1990-91 ANNUAL REPORT

VIDO

THE 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.

ORIGINS & MANDATE

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.

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.

REPORT FROM THE CHAIRMAN

B.G. Larson
Chairman

J.G. Huffman
Vice-Chairman

Scientific advances for the benefit of both humans and animals have always faced a certain degree of public scepticism. Healthy scepticism is useful and helps to ensure that new products, technology and information are safe and effective. VIDO strives to achieve these elements of quality in all that it does. Whether it is providing new housing or management information or developing new products, research results are thoroughly tested before being put into practice. The vaccines which VIDO has developed over the years, including Vicogen, Ecolan RC, Hevlan TC, and most recently Pneumo-Star™, Somnu-Star™ and Somnu-Star Ph™ are achievements that have and will contribute to diminishing economic losses caused by common diseases. Each of these products was subjected to diligent testing under experimental as well as field conditions and have met national standards maintained by Agriculture Canada for the licensing of vaccines.

In spite of the contributions which VIDO has made over the years, much work remains to be done in improving animal health. The world, and the biological systems which comprise it, do not stand still. Therefore, it is a fairly safe bet that as each disease problem is reduced or brought under control, others will emerge and become the focal point of new research. As a result, there will always be new challenges for VIDO to tackle.

Disease problems and management techniques have been the historical focus of VIDO's research efforts. New directions are already emerging and include the development of products which enhance the efficiency of performance, including reproductive efficiency, stress tolerance, carcass characteristics, and growth rate. Rather than regulating animal performance through the direct administration of drugs, VIDO and other institutions are investigating methods of regulating the animal's immune system to enhance production characteristics. The first such project started by VIDO this year is aimed at developing a vaccine to reduce "boar taint" and aggression in intact male swine.

In time, VIDO's skills and advanced technologies will produce safe and effective performance enhancement products and techniques. These products will be based on sound scientific data and extensive dialogue with end users as well as regulatory authorities. In developing these new technologies and approaches, it is imperative that institutions like VIDO ensure that the needs and interests of all groups be considered. Healthy scepticism will ensure that these approaches are safe, scientifically sound, and subject to rigorous testing.

I would like to express my personal appreciation to the Board members for their advice, support and thoughtful guidance. The VIDO staff are hard working, dedicated and have achieved much in the past year. The livestock industry will benefit from their labours. The Management team – Stephen Acres, Lorne Babiuk, Paul Hodgman and Ken Barteski have provided the vision and direction necessary to allow the Organization to prosper. As I depart from the Board, I wish VIDO well and will continue to assist where possible.

B. G. Larson

1990-91 VIDO BOARD OF DIRECTORS

Back Row - Standing - Left to Right
P.G. Hodgman (Executive Officer), C. Rennie, J. Doherty, G. Hamilton, A. Hingston, E. Moss, A. Rampton, R. Hunsberger, R. Christian

Front Row - Sitting - Left to Right
L.A. Babiuk (Associate Director, Research), B.G. Larson (Chairman), J.G. Huffman (Vice-Chairman), D. Rowlatt, S.D. Acres (Director), K.B. Barteski (Manager, Financial Operations)

Missing - G. Schoepp

REPORT FROM THE DIRECTOR

S. D. Acres

New Product Development

VIDO made major progress in the development of several new products during the year. We are pleased to announce that the development and testing of three new cattle vaccines was completed and the products were approved for sale in Canada by Agriculture Canada. One product is Pneumo-Star™ which is for the prevention of shipping fever pneumonia in cattle. One of the main protective ingredients in this vaccine is a genetically-attenuated form of toxin produced by *Pasteurella haemolytica*. As far as we are aware, this is the first genetically-engineered subunit protein in the world in a bacterial vaccine. It is combined with an extract of other components of *P. haemolytica* and this combination provides a vaccine which stimulates the development of broad protective immunity against *Pasteurella haemolytica* disease. Using the same biotechnology approach, VIDO has two other bacterial vaccines under development for *Actinobacillus pleuropneumoniae* in pigs and *Haemophilus somnus* in cattle. The second vaccine is Somnu-Star™, a bacterial extract for the prevention of *Haemophilus somnus* in cattle. This extract contains outer membrane proteins of *H. somnus* which induces protective immunity against this multi-faceted disease. The two vaccines mentioned above have also been combined into a single product called Somnu-Star Ph™ which provides protection against *Haemophilus somnus* and *Pasteurella haemolytica*.

Research Highlights

The last year has been a very hectic one at VIDO. Three new products were completed and transferred to BIOSTAR for commercialization and excellent progress was made towards the development of several other vaccines which should be ready to enter the field trial stage in the near future. Most notable amongst these are genetically-engineered vaccines for *Actinobacillus pleuropneumoniae* in swine and bovine herpesvirus-1 in cattle. *A. pleuropneumoniae* causes infections of the lungs and lung cavities of growing swine and has become a very common problem in Canadian swine herds. The disease can occur in both acute and chronic forms and losses in previously uninfected herds can be extreme. VIDO scientists have developed a vaccine which contains specific components or "subunits" from *A. pleuropneumoniae* which are highly protective when incorporated into a vaccine. They can be produced in large amounts using the genetic-engineering approach and therefore, it is likely that field trials will start in the fall of 1992. Bovine herpesvirus-1 is a common viral infection of cattle which causes a variety of clinical syndromes including respiratory disease, reproductive inefficiency, and calfhood disease. Here again, VIDO's Virology Group has developed and tested specific proteins from the virus which induce protection and these can now be produced in large quantities using genetic-engineering. Field trials with this vaccine should also take place in 1992 and ultimately this component will be combined with Pasteurella and Haemophilus vaccines developed last year.
In addition, VIDO's Immunology Group has continued its groundbreaking work with CIBA-GEIGY on exploring the potential uses of cytokines in animals. A large epidemiological study on enzootic pneumonia of dairy calves was also completed and the details are summarized in the Report of the Associate Director (Research). The Swine Technical Group was also productive and is working on a fourth bulletin for swine producers which will outline in detail the recommended procedures for depopulating and repopulating swine premises. This is another management technique which can be used to eliminate herds which are chronically troubled by infectious diseases.

New Activities

For the past 17 years, VIDO's mandate has been restricted to working on common infectious diseases of food-producing animals. However, this year the Organization expanded its mandate to include the area which we refer to as "performance enhancement." This approach is aimed at enhancing the efficiency of livestock production by improving performance parameters such as reproductive efficiency, growth rate, and lactation rate, or by reducing such things as stress or unattractive features of livestock behaviour.

VIDO's first target in this regard is the prevention of a problem referred to as "boar taint" which occurs in male pigs which have not been castrated. Intact males grow more rapidly than their castrated counterparts, and therefore some swine producers do not castrate their male pigs so that they can achieve higher growth rates. However, in some cases this leads to the deposit of certain chemicals in the pigs' meat which give off an unpleasant odour or taint during cooking. The sequence of events which leads to the taint is associated with the circulation in the blood of the hormone testosterone during the latter phases of fattening. Increased levels of testosterone may also increase the amount of fighting between intact males which leads to carcass damage.

In an attempt to prevent this problem, VIDO is working with the Government Industry Committee for the Marketing of Meat from Intact Male Pigs with the support of swine producers in the five Western Provinces. Our approach is to immunize intact male pigs against one of their own hormones, referred to as GnRH, which will lead to the lower levels of testosterone which should eliminate the problem of aggression and taint of the meat. We feel this will be a successful approach because over the years, VIDO has developed considerable technology for developing vaccines against infectious diseases. This includes expertise in microbiology, biotechnology, biochemistry and immunology. Therefore, the Organization is attempting to capitalize on this critical mass of technology by applying it to other economically important problems. If VIDO is successful in developing a vaccine against GnRH, this will have a number of benefits, including reducing the aggression and fighting amongst intact males, elimination of the taint problem, and also elimination of the need for surgical castration.

The Evolution of BIOSTAR Inc.

