are capable of preventing infection by intracellular pathogens, this is the first example of an extracellular bacterial infection being successfully treated.

Since bacterial and viral pathogens colonize mucosal surfaces naturally, one effective method of developing vaccines for mucosal immunity is to attenuate such pathogens so that they cannot survive and replicate in the host but can colonize transiently and induce an immune response. VIDO's virology group has been actively working on the development of both bovine and porcine adenoviruses and live vaccine vectors. They have identified four regions in these viruses in which foreign genes can be inserted. Such an insertion not only results in expression of the heterologous antigen, but also attenuates the ability of the adenovirus to survive in the host. A number of antigens have now been inserted into these viruses, including those from respiratory and enteric viruses, and Dr. Tikoo and his team have now developed techniques for the insertion and expression of multiple genes within a single virus. This is significant in that it will potentially reduce production costs associated with growing the vaccine viruses. In addition to applications in animal health, studies are also underway to develop genetically targeted animal viruses (bovine and porcine) for use in human vaccination and cancer therapy.

One problem associated with the development of recombinant viral subunit vaccines is the high cost of production, since mammalian expression systems are usually required to obtain immunogenic antigens. One way to circumvent this problem is to utilize nucleic acid vaccines rather than producing the actual subunit protein antigen, in effect turning the animal into a bioreactor. Dr. Sylvia van den Hurk and her team have constructed a number of prototype

DNA vaccines for pathogens of cattle, swine and humans. These vaccines have been demonstrated to protect animals against experimental infection and can be delivered to animals by a number of routes, including mucosal surfaces. DNA sequences representing the ODNs described above have also been inserted into the DNA vaccine vectors, further enhancing the ability of these formulations to induce immune responses.

The research described above is targeted at the development of platform technologies which can be rapidly applied to virtually any infectious disease problem in animals or humans. However, unless these efforts are coupled with a sound understanding of the pathogenesis of infectious diseases, rational vaccine development is difficult to achieve. Therefore, VIDO also has several projects dealing with specific diseases of animals and the development of vaccines for their prevention. These include traditional infectious diseases such as porcine circovirus, the cause of PMWS in swine, as well as bovine streptococcal mastitis. With respect to the latter, we have identified several protective antigens which appear to be involved in the induction of inflammatory responses in the mammary gland following infection and have demonstrated that vaccination with these components can prevent mastitis caused by *Streptococcus uberis* and *Streptococcus dysgalactiae*. One of these antigens, a protein known as GapC, is produced by most streptococcal strains as well as numerous other bacterial and parasitic pathogens. We are currently testing the vaccine potential of this molecule for other applications in equine health as well as the aqua-culture industry.

In addition to the development of vaccines for infectious diseases of animals, a growing area of research at VIDO is the development of food safety vaccines. Organisms such as *Campylobacter jejuni* and *Escherichia coli* O157:H7 colonize chickens and cattle, respectively, yet do not cause clinical disease in their animal hosts. When transmitted to humans via contaminated meat or environmental samples (e.g. drinking water), the results can be devastating as was seen with the *E. coli* O157:H7 outbreak in Walkerton, Ontario. We believe that vaccination of animals against such pathogens has the possibility to reduce their numbers in both food products and the environment, thereby lessening the risk of infections to humans. VIDO scientists, working in collaboration with Dr. Brett Finlay at the University of British Columbia have demonstrated proof of concept for this approach to reducing the levels of *E. coli* O157:H7 in cattle and are currently field testing a prototype vaccine in Alberta and Saskatchewan. Other pathogens under study at VIDO include *Salmonella enteritidis*, *Campylobacter jejuni*, and *Cryptosporidium parvum*. The latter is a parasite which is able to cause disease in both humans and animals and has been associated with a number of outbreaks in humans due to contaminated drinking water.