BIOSTAR Inc. is a federal company which was established by VIDO and the University of Saskatchewan in 1983 to commercialize developments made at VIDO. In 1989, BIOSTAR established BIOWEST Inc., a wholly-owned subsidiary to undertake manufacturing of products developed at VIDO. BIOSTAR Inc. is beneficially owned 100% by the University of Saskatchewan. As outlined in last year's Report, the University had entered into an arrangement with ExtraCare Corp. of Calgary which, if completed, would have seen ExtraCare acquire ownership of BIOSTAR and provide substantial new equity required to develop the Company. Unfortunately, the sale of BIOSTAR to ExtraCare was not completed and the arrangement between the University and ExtraCare has expired. BIOSTAR is currently exploring alternative ways of financing its corporate growth and development. If financing can be raised, the Company plans to proceed with building a manufacturing facility in Saskatoon to produce genetically-engineered vaccines for animals, and to expand the development of other discoveries made at VIDO or acquired from

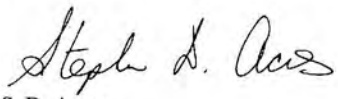
other sources. BIOSTAR is also currently exploring marketing agreements for its products both in Canada and internationally.

Board of Directors

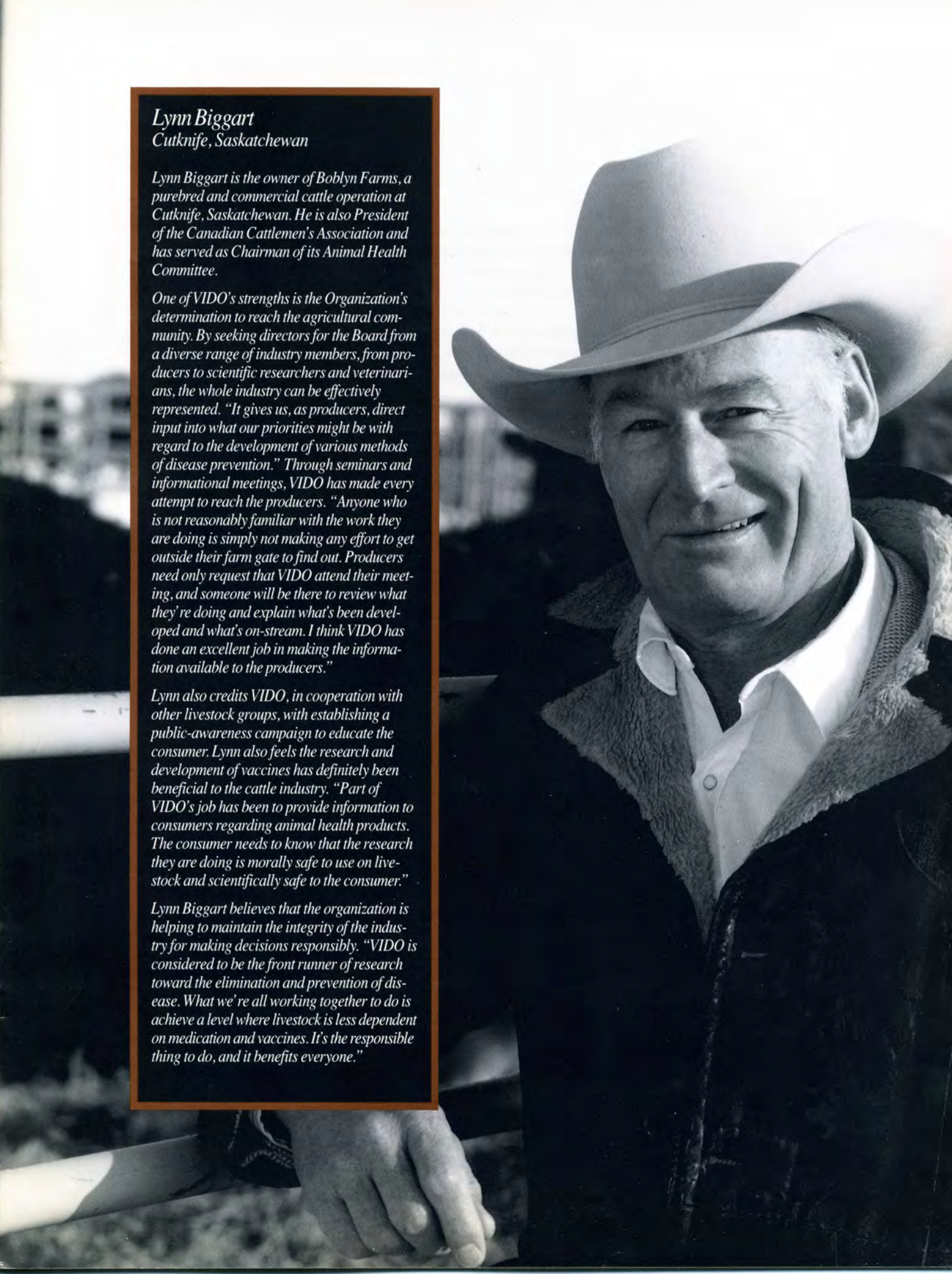
It is again a pleasure to acknowledge and thank VIDO's Directors for their guidance and support. The VIDO Board is comprised of thirteen individuals representing the livestock industry, the business community, the University of Saskatchewan, and federal and provincial governments. It is my privilege to thank Art Rampton of Dauphin, Manitoba who retired from the Board after four years of service, and Stuart Kramer, Deputy Minister of Saskatchewan Agriculture and Food, who retired after seven years of service on the Board. I would also like to acknowledge the long extensive contributions of Dr. Ralph Christian and Dr. Gavin Hamilton who were both reappointed to serve their third terms on the Board. It is also a pleasure to welcome as new directors Al Hingston representing Saskatchewan Agriculture and Food, and Bob Byle, a poultry producer from Winnipeg, Manitoba.

Staff

I would also again like to thank each member of VIDO's staff. Their combined talents, hard work, and enthusiasm make VIDO a vibrant and relevant research organization.



S. D. Acres



Lynn Biggart
Cutknife, Saskatchewan

Lynn Biggart is the owner of Boblyn Farms, a purebred and commercial cattle operation at Cutknife, Saskatchewan. He is also President of the Canadian Cattlemen's Association and has served as Chairman of its Animal Health Committee.

One of VIDO's strengths is the Organization's determination to reach the agricultural community. By seeking directors for the Board from a diverse range of industry members, from producers to scientific researchers and veterinarians, the whole industry can be effectively represented. "It gives us, as producers, direct input into what our priorities might be with regard to the development of various methods of disease prevention." Through seminars and informational meetings, VIDO has made every attempt to reach the producers. "Anyone who is not reasonably familiar with the work they are doing is simply not making any effort to get outside their farm gate to find out. Producers need only request that VIDO attend their meeting, and someone will be there to review what they're doing and explain what's been developed and what's on-stream. I think VIDO has done an excellent job in making the information available to the producers."

Lynn also credits VIDO, in cooperation with other livestock groups, with establishing a public-awareness campaign to educate the consumer. Lynn also feels the research and development of vaccines has definitely been beneficial to the cattle industry. "Part of VIDO's job has been to provide information to consumers regarding animal health products. The consumer needs to know that the research they are doing is morally safe to use on livestock and scientifically safe to the consumer."

Lynn Biggart believes that the organization is helping to maintain the integrity of the industry for making decisions responsibly. "VIDO is considered to be the front runner of research toward the elimination and prevention of disease. What we're all working together to do is achieve a level where livestock is less dependent on medication and vaccines. It's the responsible thing to do, and it benefits everyone."

REPORT FROM THE EXECUTIVE OFFICER

P. G. Hodgman

"*For those agri-business managers planning to be rescued by a commodity price resurgence, there may be short-term hope but longer-term commodity and price trends can be safely forecast as trending downward...*" Patrick M. Moncrieff, Former Chairman, VIDO Board of Directors, President, Moncrieff Agri Business Ltd.

Agri-business managers continue to look for ways that will help them understand fluctuations in their industry's costs and prices. An essential component of this process is trend analysis which helps individuals and organizations better understand their business environment.

Over the long term in a competitive commodity market, costs and prices tend to equate and to move downward. A prime example is farm commodity prices which not only tend to follow this downward movement but are generally below these long-term trend lines. Although there may be some short-term relief in farm commodity prices, producers should not count on this for their long-term profitability.

In order to adjust to the longer term, the methods of doing business on Canadian farms and in agri-business in general will have to change. There is a strong need to bring down the costs per unit of output. The answer as to how this can be achieved is relatively straight forward and consistent with past experience — that answer being — enhanced productivity. Increased productivity and throughput are attained in two ways. Firstly, the immediate and more tangible way is to incorporate new productivity enhancing technology. Secondly, the less tangible but equally as important way is to improve management techniques. Both offer opportunities in which costs per unit of output can be brought down and bring high returns at the same time.