Since many of our research projects are targeted at the development of platform technologies for vaccine formulation and delivery, they have application in both human and animal health sectors. The technology for producing vaccine components is very similar for human and animal vaccines, unlike the situation 20 years ago. Thus, VIDO is actively seeking applications of our technologies developed for the animal health field in human medicine and over the past year, we have initiated our first vaccine project targeted specifically at a human infection. This is for the Hepatitis C virus and VIDO scientists are utilizing technologies from our DNA immunization and vaccine formulation projects to develop and test novel vaccines for this virus. At the current time, no effective prophylactic strategies are available for the prevention of Hepatitis C infection, a virus which infects 170 million individuals annually.

In summary, a large proportion of VIDO's research activities are currently devoted to the development of new vaccine formulations and vaccination strategies which, when combined with advances made in antigen production over the past decade, will result in a new generation of infectious disease products based upon sound scientific principles. We believe that without the development of such technologies, the full potential of vaccination as a disease management tool will not be realized. During the next year, VIDO's building expansion will be completed which will allow further growth of several of our research programs, including those dealing with food and water safety vaccines. This is an area in which we foresee significant growth over the next two to five years and a requirement for us to meet the evolving needs of our stakeholders.

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Carol Martel
Manager
Financial Operations

Deloitte & Touche

AUDITORS' REPORT

TO THE BOARD OF DIRECTORS OF THE 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, 2001 and the statements of income, expenditure and fund balance (Research Trust, Dr. Alfred Savage VIDO Research Fund and Capital Trust) and combined statement of cash flows 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.

Except as explained in the following paragraph, we conducted our audit in accordance with Canadian 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.

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, 2001 and the results of its operations and the changes in its cash flows for the year then ended in accordance with Canadian generally accepted accounting principles.

Deloitte + Touche LLP

Chartered Accountants

Saskatoon, Canada
January 11, 2002

Deloitte
Touche
Tohmatsu

UNIVERSITY OF SASKATCHEWAN
VETERINARY INFECTIOUS DISEASE ORGANIZATION (VIDO)

RESEARCH TRUST - STATEMENT OF INCOME, EXPENDITURE AND FUND BALANCE
YEAR ENDED SEPTEMBER 30, 2001

	2001	2000
INCOME		
Donations and unconditional grants (Schedule 1)	$ **326,053**	$ 200,934
Conditional grants (Schedule 2)	**3,473,454**	2,517,880
Amortization of Conditional grants - Building expansion (Note 6)	**2,842**	-
Contract research		
Department of Western Economic Diversification	**24,575**	45,000
Commercial	**1,659,401**	1,326,823
Associated Company	**-**	2,825
Government of the Province of Saskatchewan		
-Saskatchewan Department of Agriculture & Food	**275,000**	300,000
-Department of Saskatchewan Economic and Co-operative Development	**250,000**	590,504
Ag-West Biotech Inc.	**-**	5,381
Department of National Defence	**-**	1,765
Licensing fees	**11,026**	100,000
Royalties and dividends	**357,015**	239,085
Investment income	**76,157**	139,391
Animal sales	**193,441**	99,704
University of Saskatchewan	**121,563**	153,273
	6,770,527	5,722,565
EXPENDITURE		
Salaries and benefits	**3,774,722**	3,185,673
Materials and supplies	**1,367,007**	1,190,350
Animal services	**444,739**	239,863
Equipment repair and service agreements	**80,476**	52,855
Sub-contract research (Note 7)	**87,593**	117,211
Travel and recruiting	**167,456**	138,694
Patents and legal fees	**133,918**	355,542
Amortization	**314,385**	288,568
Other expenditures (Note 8)	**107,580**	40,829
	6,477,876	5,609,585
EXCESS OF INCOME OVER EXPENDITURE	**292,651**	112,980
FUND BALANCE, BEGINNING OF YEAR	**4,989,018**	4,964,702
	5,281,669	5,077,682
TRANSFER TO CAPITAL TRUST, NET OF ASSET PURCHASES	**(94,243)**	(88,664)
	$ **5,187,426**	$ 4,989,018

See accompanying notes

UNIVERSITY OF SASKATCHEWAN
VETERINARY INFECTIOUS DISEASE ORGANIZATION (VIDO)