How does VIDO fit into this likely scenario? Our goals clearly state that the Organization is to conduct research which helps provide higher quality food to consumers, reduce the suffering and wastage of animals due to disease, and improve the economic well-being of producers and the agrifood system. Our research is sharply focused and closely managed to achieve the above by providing safe, efficacious, cost effective animal health and performance products and improved management techniques. Modern animal health and performance products must do two things: provide a lower cost of doing business, and offer a distinct production advantage. VIDO has the technical capabilities and creative knowledge, skills, and leadership to develop these new products on a world class basis. Of the seven products VIDO has commercialized, three were world firsts. However, vaccines and products alone are not the entire solution — improved effective management is essential. The Organization has provided new information on specific diseases by publishing Fact Sheets and improved housing information for swine producers contained in Technical Bulletins, all of which are allowing Canadian producers to gain long-term production and profit advantages. Thus the utilization of new information systems and advanced technologies are having a long-term impact on agriculture.

Another effect of the downward trend lines in agriculture commodity prices, is to force producers and agri-business to continually innovate. If individuals and industries do not do so, their future success will depend entirely on cost/price reductions which are tenuous at best.

Innovation is a key to success for publicly and privately funded research organizations such as VIDO. Until recently, organizations, universities and to some extent agri-business have developed products and services from an internal perspective, that is, "the consumer will adapt to what we develop or sell." In the past, this approach has served some organizations well. Today, a great deal more attention is being given to defining the organization's or company's mission as "serving the needs of the end-user." If fulfilling the needs of the customer is indeed the reason for one to exist, it is reasonable to expect that R & D will provide results that fill customer needs within an acceptable time and at an acceptable quality and price.

VIDO uses the above approach of "serving the needs of the livestock industry" by tackling only those problems that the livestock industry deems of great economic importance to them. Before initiating any new project, VIDO assesses several things:

1. Is this a major industry problem of significant economic value?
2. What research is already underway internationally in the field? That is, can VIDO make a real contribution and can we make it before other researchers?
3. Do we have the technical expertise to carry out the project?
4. Is the project fundable?

The use of advanced technologies such as biotechnology, genetic engineering, and modern immunology is allowing progress to be made on difficult pathogens, organisms, and production limiting factors. Past advances were not as great as they could be because of limited knowledge and the lack of proper research tools. In the early 1980's, VIDO made a commitment to become a leader in the development and evaluation of vaccines, biotechnology and immunology, by investing in quality scientists. This investment is now starting to pay off with new products and techniques becoming available at an ever increasing rate. Innovation and aggressiveness will enable VIDO to stay on the cutting edge of science so that the livestock industry will benefit from our efforts on their behalf.

The moral to be drawn from the lessons of the trend lines and innovation is that there is a national need for a high degree of competitive technological advances and their rapid adoption by managers to ensure that industry and individuals remain viable, competitive and profitable.

P. G. Hodgman

REPORT FROM THE ASSOCIATE DIRECTOR (RESEARCH)

L. A. Babiuk

Today we hear much about competitiveness and Canada's position in the global economy. I feel that we can become competitive only if we combine the latest technology with dedicated people and provide them with facilities and an environment which challenges them to be productive and creative. Under these conditions, research will provide industry with the tools to be competitive. Since pride comes with achievement and increases the motivation to do even better, VIDO has attempted to create an environment that motivates talented individuals to increase their competitiveness and achieve their maximum potential. This pride of achievement combined with a focused effort at solving relevant problems is the foundation of our research programs. In the present report I will focus on a few highlights of our achievement in the past year.

New Vaccines

During the past year VIDO continued its success towards commercialization of their research efforts by obtaining licenses to three new vaccines. These new vaccines were produced and marketed by BIOSTAR Inc. during the latter part of this year. Pneumo-Star™ is one of the world's first recombinant DNA subunit vaccines produced and licensed for use in animals. The advantage of this vaccine is that it contains large quantities of one of the most important protective components of *Pasteurella haemolytica*, the cause of pneumonia in cattle and sheep. It has been known for a number of years that leukotoxin produced by *P. haemolytica* is secreted from the bacterium and therefore is not present in conventional bacterins. One of the properties of leukotoxin is that it can kill the immune cells that are attempting to clear the bacteria from the lungs of infected animals. Thus it was proposed that a vaccine against leukotoxin would help the animals' normal defense mechanism to eliminate *P. haemolytica* infection. Unfortunately, this component is produced in very small quantities when *P. haemolytica* is grown under normal conditions, thus making it difficult to produce sufficient quantities of this component to use as a vaccine. Researchers at VIDO, led by Dr. Andrew Potter, were able to use genetic engineering technology to isolate the gene from *P. haemolytica* that is responsible for producing the leukotoxin, and introduce the gene into a strain of *Escherichia coli*. Using these manipulations it has been possible to not only increase the quantity of leukotoxin produced but also to change the properties of leukotoxin in such a way that it is highly immunogenic but no longer toxic. Thus in one step we have removed the toxic properties of the leukotoxin without altering its ability to stimulate immunity, and have increased the concentration of this important component in the vaccine. Studies are continuing to identify additional components present on the outer surface of *P. haemolytica* to combine with the leukotoxin to make a totally genetically engineered second generation vaccine containing leukotoxin plus outer-membrane proteins. It is anticipated that a field trial with the second generation Pasteurella vaccine will be conducted next year.

The second vaccine that was licensed is designed to prevent *Haemophilus somnus* in cattle. This vaccine called Somnu-Star™ is comprised of a bacterial extract containing the outer surface proteins of *H. somnus* cells. Using this approach it is possible to concentrate the important protective proteins of the bacteria and separate them from the internal proteins which have very little relevance to protection. Based on experimental trials this approach proved to be very effective for producing a vaccine against *H. somnus*. We are now working on a second generation *H. somnus* vaccine by identifying the individual

protective proteins of *H. somnus* and to use genetic engineering techniques to produce large quantities of them, similar to that described above for *P. haemolytica*.

The third vaccine named Somnu-Star Ph™ combined *P. haemolytica* and *H. somnus* into a single product designed to control both diseases.

Actinobacillus pleuropneumoniae

Last year I reported that we had anticipated that a vaccine would be available by the end of this fiscal year against *A. pleuropneumoniae*. Since there are a number of different types (serotypes) of *A. pleuropneumoniae* it was important to find specific proteins that would protect against all the different serotypes of bacteria that cause disease in pigs. Our initial approach was to develop an extract similar to that described above for *H. somnus*. Such an extract was found to be effective under experimental conditions against some serotypes. However, it was not protective against all the serotypes. Therefore, we continued this project to identify the important protective proteins in the extract and to produce them by genetic engineering methods. Using this approach we have identified protective proteins that protect pigs against the important serotypes and are also safer for use in pigs than the extract. Thus, we have delayed our field studies with the extract and are initiating studies with the purified components. It is anticipated that the one-year delay in field testing and licensing the vaccine will be well worth the wait with regards to both safety and efficacy of these products.

***E. coli* septicemia**

E. coli septicemia has become very prevalent in the turkey population, especially in animals which are stressed or infected with specific viruses. This combination of pathogens results in a generalized infection of the blood, internal organs and air sacs. The approach that we are using to control this disease is to "cripple" field strains of *E. coli* by removing the portion of their genetic material which is responsible for causing disease, but which does not prevent the bacteria from replicating in the intestine of the bird. We have been successful in crippling the *E. coli* and are now in the process of testing its ability to immunize poults. If this approach is successful, the crippled *E. coli* will be administered in the drinking water. This approach to immunization should prove to be extremely economical both with regards to production as well as administration of the vaccine.

Enzootic pneumonia

In addition to producing vaccines, VIDO has continued to conduct investigations designed to assess risk factors associated with disease. One of these projects focused on enzootic pneumonia. The objectives of this study were: (1) to determine the prevalence, occurrence and economic losses from enzootic calf pneumonia in Saskatchewan dairy herds and, (2) to identify immunological, infectious, and environmental factors which increase the risk of pneumonia.

Three hundred and thirty-six calves were clinically examined for the presence of pneumonia every 2 weeks during the study by research veterinarian Dr. Joyce Van Donkersgoed. Samples were collected for serological and immunological assays. Producers maintained calving and treatment records as well as their own clinical assessment of whether calves had pneumonia or not.

Pneumonia was found to be the most common disease problem in dairy calves in the Saskatoon area. In total, 38% of the calves were treated for pneumonia by producers, however, this risk varied from between 0-91% among herds. The average age of treatment for pneumonia was 27 days of age. The death rate from pneumonia was 1.8% and ranged from 0-7% among herds. A variety of viruses and bacteria were isolated from pneumonic lungs of calves which died, including bovine respiratory syncytial virus, parainfluenza-3 virus, *Pasteurella haemolytica, Pasteurella multocida* and *Corynebacteria pyogenes*. Average treatment costs and death losses from pneumonia were $7.00/calf born, but ranged from between $0-$20.00/calf in different herds.The risk factors found to be significantly associated with the occurrence of pneumonia included the following.

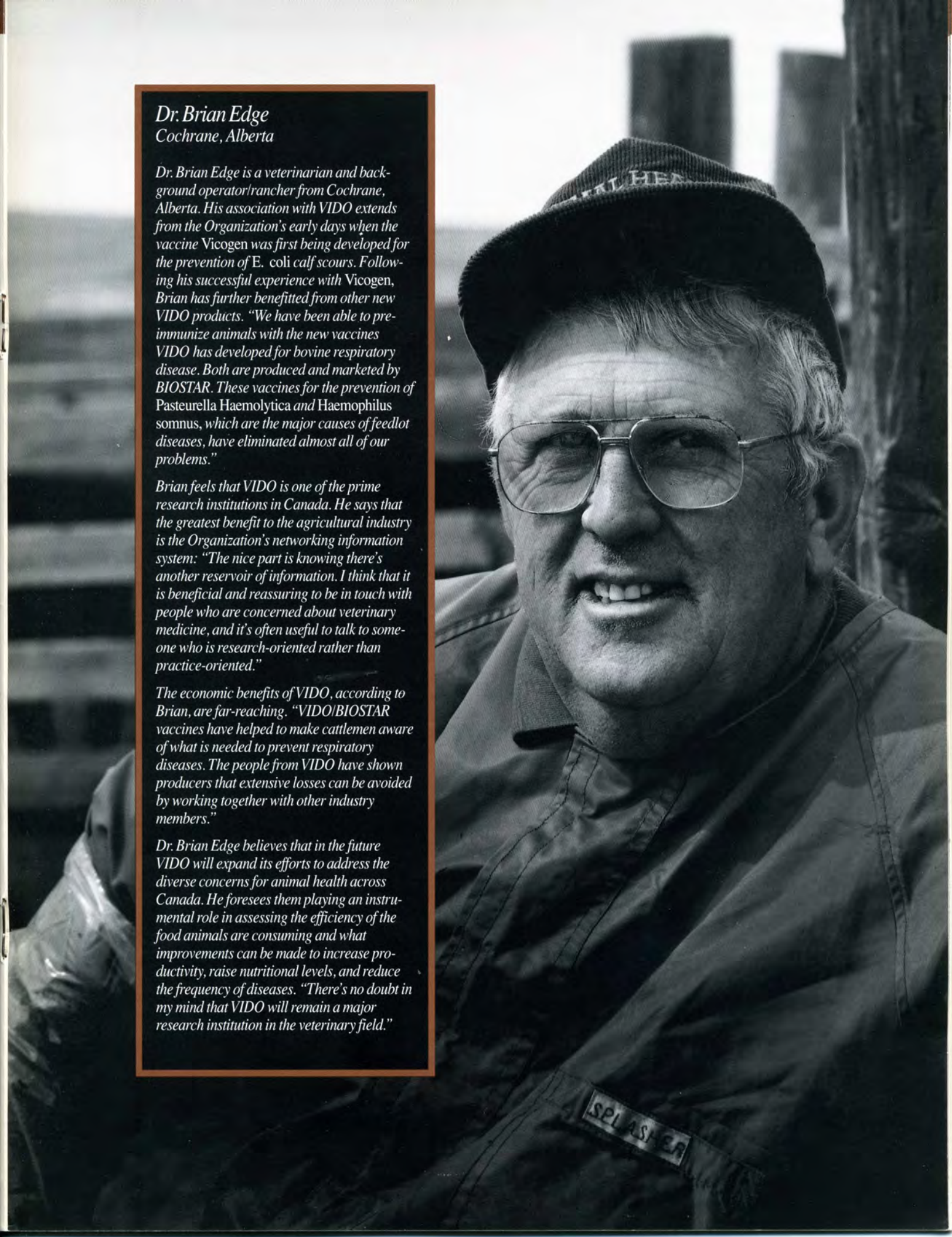
(1) Calves with inadequate levels of colostral antibodies were 2.6 times more likely to develop pneumonia than those with adequate levels of colostral antibodies. These studies reinforce the need for producers to ensure adequate colostral intake by new-born calves. Growth rates during the first month of age were also lower in calves with low levels of colostral antibodies. Growth rates in calves with pneumonia were also lower than in healthy calves.

(2) The risk of pneumonia in a herd increased as the number of calves in the herd increased. This probably occurs because the level of infectious organisms and the transmission rate increased as the stocking density or duration of confinement increased.

(3) The risk of pneumonia in a herd increased as the proportion of Holstein calves in the herd increased (in comparison with cross-bred calves). This may reflect differences in genetic resistance to disease or be due to management factors. These factors could not be adequately assessed in this limited study.

(4) *In vitro* analysis of the animal's white blood cells demonstrated that some animal's white blood cells were less active than other animals. Those animals with less active white cells had a higher chance of developing pneumonia. These studies suggest a role of immune systems and development of the disease. Further studies are required to determine what specific genetic, environmental and nutritional factors cause lowered immune responsiveness so that this could be reversed.

(5) There was no association between the risk of pneumonia and the level of colostral antibody to any one specific viral or bacterial pathogen. This suggests that pneumonia may be caused by a variety of different infectious organisms, and that specific infectious causes of pneumonia may vary among herds, among calves and over time. Furthermore, pathogens not involved in pneumonia, (i.e. those that cause scours) also increase the risk of pneumonia. Thus a vaccine would need to provide protection against a wide spectrum of common infectious organisms.



Dr. Brian Edge
Cochrane, Alberta

Dr. Brian Edge is a veterinarian and background operator/rancher from Cochrane, Alberta. His association with VIDO extends from the Organization's early days when the vaccine Vicogen *was first being developed for the prevention of* E. coli *calf scours. Following his successful experience with* Vicogen, *Brian has further benefitted from other new VIDO products. "We have been able to pre-immunize animals with the new vaccines VIDO has developed for bovine respiratory disease. Both are produced and marketed by BIOSTAR. These vaccines for the prevention of* Pasteurella Haemolytica *and* Haemophilus somnus, *which are the major causes of feedlot diseases, have eliminated almost all of our problems."*

Brian feels that VIDO is one of the prime research institutions in Canada. He says that the greatest benefit to the agricultural industry is the Organization's networking information system: "The nice part is knowing there's another reservoir of information. I think that it is beneficial and reassuring to be in touch with people who are concerned about veterinary medicine, and it's often useful to talk to someone who is research-oriented rather than practice-oriented."

The economic benefits of VIDO, according to Brian, are far-reaching. "VIDO/BIOSTAR vaccines have helped to make cattlemen aware of what is needed to prevent respiratory diseases. The people from VIDO have shown producers that extensive losses can be avoided by working together with other industry members."

Dr. Brian Edge believes that in the future VIDO will expand its efforts to address the diverse concerns for animal health across Canada. He foresees them playing an instrumental role in assessing the efficiency of the food animals are consuming and what improvements can be made to increase productivity, raise nutritional levels, and reduce the frequency of diseases. "There's no doubt in my mind that VIDO will remain a major research institution in the veterinary field."

In conclusion, our study has identified a number of factors which may predispose calves in the development of enzootic pneumonia. Through various management practices, the level of colostral antibodies in calves can be increased and stocking density reduced, thereby reducing the risk of pneumonia.

Increased Performance Through Immunology

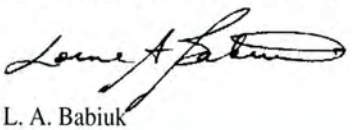
For the past number of years VIDO has invested a considerable amount of effort into understanding the animal's response to infectious diseases. During these investigations we have developed a much better understanding of the immune system and how it can be used to increase the animal's resistance to infection. In collaboration with investigators at the University of Saskatchewan, Growth and Reproductive Immunology Program (GRIP) we have also demonstrated that some hormones can influence disease resistance. Building on this knowledge we saw an opportunity to improve the welfare of animals and to reduce their suffering by using immunological approaches to modulate some of the animal's natural physiological mechanisms. This can be done by developing vaccines to regulate the levels of some hormones.One example of this approach is to use immunology to reduce the problem of aggression and "boar taint" in male pigs. By developing a vaccine against the hormone GnRH, the level of testosterone can be reduced in intact males. This reduces aggression and the damage which occurs as a result of fighting, improves growth, and provides higher quality, leaner carcasses for consumers. It also eliminates the need to castrate animals, thereby reducing the pain of castration.