DR. ALFRED SAVAGE VIDO RESEARCH FUND
STATEMENT OF INCOME, EXPENDITURE AND FUND BALANCE
YEAR ENDED SEPTEMBER 30, 2001

	2001			2000		
	Restricted for Endowment Purposes	**Expendable Funds**	**TOTAL**	Restricted for Endowment Purposes	Expendable Funds	TOTAL
EXCESS OF INCOME OVER EXPENDITURE						
Investment (Loss) Earnings	**$ (4,915)**	**$ 4,155**	**$ (760)**	$ 8,831	$ 3,807	$ 12,638
FUND BALANCE, BEGINNING OF YEAR	**68,607**	**22,085**	**90,692**	59,776	18,278	78,054
FUND BALANCE, END OF YEAR	**$ 63,692**	**$ 26,240**	**$ 89,932**	$ 68,607	$ 22,085	$ 90,692

UNIVERSITY OF SASKATCHEWAN
VETERINARY INFECTIOUS DISEASE ORGANIZATION (VIDO)

CAPITAL TRUST
STATEMENT OF INCOME, EXPENDITURE AND FUND BALANCE
YEAR ENDED SEPTEMBER 30, 2001

	2001	2000
EXCESS OF INCOME OVER EXPENDITURE		
Investment earnings	**$ 28,119**	$ 38,878
FUND BALANCE, BEGINNING OF YEAR	**771,297**	643,755
	799,416	682,633
Purchase of Capital Assets	**(105,757)**	(111,336)
Transfer from Research Trust	**200,000**	200,000
FUND BALANCE, END OF YEAR	**$ 893,659**	$ 771,297

See accompanying notes

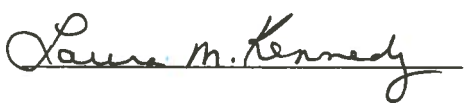
UNIVERSITY OF SASKATCHEWAN
VETERINARY INFECTIOUS DISEASE ORGANIZATION (VIDO)

COMBINED BALANCE SHEET
AS AT SEPTEMBER 30, 2001

ASSETS	2001	2000
CURRENT ASSETS		
Funds held - University of Saskatchewan	**$ 1,893,961**	$ 2,001,220
Due from University of Saskatchewan - operating fund	**4,903,752**	830,785
Accounts receivable (Note 3)	**303,345**	168,294
Inventories (Note 4)	**290,862**	149,077
	7,391,920	3,149,376
INVESTMENTS	**834,736**	834,084
CAPITAL ASSETS (Note 5)	**3,363,618**	3,289,433
	$ 11,590,274	$ 7,272,893
LIABILITIES		
CURRENT LIABILITIES		
Accounts payable	**$ 6,600**	$ 6,800
Accrued vacation pay	**254,031**	223,865
Unearned grants (Schedule 2)	**1,382,171**	1,191,221
	1,642,802	1,421,886
UNEARNED GRANTS - BUILDING EXPANSION (Note 6)	**3,776,455**	-
	5,419,257	1,421,886
EQUITY		
RESEARCH TRUST	**$ 5,187,426**	$ 4,989,018
DR. ALFRED SAVAGE VIDO RESEARCH FUND	**89,932**	90,692
CAPITAL TRUST	**893,659**	771,297
	6,171,017	5,851,007
	$ 11,590,274	$ 7,272,893

APPROVED BY THE BOARD:


Director


Trustee

See accompanying notes

UNIVERSITY OF SASKATCHEWAN
VETERINARY INFECTIOUS DISEASE ORGANIZATION (VIDO)