Immunosuppression by Modified-Lived Viral Vaccines

Cattle are often injected with multiple vaccines on entry into feedlots. Since it is well known that some viruses can cause immunosuppression we attempted to determine whether modified live viruses could also lower the animal's ability to fight off infection and interfere with responses to other vaccines administered simultaneously. Based on this hypothesis we conducted a series of experiments to determine what effect modified-live virus vaccines had on immune responses to bacterial vaccines given at the same time. Although these studies are preliminary, they clearly indicate that modified-live virus vaccines, containing bovine herpesvirus-1 and parainfluenza-3 viruses, were capable of reducing the ability of calves vaccinated at feedlot entry to develop immunity to other vaccines. They also increased the animal's susceptibility to bacterial infection as demonstrated by an increase in respiratory disease. Delaying the administration of modified-live virus vaccines to 14 days after entry into the feedlot also resulted in an increase in morbidity at that time. Therefore, these results clearly indicate that modified-live virus vaccines can lower the animal's resistance to infection under some circumstances. These studies have tremendous implications regarding the use of modified-live virus vaccines in cattle entering feedlot situations. Similar effects were not observed when animals were immunized with subunit viral vaccines and this provides further impetus for our studies designed to develop safer and more effective vaccines through genetic engineering.

Summary

In many businesses, location is the major factor to success. In research and development, people are the most important component because they are the engine of discovery and innovation. The dedicated staff at VIDO deserve a special thanks for their commitment to the Organization and to the livestock industry. Quality does not occur by accident, but rather by individuals prepared to make intelligent choices, followed by dedicated efforts to do their best. These are the types of personnel VIDO has been fortunate enough to recruit. I thank them all for their dedication and support during this past year.



L. A. Babiuk

DR. ALFRED SAVAGE - VIDO RESEARCH FUND ESTABLISHED

Friends of the late Dr. Alfred Savage of Winnipeg have provided $50,000.00 to establish a 20-year endowment to support research at VIDO. During the endowment period, approximately 80% of the Fund's annual interest earnings will be available to VIDO to help pay for research materials, equipment, and the housing and maintenance of experimental animals. The remaining 20% of the annual interest will be added to the principal so that it will grow, allowing the annual allocation to increase over time. At the end of the endowment period, the capital and accumulated interest of the Fund will be available to VIDO for use at the discretion of its Board of Directors.

Dr. Savage was born in Montreal in 1889 and became widely known in Canada and internationally for his contributions to veterinary medicine and agriculture. He earned several advanced degrees including a BSA (McGill University, 1911); DVM (Cornell University, 1914); and MRCVS (Edinborough Royal Dick, 1928). Dr. Savage taught at Macdonald College, the Agricultural College of Winnipeg, and later the University of Manitoba where he served as Professor of Animal Pathology from 1921 to 1964. During this time he also served as Head of the Department of Animal Pathology and Bacteriology, Dean of Agriculture, and was Provincial Animal Pathologist for the Manitoba Department of Agriculture from 1938 to 1955.

Throughout his career, Dr. Savage was an active member of the veterinary profession, the agricultural community, and society at large. He was a Past President and Life Member of the Canadian Veterinary Medical Association, Honorary Member of the American Veterinary Medical Association and Life Member of the Manitoba Veterinary Medical Association. The Fellowship of the Royal College of Veterinary Surgeons was bestowed on Dr. Savage in 1963 for "meritorious contributions to learning." Dr. Savage was widely known within the agricultural community particularly in Western Canada. For several years he wrote a column which was published by The Western Producer under the title "Doc Savage Says," which consisted of veterinary advice in response to letters sent to the paper by livestock producers. Dr. Savage died in Winnipeg in 1970 and is survived by his wife, Mary, now living in Edmonton, and two children.

The friends of Dr. Savage, who established the Fund, have made donations to VIDO as part of their estate planning process. Other friends and colleagues of Dr. Savage who wish to contribute to the Fund may do so by contacting VIDO.

REPORT FROM THE MANAGER
FINANCIAL OPERATIONS

K. B. Barteski

Financial Review

VIDO's 1991 total income remained essentially unchanged from the previous year; $4,274,626 in 1991 compared to $4,265,031 in 1990. Even though several new grants were received during the year, the additional income from these was offset by the loss of income from other grants, the terms and conditions of which were completed during the year. Schedule 2 of the accompanying Audited Financial Statements identifies the fluctuations in VIDO's conditional grant income. Schedule 1 outlines in detail the sources of donations and unconditional grants.

Conditional grant income accounted for 53.6% of total income in 1991, an increase of 2.5% from 1990 and an increase of 8% from 1987 (See figure 1). This shift towards conditional funding has resulted in a corresponding reduction in the funds available to cover infrastructure costs such as secretarial, office administration, research support, glassware and media, patenting costs, etc. Ironically, as more work is required to meet the conditions of the increasing number of conditional grants, a higher level of funding is needed for infrastructure costs, yet less money is available to allocate to these costs. It is becoming increasingly more difficult to fund the research support services required to ensure VIDO's scientific excellence remains unaffected.

Total expenditures increased by $195,884 to $4,341,144 or 4.7% over 1990. The majority of this increase can be attributed to increases in salaries and fringe benefits. Staff levels remained relatively consistent with the prior year. The marked reduction in the level of spending on materials and supplies is directly related to a focused effort to become more cost conscious. The increase in patent and legal fees is evidence of VIDO's aggressive patent policy. The increased costs are reflective of the larger number of patents in process and the increased filing fees required as patent applications near acceptance in a number of jurisdictions.