COMBINED STATEMENT OF CASH FLOWS
YEAR ENDED SEPTEMBER 30, 2001

	2001	2000
CASH FLOWS FROM OPERATING ACTIVITIES		
Cash received from Livestock industry	$ 306,953	$ 182,028
Cash received from Provincial Governments and Individuals	19,100	18,906
Cash received on Conditional grants	3,503,865	3,190,045
Cash received from Contract research	2,233,976	2,901,863
Cash received from Royalties, licensing and dividends	368,041	439,085
Cash transferred from University of Saskatchewan	121,563	153,273
Interest income received for operating purposes	76,157	139,391
Cash paid for Salaries and benefits	(3,744,756)	(3,218,578)
Cash paid for Materials, supplies and sub-contractors	(1,456,584)	(1,314,048)
Cash paid for Patent and legal costs	(133,918)	(355,542)
Cash paid for Animal services, net of animal sales	(391,099)	(170,322)
Cash paid for Other expenditures	(353,254)	(227,572)
	550,044	1,738,529
Interest earned on Dr. Alfred Savage VIDO Research Fund	4,155	3,807
Net cash generated through operating activities	554,199	1,742,336
CASH FLOWS FROM INVESTING ACTIVITIES		
Decrease in University of Saskatchewan investment pool	(652)	(186,507)
Purchase of Capital Assets from Capital Trust	(105,757)	(111,336)
Purchase of Capital Assets from Research Trust	(94,958)	(186,764)
Purchase of Capital Assets from Research Trust-Building Expansion funds	(190,113)	-
Net cash provided by (used in) investing activities	(391,480)	(484,607)
CASH FLOWS FROM FINANCING ACTIVITIES		
Funds received for building expansion - Research Trust	3,779,297	-
Increase (decrease) Dr. Alfred Savage VIDO Research Fund investments	(4,915)	8,831
Interest income received on Capital Trust Funds	28,607	37,744
Net cash provided by (used in) financing activities	3,802,989	46,575
NET INCREASE IN CASH HELD	3,965,708	1,304,304
CASH, BEGINNING OF YEAR	2,832,005	1,527,701
CASH, END OF YEAR	6,797,713	2,832,005
Funds Held - University of Saskatchewan	1,893,961	2,001,220
Due from University of Saskatchewan - operating fund	4,903,752	830,785
	$ 6,797,713	$ 2,832,005

See accompanying notes

UNIVERSITY OF SASKATCHEWAN
VETERINARY INFECTIOUS DISEASE ORGANIZATION (VIDO)
NOTES TO THE FINANCIAL STATEMENTS
SEPTEMBER 30, 2001

1. ESTABLISHING AGREEMENT

The Organization (VIDO) 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 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 generally accepted accounting principles which include the following policies:

Fund Accounting

The Organization (VIDO) follows the deferral method of accounting for contributions and grants to each of its funds. The Organization (VIDO) classifies its funds by purpose and objective as follows:

The Research Trust fund consists of revenue and expenditures related to the Organization's (VIDO's) program delivery and administrative activities. This may also include funds raised specifically for the building expansion and for the purchase of assets through grants.

The Capital Trust fund consists of grants, investment earnings and authorized transfers from the Research Trust fund and Dr. Alfred Savage VIDO Research Fund to be used for the purpose of acquiring capital assets approved by the Board of Directors.

The Dr. Alfred Savage VIDO Research fund was approved as an endowment for the Organization (VIDO) until 2010. During the endowment period, 80% of the fund's annual investment earnings are available to purchase equipment, instruments, materials and supplies to be used in research projects.

Inventories

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

Investments

Funds designated as endowment funds, restricted for the purposes of acquiring capital assets or future expenditures are invested with other funds from the University of Saskatchewan in a long-term investment pool. Long-term investments are carried at market value.

Revenue Recognition

Restricted contributions are recognized as revenue of the Research Trust fund in the year in which the related expenditures are incurred. Unrestricted contributions are recognized as revenue of the Research Trust fund when received. License fees, research payments and royalties are recognized as they are received under the terms of the agreements with the licensees or contractors.

Investment income earned on the Dr. Alfred Savage VIDO Research fund is recognized as income of that fund; 20% of the fund's earnings are retained for reinvestment. Investment income earned on the Research Trust fund and Capital Trust fund is recognized as revenue when earned.

Capital Assets

Purchased capital assets are recorded at cost. Amortization is provided on a straight-line basis over the asset's estimated life as follows:

Computers	3 years
Software	3 years
Vehicles	6 years
Furnishings and equipment	8 years
Site improvements	20 years
Buildings	40 years

Royalties

Royalties are recognized as they are received or earned.