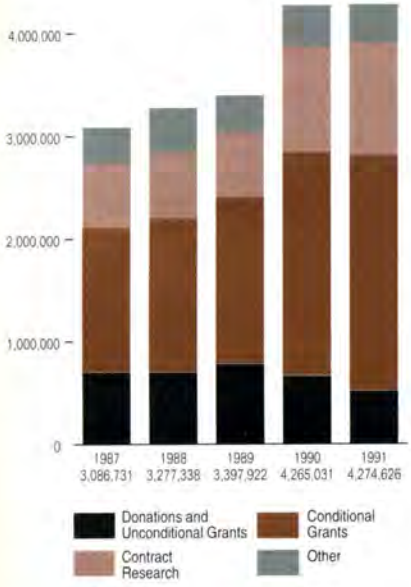


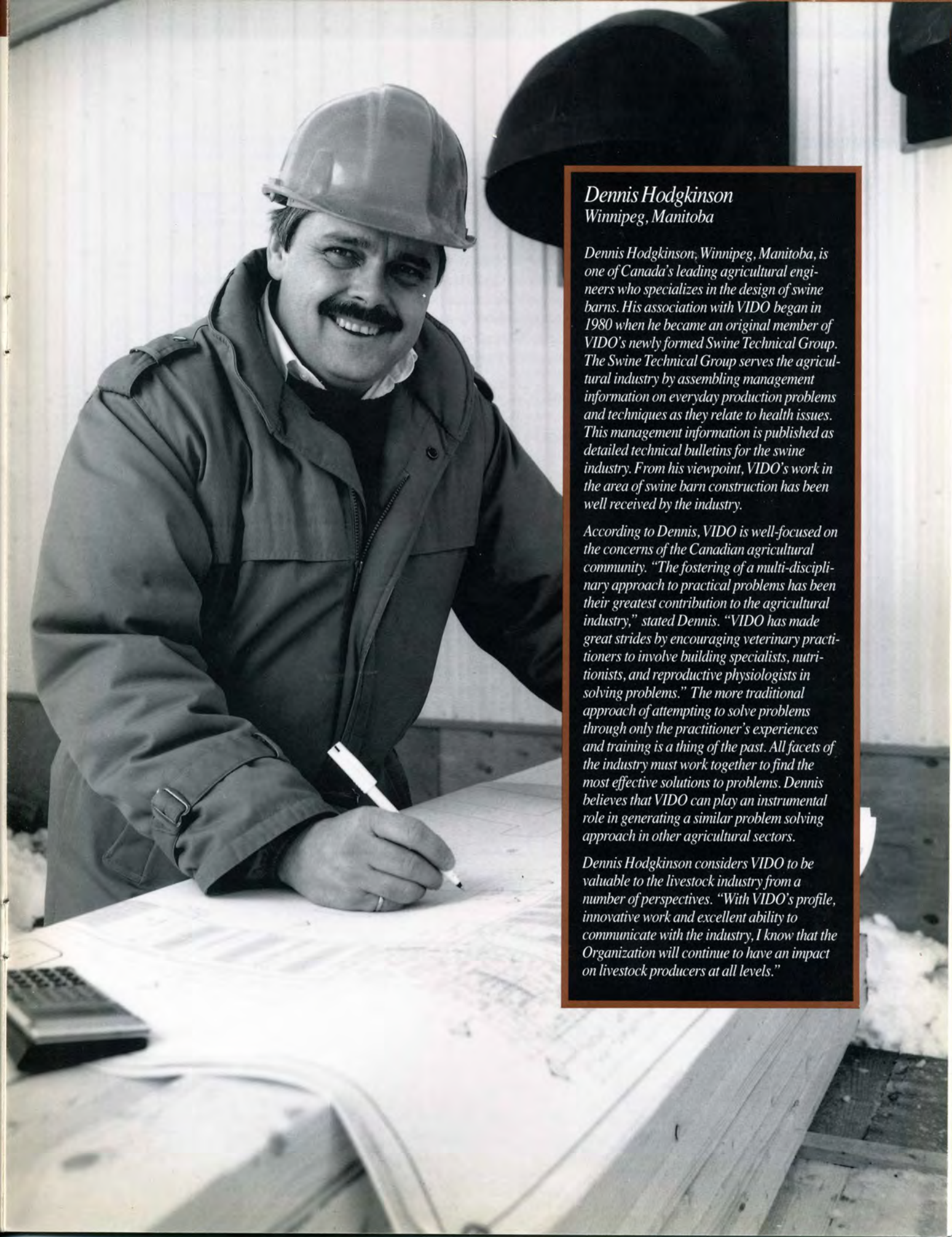
Figure 1

The increase in total expenditures coupled with the relative stability in total income resulted in an excess of expenditure over income, or decrease in the Research Trust Fund balance, of $66,518 for the year. This compares to an excess of income over expenditure, or increase in the Research Trust Fund balance of $119,771 in 1990. The Research Trust Fund balance was further reduced by a transfer of $15,000 to the Capital Trust Fund for future capital expenditures. The net effect of the above two items on the Research Trust Fund was to reduce the balance in the Fund to $1,215,681 at September 30, 1991. This is the lowest the Fund Balance in the Research Trust Fund has been for the past ten years.

Current income projections indicate VIDO's 1992 income will approximate that of 1991. This reality has required that VIDO's 1992 operating budget be set at $4.2M which is less than the $4.3M in total expenditures incurred this year. The Organization will require a concerted effort by everyone to ensure expenditures are within the established budget.

VIDO must continue to aggressively seek income from existing as well as innovative sources to ensure that its research focus is not adversely affected. Every effort will be directed towards this task and I am confident that the appropriate levels of funding will be obtained.This past year has been a demanding year for everyone at VIDO as we strive to become more cost effective. I would like to thank everyone for contributing towards the reduction of expenditures throughout the year. I would also like to express my thanks to Deanna Kirchmeier and Marilee Hagen for their continued commitment and dedication in assisting me in my responsibilities. In addition, the assistance and direction provided by Paul Hodgman and Drs. Acres and Babiuk has been most helpful.

K. B. Barteski



Dennis Hodgkinson
Winnipeg, Manitoba

Dennis Hodgkinson, Winnipeg, Manitoba, is one of Canada's leading agricultural engineers who specializes in the design of swine barns. His association with VIDO began in 1980 when he became an original member of VIDO's newly formed Swine Technical Group. The Swine Technical Group serves the agricultural industry by assembling management information on everyday production problems and techniques as they relate to health issues. This management information is published as detailed technical bulletins for the swine industry. From his viewpoint, VIDO's work in the area of swine barn construction has been well received by the industry.

According to Dennis, VIDO is well-focused on the concerns of the Canadian agricultural community. "The fostering of a multi-disciplinary approach to practical problems has been their greatest contribution to the agricultural industry," stated Dennis. "VIDO has made great strides by encouraging veterinary practitioners to involve building specialists, nutritionists, and reproductive physiologists in solving problems." The more traditional approach of attempting to solve problems through only the practitioner's experiences and training is a thing of the past. All facets of the industry must work together to find the most effective solutions to problems. Dennis believes that VIDO can play an instrumental role in generating a similar problem solving approach in other agricultural sectors.

Dennis Hodgkinson considers VIDO to be valuable to the livestock industry from a number of perspectives. "With VIDO's profile, innovative work and excellent ability to communicate with the industry, I know that the Organization will continue to have an impact on livestock producers at all levels."

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, 1991 and the statements of income, expenditure and fund balance (Research Trust and Capital 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, 1991 and the results of its operations and the changes in its financial position for the year then ended in accordance with the accounting policies described in Note 2.

Deloitte & Touche

Deloitte & Touche
Chartered Accountants
December 19, 1991
Saskatoon, Saskatchewan

University of Saskatchewan
Veterinary Infectious Disease Organization (VIDO)

RESEARCH TRUST STATEMENT OF INCOME, EXPENDITURE AND FUND BALANCE

Year Ended September 30, 1991

	1991	1990
INCOME		
Donations and unconditional grants (Schedule 1)		
Livestock and poultry industries - beef	$ 119,950	$ 120,700
- dairy	71,000	71,000
- swine	101,179	101,154
- turkey	44,200	37,000
Provincial governments	80,500	230,500
Other contributors	100,200	100,000
	517,029	660,354
Conditional grants (Schedule 2)	2,292,307	2,180,501
Contract research		
Commercial	727,619	879,194
Government	373,463	150,000
Contract services	55,189	49,373
Royalties	24,567	29,768
Interest	124,751	168,020
Animal Services	124,301	111,821
License fees	35,400	36,000
	4,274,626	4,265,031
EXPENDITURE		
Salaries and fringe benefits	2,336,214	2,109,581
Materials and supplies	751,858	853,044
Animal services	409,721	304,952
Equipment and service agreements	244,628	336,557
Travel and recruiting	131,556	172,828
Patents and legal fees	151,450	51,748
Other (Note 7)	315,717	316,550
	4,341,144	4,145,260
EXCESS OF (EXPENDITURE OVER INCOME) INCOME OVER EXPENDITURE	(66,518)	119,771
FUND BALANCE, BEGINNING OF YEAR	1,297,199	1,366,696
	1,230,681	1,486,467
TRANSFER TO CAPITAL TRUST	(15,000)	(189,268)
FUND BALANCE, END OF YEAR	$1,215,681	$1,297,199

University of Saskatchewan
Veterinary Infectious Disease Organization (VIDO)

CAPITAL TRUST STATEMENT OF INCOME, EXPENDITURE AND FUND BALANCE

Year Ended September 30, 1991

	1991	1990
EXPENDITURE		
Furnishings, fixtures and equipment	$ –	$ 12,969
Buildings	–	49,235
	–	62,204
FUND BALANCE, BEGINNING OF YEAR	–	(127,064)
	–	(189,268)
TRANSFER FROM RESEARCH TRUST	15,000	189,268
FUND BALANCE, END OF YEAR	$ 15,000	$ –

APPROVED BY THE BOARD:

Director

Trustee

COMBINED BALANCE SHEET

September 30, 1991

University of Saskatchewan
Veterinary Infectious Disease Organization (VIDO)

	1991	1990
ASSETS		
Current Assets		
Funds held by University of Saskatchewan	$ 14,108	$ 262,303
Due from University of Saskatchewan - operating fund	1,031,958	865,082
Accounts receivable (Note 3)	1,120,738	785,234
Inventories (Note 4)	98,968	104,463
	2,265,772	2,017,082
Investments (quoted market value $508,432; 1990 - $554,440)	508,639	558,701
Plant 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
	$8,417,662	$8,219,034
LIABILITIES		
Current Liabilities		
Accounts Payable	$ 14,458	$ 26,010
Deferred revenue (Note 5)	1,479,272	1,177,574
Current portion of loan payable	25,000	25,000
	1,518,730	1,228,584
Loan Payable (Note 6)	25,000	50,000
	1,543,730	1,278,584
EQUITY		
Capital Assets	5,643,251	5,643,251
Research Trust	1,215,681	1,297,199
Capital Trust	15,000	–
	6,873,932	6,940,450
	$8,417,662	$8,219,034