3. ACCOUNTS RECEIVABLE

	2001	2000
Conditional grants (Schedule 2)	**$ 290,358**	$ 129,819
Contract research	**11,250**	36,250
Accrued interest	**1,737**	2,225
	$ 303,345	$ 168,294

4. INVENTORIES

	2001	2000
Animals	**$ 229,720**	$ 89,919
Materials and supplies	**61,142**	59,158
	$ 290,862	$ 149,077

5. CAPITAL ASSETS

	2001			2000
	Cost	Accumulated Amortization	Net Book Value	Net Book Value
Computers	$ 357,718	$ 317,188	$ 40,530	$ 48,014
Software	11,934	7,969	3,965	4,457
Vehicles	170,883	73,221	97,662	53,924
Furnishings & Equipment	2,437,849	1,548,528	889,321	750,316
Site Improvements	169,228	151,520	17,708	15,431
Buildings	5,131,713	2,817,281	2,314,432	2,417,291
	$ 8,279,325	$ 4,915,707	$ 3,363,618	$ 3,289,433

6. UNEARNED GRANTS – BUILDING EXPANSION

Unearned grants reported in the Research Trust fund include the unamortized portions of restricted funding designated for the building and equipping of an expanson to the current VIDO facility.

Construction of the expansion will begin in March, 2002, and scheduled for completion by June, 2003.

Funding details are as follows:

				2001
	Committed	Received during year	Amortized to Revenue	Unearned
Canada Foundation for Innovation	$ 5,151,773	$ 1,235,335	$ -	$ 1,235,335
Province of Saskatchewan	5,151,773	510,000	-	510,000
Alberta Science and Research Authority				
- Income earned	2,000,000	2,000,000	2,711	1,997,289
- Interest earned	-	33,962	131	33,831
	$ 12,303,546	$ 3,779,297	$ 2,842	$ 3,776,455

Funds received from Alberta Science and Research Authority and interest earned on those funds are restricted to the purchase of equipment.

7. SUB-CONTRACT RESEARCH

During the year the Organization (VIDO) entered into sub-contract research collaborations with various third parties relating to funding from conditional grants and contracts including the following:

	2001	2000
University of British Columbia	$ -	$ 38,346
National Research Council of Canada	8,702	30,667
University of Calgary	78,891	48,198
	$ 87,593	$ 117,211

8. OTHER EXPENDITURES

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

9. INCOME TAXES

The Organization (VIDO) is not subject to either federal or provincial income taxes. The Organization (VIDO) is required to pay GST and PST on taxable services and supplies.

10. RELATED PARTY TRANSACTIONS

a) The Organization (VIDO) is a research unit of the University of Saskatchewan. The University of Saskatchewan maintains, as part of its normal operations, various financial and administrative functions relating to the Organization (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 16.44% Star Biotech Inc. (formerly BIOSTAR Inc.) as at March 31, 2001 (2000-16.44%). Star Biotech Inc. is a research and development company associated with the development of some of the Organization's (VIDO's) products and technologies. During the year the Organization (VIDO) had the following transactions with Star Biotech Inc.:

	2001	2000
Income from Star Biotech Inc. to VIDO		
Contract research	$ -	$ 2,825
Royalties	37,500	175,000
Dividends	32,175	-
	$ 69,675	$ 177,825

11. CONTINGENCIES

The Organization (VIDO) has entered into certain contractual arrangements, which may require repayment of the contracted amount if the research sponsored by the contract results in commercialization. There are no amounts repayable under these contracts at September 30, 2001.

12. COMPARATIVE FIGURES

Certain of the comparative figures have been reclassified to conform to the current year's presentation. The prior year's financial statements have been reported on by another accounting firm.

UNIVERSITY OF SASKATCHEWAN
VETERINARY INFECTIOUS DISEASE ORGANIZATION (VIDO)

SCHEDULE OF DONATIONS AND UNCONDITIONAL GRANTS
YEAR ENDED SEPTEMBER 30, 2001

	2001	2000
LIVESTOCK INDUSTRY		
Beef		
Saskatchewan Horned Cattle Trust Fund	$ 37,500	$ 35,000
Kamloops Stockmen's Association	700	1,400
Saskatchewan Cattle Marketing Deductions Fund	180,000	75,000
Alberta Cattle Commission	10,000	-
	228,200	111,400
Dairy		
South Coastal Dairy Education Association	500	-
	500	-
Swine		
Ontario Pork Producers' Marketing Board	-	12,000
Alberta Pork	30,150	40,000
BC Hog Marketing Commission	-	2,500
Manitoba Pork	20,000	-
Sask Pork	28,000	-
Swine Improvement Services Cooperative	103	128
	78,253	54,628
Poultry		
Alberta Chicken Producers	-	16,000
	-	16,000
PROVINCIAL GOVERNMENTS		
British Columbia	3,900	3,200
Manitoba	15,200	15,200
	19,100	18,400
OTHER FOUNDATIONS, COMPANIES AND INDIVIDUALS		
Individuals	-	506
	$ 326,053	$ 200,934

See accompanying notes

Schedule 2

UNIVERSITY OF SASKATCHEWAN
VETERINARY INFECTIOUS DISEASE ORGANIZATION (VIDO)
SCHEDULE OF CONDITIONAL GRANTS AND CONTRACTS
YEAR ENDED SEPTEMBER 30, 2001

	September 30, 2000		2001	September 30, 2001			
	Accounts Receivable	Unearned Revenue	Funds Received	Accounts Receivable	Unearned Revenue	2001 Income	2000 Income
Natural Sciences & Engineering Research Council of Canada (NSERC)							
Operating, Strategic and Equipment	$ -	$ 157,800	$ 452,627	$ -	$ 387,310	$ 223,117	$ 329,131
Industry Matching	-	5,617	-	-	-	5,617	68,020
Canadian Institutes of Health Research	-	185,190	341,041	-	294,581	231,650	258,778
Agriculture Canada/NSERC Research Partnership Grants	-	45,230	104,100	7,637	-	156,967	101,047
Canadian Bacterial Diseases Network (CBDN)	-	7,087	204,999	72,979	-	285,065	173,211
Agriculture and Agri-Food Canada	-	350,000	642,447	18,562	-	1,011,009	-
Canada Research Chair							
Infrastructure	-	-	127,440	-	127,440	-	-
Operating	-	-	92,119	-	47,307	44,812	-
Research Network on Bacterial Pathogens of Swine	-	69,038	73,875	-	70,552	72,361	9,212
Canvac	-	-	171,000	-	171,000	-	-
Saskatchewan Council for Community Development	-	-	300,000	65,128	-	365,128	-
Saskatchewan Agriculture Development Fund	27,760	24,189	148,073	20,100	22,631	141,971	143,807
Agri-Food Innovation Fund	-	135,136	80,000	-	50,916	164,220	368,635
Health Services Utilization and Research Commission	-	21,237	115,313	-	27,488	109,062	112,420
Saskatchewan Health Research Board Fellowship	-	19,292	76,332	-	47,683	47,941	66,222
Alberta Agriculture Research Institute (AARI)	19,437	69,755	296,912	30,438	72,088	305,580	219,760
Canada-Alberta Beef Industry Development Fund	10,619	22,404	19,421	41,314	-	72,520	231,298
Saskatchewan Beef Development Board	18,509	-	55,000	19,200	-	55,691	57,788
Ontario Cattlemen's Association	11,859	30,681	26,400	-	11,517	33,705	35,050
Beef Industry Development Fund	-	-	-	-	-	-	82,109
Beef Cattle Industry Development Fund	5,694	33,488	60,540	-	20,798	67,536	63,469
Poultry Industry Council	7,288	-	46,388	7,500	7,570	39,030	12,146
British Columbia Investment Agriculture Foundation	28,653	-	55,000	7,500	-	33,847	77,597
Dairy Farmers of Canada	-	25	-	-	-	25	62,473
Livestock Environmental Initiative	-	-	14,838	-	23,290	(8,452)	-
World Health Organization	-	15,052	-	-	-	15,052	45,707
	$ 129,819	$ 1,191,221	$ 3,503,865	$ 290,358	$ 1,382,171	$ 3,473,454	$ 2,517,880

See accompanying notes

Patents, Publications & Presentations

2000/2001 Publications

Patents

Singapore Patent #61346
Title: GnRH-Leukotoxin Chimeras.
Date: October 24, 2000
Authors: Potter, A.A. and Manns, J.G.