COMBINED STATEMENT OF CHANGES IN FINANCIAL POSITION

Year Ended September 30, 1991

University of Saskatchewan
Veterinary Infectious Disease Organization (VIDO)

	1991	1990
OPERATING ACTIVITIES		
Working capital from operations		
Research Trust excess of (expenditure over income) income over expenditure	$ (66,518)	$ 119,771
Changes in non-cash operating working capital		
Due from University of Saskatchewan	(166,876)	(66,588)
Accounts receivable	(335,504)	(372,713)
Inventories	5,495	(3,815)
Accounts payable	(11,552)	(12,376)
Deferred revenue	301,698	(132,706)
Cash used in operating activities	(273,257)	(468,427)
INVESTING ACTIVITIES		
Reductions in investments	50,062	69,988
Capital Trust excess of expenditure over income	–	(62,204)
Cash provided by investing activities	50,062	7,784
FINANCING ACTIVITIES		
Repayment of loan payable	(25,000)	(25,000)
Cash used in financing activities	(25,000)	(25,000)
(DECREASE) IN CASH	(248,195)	(485,643)
CASH, BEGINNING OF YEAR	262,303	747,946
CASH, END OF YEAR	$ 14,108	$ 262,303

Cash represents funds held by the University of Saskatchewan

University of Saskatchewan
Veterinary Infectious Disease Organization (VIDO)

NOTES TO THE FINANCIAL STATEMENTS

September 30, 1991

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 balance sheet and statement of changes in financial position have been presented on a combined basis reflecting the activities of both funds.

Capital assets

Capital assets are recorded as Capital Trust expenditures when purchased. The same assets are included in the balance sheet as plant assets offset by the "equity in capital assets" 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.

Deferred 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

	1991	1990
Donations and unconditional grants	$ 115,000	$ 18,500
Conditional grants (Schedule 2)	259,088	255,965
Contract research	690,114	423,604
Contract services	13,505	–
Royalties	21,288	26,805
Accrued interest	21,743	24,360
License fees	–	36,000
	$1,120,738	$ 785,234

4. INVENTORIES

	1991	1990
Animals	$ 63,108	$ 58,905
Materials and supplies	35,860	45,558
	$ 98,968	$ 104,463

5. DEFERRED REVENUE

	1991	1990
Donations and unconditional grants	$ 125,000	$ 25,000
Conditional grants (Scedule 2)	1,109,479	1,044,647
Contract research	244,793	107,927
	$1,479,272	$1,177,574

6. LOAN PAYABLE

The loan payable is interest free and repayable to the University of Saskatchewan in equal installments of $25,000 per annum ending October 1, 1993.

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 owns 82% of BIOSTAR Inc. whose primary purpose is to assist VIDO in both research and development of its products and technologies. During the year VIDO had the following transactions with BIOSTAR Inc.:

	1991	1990
Income from BIOSTAR Inc. to VIDO		
Contract research	$ 148,267	$ 158,185
Contract services	55,189	49,373
Material purchases	19,391	7,714
Sponsorship of two industrial research chairs at VIDO in conjunction with NSERC	122,157	106,518
Expenditure by VIDO to BIOSTAR Inc.		
Management service fees	26,206	27,600
Research and Veterinary Services	77,815	114,906
Equipment lease	20,757	20,400

At September 30, 1991 the Organization has a receivable from BIOSTAR Inc. of $115,458. (1990 - $56,946).

10. COMPARATIVE FIGURES

Certain of the prior year's figures have been reclassified to conform to the current year's presentation.

Schedule 1

SCHEDULE OF DONATIONS AND UNCONDITIONAL GRANTS

Year ended September 30, 1991

University of Saskatchewan
Veterinary Infectious Disease Organization (VIDO)

	1991	1990
LIVESTOCK AND POULTRY INDUSTRIES		
Beef		
Alberta Cattle Commission	$ 36,750	$ 35,000
British Columbia Cattlemen's Association	5,000	5,000
Kamloops Stockmen's Association	700	700
Manitoba Cattle Producers Association	2,500	5,000
Saskatchewan Cattle Marketing Deductions Fund	75,000	75,000
	119,950	120,700
Dairy		
Alberta Milk Producers' Society	10,000	10,000
Fraser Valley Milk Producers Cooperative Association	1,000	1,000
Manitoba Milk Producers' Marketing Board	10,000	10,000
Saskatchewan Dairy Producers Co-operative Limited	50,000	50,000
	71,000	71,000
Swine		
Alberta Pork Producers Development Corporation	41,291	41,738
B.C. Hog Marketing Commission	6,535	6,431
Manitoba Pork est.	33,262	33,187
Saskatchewan Pork Producers Marketing Board	18,912	18,644
Swine Improvement Services Co-operative (SISCO)	1,179	1,154
	101,179	101,154
Turkey		
Alberta Turkey Growers' Marketing Board	–	10,619
B.C. Turkey Marketing Board	–	12,654
Canadian Turkey Marketing Agency	44,200	–
Manitoba Turkey Producers' Marketing Board	–	8,991
Saskatchewan Turkey Producers' Marketing Board	–	4,736
	44,200	37,000
PROVINCIAL GOVERNMENTS		
Alberta	50,000	50,000
British Columbia	15,000	15,000
Manitoba	15,500	15,500
Saskatchewan	–	150,000
	80,500	230,500
OTHER CONTRIBUTORS		
The W. Garfield Weston Foundation	100,000	100,000
Individuals	200	–
	100,200	100,000
	$ 517,029	$ 660,354

Schedule 2

SCHEDULE OF CONDITIONAL GRANTS

Year ended September 30, 1991

	September 30, 1990		1991	September 30, 1991			
	Accounts Receivable	Deferred Revenue	Funds Received	Accounts Receivable	Deferred Revenue	1991 Income	1990 Income
Natural Sciences and Engineering Research Council of Canada (NSERC)							
- Co-operative Research Development Agreement	$ –	$ 481,115	$ 700,000	$ –	$ 526,337	$ 654,778	$ 743,378
- Industrial Research Chairs	–	67,018	120,030	–	60,015	127,033	257,785
- Operating, Strategic and Equipment	–	74,787	450,540	–	117,353	407,974	309,353
- Industry Matching	–	53,142	67,182	–	–	120,324	–
BIOSTAR Inc. - NSERC Industrial Research Chairs	–	75,336	129,216	–	82,395	122,157	106,518
Canadian Bacterial Diseases Network	–	61,944	240,438	–	56,937	245,445	87,595
Agriculture Canada/NSERC Research Partnerships Grants	–	150,000	99,800	99,800	149,700	199,900	200,000
Alberta Agriculture Research Institute (AARI)							
- Matching Grants Program	13,356	10,962	120,645	28,034	51,237	95,048	65,003
- Farming for the Future Program	–	70,343	122,575	6,746	44,615	155,049	87,169
Province of Ontario (OMAF) and Agriculture Research Institute of Ontario	104,314	–	110,145	37,656	–	43,487	78,895
Canada - Manitoba Agri-Food Development Agreement (ERDA)	35,000	–	35,000	–	–	–	80,170
Saskatchewan Health Research Board Fellowship	-	–	38,445	–	20,890	17,555	–
Saskatchewan Agriculture and Food - Agriculture Development Fund (SADF)	52,607	–	100,000	–	–	47,393	113,947
Saskatchewan Horned Cattle Trust Fund	-	-	20,000	-	-	20,000	-
University of Minnesota	50,688	-	-	86,852	-	36,164	50,688
	$255,965	$1,044,647	$2,354,016	$259,088	$1,109,479	$2,292,307	$2,180,501

PUBLICATIONS, PRESENTATIONS AND RESEARCH COLLABORATORS

RESEARCH PUBLICATIONS IN SCIENTIFIC JOURNALS

Anderson, C.M., Potter, A.A., and Gerlach, G.F. 1991. Isolation and molecular characterization of spontaneously occurring cytolysin-negative mutants of *Actinobacillus pleuropneumoniae* serotype 7. Infect. Immun. 59: 4110-4116.

Harland, R.J., Jim, G.K., Guichon, P.T., Townsend, H.G.G., and Janzen, E.D. 1991. Efficacy of parenteral antibodies for disease prophylaxis in feedlot calves. Can. Vet. J. 32: 163-168.

Hutchings, D.L., Campos, M., Qualtiere, L., and Babiuk, L.A. 1990. Inhibition of antigen-induced and interleukin-2 induced proliferation of bovine peripheral blood leukocytes by inactivated bovine herpesvirus-1. J. Virol. 64:4146-4151.