New Zealand Patent #333999
Title: GnRH-Leukotoxin Chimeras.
Date: November 9, 2000
Authors: Potter, A.A. and Manns, J.G.

North Korea Patent #34274
Title: GnRH-Leukotoxin Chimeras.
Date: September 22, 2000
Authors: Potter, A.A. and Manns, J.G.

Australian Patent #725233
Title: GnRH-Leukotoxin Chimeras.
Date: January 25, 2001
Authors: Potter, A.A. and Manns, J.G.

US Patent #6,319,716 B1
Title: Bovine adenovirus type 3 genome and vector systems derived therefrom.
Date: November 20, 2001
Authors: Tikoo, S.K., Babiuk, L.A., Reddy, P.S., Zakhartchouk, A., and Baxi, M.

US Patent # 60,224,737
Title: *In utero* oral nucleic acid immunization.
Date: August 10, 2001
Authors: Gerdts, V., Babiuk, LA., van Drunen Littel-van den Hurk, S., and Griebel, P.J.

Research Publications in Scientific Journals

Connolly, S.A., Whitbeck, J.C., Rux, A.H., Krummenacher, C., van Drunen Littel-van den Hurk, S., Cohen, G.H., and Eisenberg, R.J. 2001. Glycoprotein D homologues in herpes simplex virus type-1, pseudorabies virus, and bovine herpesvirus type-1 bind directly to human HveC (Nectin-1) with different affinities. Virology 280: 7-18.

Deregt, D., Jordan, L.T., van Drunen Littel-van den Hurk, S., Masri, S., Tessaro, S.V., and Gilbert, S.A. 2000. A genital herpesvirus isolated from a North-American elk is an unique virus antigenically related to bovine herpesvirus-1. American J. Vet. Res. 61: 1614-1618.

Gerdts, V., Uwiera, R.R.E., Mutwiri, G., Bowersock, T., Kidane, A., Sanchez, M., Wilson, D., M., Beskorwayne, T., Babiuk, L.A., and Griebel, P.J. 2001. Multiple intestinal "loops" provide an *in vivo* model to analyze mucosal immune responses. J. Immunol. Methods 256: 19-33.

Gomis, S.M., Riddell, C., Potter, A.A. and B.J. Allan. 2000. Phenotypic and genotypic characterization of virulence factors of *Escherichia coli* isolated from broilers with simultaneous occurrence of cellulitis and other colibacillosis lesions. Can. J. of Vet Res. 65:1-6.

Gomis, S.M., Riddell, C., Potter, A.A., and Allan, B.J. 2001. Phenotypic and genotypic characterization of virulence factors of *Escherichia coli* isolated from broiler chickens with simultaneous occurrence of cellulitis and other colibacilosis lesions. Can. J. Microbiol. Res. 65: 1-6.

Liu, Q., Wang, L., Willson, P., and Babiuk, L.A. 2000. Quantitative, competitive PCR analysis of porcine circovirus DNA in serum from pigs with postweaning multisystemic wasting syndrome. J. Clin. Microbiol 38: 3474-3477.

Liu, Q., Willson, P., Attah-Poku, S., and Babiuk, L. 2001. Bacterial expression of an immunologically reactive PCV2 ORF2 fusion protein. Protein Expr. Purif. 21:115-120.

Loehr, B.I., Willson, P., Babiuk, L.A., van-Drunen Littel-van den Hurk, S. 2000. Gene gun-mediated DNA immunization primes development of mucosal immunity against bovine herpesvirus-1 in cattle. J. Virol. 74: 6077-86.

Song, X.M, Perez-Casal, J., Bolton, A., and Potter, A.A.. 2001. Surface-expressed Mig protein protects *Streptococcus dysgalactiae* against phagocytosis by bovine neutrophils. Infect. Immun. 69: 6030-6037.

Uwiera, R., Rankin, R., Adams, G.P., Pontarollo, R., van Drunen Littel-van den Hurk, S., Middleton, D., Babiuk, L.A., and Griebel P.J. 2001. Effects of intradermally administered plasmid deoxyribonucleic acid on ovine popliteal lymph node morphology. Anatomical Record 262: 186-192.

van den Broeke, A., Cleuter, Y., Beskorwayne, T., Kerkhofs, P., Syznal, M., Bagnis, C., Burny, A., and Griebel, P. 2001. CD154-co-stimulated ovine primary B cells: A cell culture system that supports productive infection by bovine leukemia Virus. J. Virol. 75: 1095-1103.

van Donkersgoed, J., Berg, J., Potter, A.A., Hancock, D., Besser, T., Rice, D., LeJeune, J., and Klashinsky, S. 2001. Environmental sources and transmission of *Escherichia coli* O157:H7 in feedlot cattle. Can. Vet. J. 42:714-720.

van Drunen Littel-van den Hurk, S, Myers, D., Doig, P.A., Karvonen, B., Habermehl, M., Babiuk, L.A., Jelinski, M., van Donkersgoed, J., Schlesinger K., and Rinehart, C. 2001. Identification of a mutant bovine herpesvirus-1 (BHV-1) in post-arrival outbreaks of IBR in feedlot calves and protection with conventional vaccination. Can. J. Vet. Res. 65: 81-88.

Willson, P.J., Gerlach, G.F., Klashinsky, S., and Potter, A.A. 2001. Cloning and characterization of the gene coding for NADPH-sulfite reductase hemoprotein from *Actinobacillus pleuropneumoniae* and use of the protein product as a vaccine. Can. J. of Vet. Res. 65:206-212.

Research Presentations, Posters, and Abstracts Presented at Meetings

Amoako, K., Zhu, C., Allan, B.J., and Potter, A.A. Implication of a kdpE gene mutation in the attenuation of an avian pathogenic *Escherichia coli*. CBDN Meeting, May 12-15 2001. Canmore, AB.

Fontaine, M.C. and Potter, A.A. Identification of a novel two-component regulatory system that represses beta-haemolysin expression in Streptococcus agalactiae. CBDN Meeting. May 12-15, 2001. Canmore, AB.

Gerdts, V., Babiuk, L.A., and Griebel, P. 2000. "Gut-loop" as a model to develop oral veterinary vaccines. European Federation of Immunological Sciences (EFIS) Satellite Workshop: Infectious Immunity and Vaccines, Kazimnierz Dolyn n. Wilsa, Poland.

Gerdts, V., Babiuk, L.A., and Griebel, P. 2001. *In utero* DNA vaccination induces protective immunity. 15th Spring Meeting of the Canadian Society for Immunology, Lake Louise, AB.

Gerdts, V., Babiuk, LA., van Drunen Littel-van den Hurk, S., and Griebel, P.J. 2000. Fetal immunization by a DNA vaccine delivered orally into the amniotic fluid. 14th European Immunology Conference, Poznan, Poland.

Gerdts, V., Snider, M., Brownlie, R. Babiuk, L.A., and Griebel, P.J. Immunological lessons *in utero*: the induction of mucosal immunity and immune memory. German Society for Immunology. Hannover, Germany.

Gomis, S., Amoako, K., Ngeleka, M., Belanger, L, Althouse, B., Kumor, L., Waters, E., Stephens, S., Riddell, C., Potter, A., and Allan, B. Cellulitis in legs and caudal thoracic area of market weight turkeys in Western Canada: Histopathological and bacteriological evaluations. 50th Western Poultry Disease Conference March 24-26, 2001, Davis, CA.

Griebel, P., Mutwiri, G., Gerdts, V., Beskorwayne, T., Kaushik, R., and Brownlie, R. 2000. B-cell development in Peyer's patches. Australian Society of Immunology 30th Annual Conference, Sydney, Australia.

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