Ijaz, K.M., Attah-Poku, S.K., Redmond, M.J., Parker, M.D., Sabara, M.I., and Babiuk, L.A. 1991. Heterotypic passive protection induced by synthetic peptides corresponding to VP7 and VP4 of bovine rotavirus. J. Virol. 65:3106-3113.

Liang, X.P., Babiuk, L.A., van Drunen Littel-van den Hurk, S., Fitzpatrick, D.R., and Zamb, T.J. 1991. Bovine herpesvirus type-1 attachment to permissive cells is mediated by its major glycoproteins gI, gIII and gIV. J. Virol. 65: 1124-1132.

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Sordillo, L.M., and Babiuk, L.A. 1991. Modulation of bovine mammary neutrophil function following *in vitro* exposure to recombinant bovine interferon gamma. Vet. Immunol. Immunopathol. 27:393-402.

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Sordillo, L.M., Campos, M., and Babiuk, L.A. 1991. Antibacterial activity of bovine mammary gland lymphocytes following treatment with interleukin-2. J. Dairy Sci. 74:3370-3375.

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Van Donkersgoed, J., and Babiuk, L.A. Management of the respiratory form of IBR. Vet. Med. 1:86-94.

Van Donkersgoed, J., Janzen, E.D., and Harland, R.J. 1990. Epidemiological features of calf mortality due to Hemophilosis in a large feedlot. Can Vet J. 31:821-825.

van Drunen Littel-van den Hurk, S., Parker, M.D., Fitzpatrick, D.R., Zamb, T.J., van den Hurk, J.V., Campos, M., Harland, R.J., and Babiuk, L.A. 1991. Expression of bovine herpesvirus-1 (BHV-1) glycoprotein gVI by recombinant baculovirus and analysis of its immunogenic properties. J. Virol. 65: 263-271.

Yoo, D., Parker, M.D., and Babiuk, L.A. 1991. The S2 subunit of the spike glycoprotein of bovine coronavirus mediates membrane fusion in insect cells. Virology 180:395-399.

Yoo, D., Parker, M.D., Song, J., Cox, G.J., Deregt, D., and Babiuk, L.A. 1991. Structural analysis of the conformational domains involved in neutralization of bovine coronavirus using deletion mutants of the spike glycoprotein S1 subunit expressed by recombinant baculoviruses. Virology 183:91-98.

RESEARCH PRESENTATIONS, POSTERS AND ABSTRACTS PRESENTED AT MEETINGS

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Allan, B.J., and Potter, A.A. 1990. Characterization of avian *E. coli* strains isolated in Western Canada. 71st Conference of Research Workers in Animal Diseases. Chicago, Illinois, U.S.A. November.

Allan, B.J., van den Hurk, J.V., Riddell, C., and Potter, A.A. 1991. Prevention of colisepticemia in turkeys by oral immunization with *E. coli*. Canadian Society of Microbiologists Annual Meeting. London, Ontario. June.

Anderson, C.M., Gerlach, G.F., Potter, A.A., Klashinsky, S.L., and Willson, P.J. 1991. Molecular characterization of an *Actinobacillus pleuropneumoniae* serotype 7 cytolysin gene. Abstr. Annual Meeting American Society of Microbiology. Dallas, Texas, U.S.A. May.

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RESEARCH COLLABORATORS

Dr. W.A. Aitchison. BIOSTAR Inc. Saskatoon, Saskatchewan.

Dr. W. Albritton. Provincial Laboratory of Public Health, Alberta Social Services and Community Health. Edmonton, Alberta.

Dr. J. Collins. Colorado State University Diagnostic Lab. Fort Collins, Colorado, U.S.A.

Dr. Corbeil. Department of Pathology, University of San Diego. San Diego, California, U.S.A.

Dr. K. Dryden. Department of Biological Sciences, Purdue University. West Lafayette, Indiana, U.S.A.

Dr. R. Duncan. Animal Disease Research Institute, Agriculture Canada. Nepean, Ontario.

Dr. J. Ellis. Wyoming State Veterinary Laboratory, Department of Veterinary Sciences, University of Wyoming. Laramie, Wyoming, U.S.A.

Dr. H.M. Friedman. Department of Medicine, University of Pennsylvania. Philadelphia, Pennsylvania, U.S.A.

Dr. S. Garzon. Department of Microbiology and Immunology, University of Montreal. Montreal, Quebec.

Dr. F.L. Graham. Departments of Biology and Pathology, McMaster University. Hamilton, Ontario.

Dr. G. Kiel. Animal Diseases Institute. Tubingen, Germany.

Dr. R. Koganty. Biomira Inc. Edmonton, Alberta.

Dr. Kostas. Department of Biochemistry, University of Calgary. Calgary, Alberta.

Dr. M. Longenecker. Biomira Inc. Edmonton, Alberta.

Dr. B. Massie. Biotechnology Research Institute, National Research Council. Montreal, Quebec.

Dr. D. McCartney. Agriculture Canada Research Station. Melfort, Saskatchewan.

Dr. J. Menill. Elanco Division, Eli Lilly Canada Inc. Calgary, Alberta.

Dr. H.C. Minocha. Department of Laboratory Medicine, College of Veterinary Medicine, Kansas State University. Manhattan, Kansas, U.S.A.

Dr. T. Molitor. College of Veterinary Medicine, University of Minnesota. Minneapolis, Minnesota.

Dr. Y. Nakajimo. Hokkaido Branch Laboratory, National Institute of Animal Health. Sapporo, Japan.

Dr. J. Peel. CIBA-GEIGY Ltd., St. Aubin, Switzerland.

Dr. L. Prevec. Departments of Biology and Pathology, McMaster University. Hamilton, Ontario.

Dr. M.J. Rollins. BIOSTAR Inc. Saskatoon, Saskatchewan.

Dr. M. Sabara. Lederle-Praxis Biologics Ltd. Rochester, New York, U.S.A.

Dr. G. Splitter. Department of Veterinary Science, University of Wisconsin. Madison, Wisconsin, U.S.A.

Dr. J. Squires. Department of Animal and Poultry Science, Ontario Agriculture College, University of Guelph. Guelph, Ontario.

Dr. S. Srikumaran. Department of Veterinary Sciences, University of Nebraska. Lincoln, Nebraska, U.S.A.

Dr. P. Tijssen. Institute Armand Frappier, University of Quebec. Lavalle, Quebec.

Dr. R. Walker. Animal Health Diagnostic Laboratory. East Lansing, Michigan, U.S.A.

Dr. S. Weiss. Gibco Inc., New York, New York, U.S.A.

Dr. G. Wertz. Department of Microbiology, University of Alabama. Birmingham, Alabama, U.S.A.

Dr. C. Whetstone. United States Department of Agriculture. Ames, Iowa, U.S.A.

Dr. Y. Yokomizo. National Institute of Animal Health. Ibarakiken, Japan.

University of Saskatchewan

- Dr. M. Chinino-Trejo. Department of Veterinary Microbiology, Western College of Veterinary Medicine.
- Dr. D.M. Haines. Department of Veterinary Microbiology, Western College of Veterinary Medicine.
- Dr. E.D. Janzen. Department of Herd Medicine and Theriogenology, Western College of Veterinary Medicine.
- Dr. L. Loh. Department of Microbiology, College of Medicine.
- Dr. C. Riddell. Department of Veterinary Pathology, Western College of Veterinary Medicine.

Growth and Reproductive Immunology Program at the University of Saskatchewan - A multidisciplinary group of investigators from VIDO, WCVM, and the Colleges of Medicine and Agriculture with the mandate of improving livestock production through the immunoregulation of hormone activity.

- Dr. B. Laarveld. Department of Animal and Poultry Science, College of Agriculture.
- Dr. J.G. Manns. Associate Vice-President (Research), University of Saskatchewan.
- Dr. R. Mapletoft. Department of Herd Medicine & Theriogenology, Western College of Veterinary Medicine.
- Dr. B. Murphy. Department of Obstetrics & Gynecology, College of Medicine.

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.

PATENTS ISSUED ON WHICH VIDO STAFF ARE INVENTORS

United States Patent No 5049578
- Title - Prevention of Porcine Haemophilus Pneumoniae
- Date - September 17, 1991
- Inventor - Manuel Campos
- Assignee - Ciba-Geigy Canada Ltd.

VIDO FINANCIAL SUPPORTERS

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Alberta Agricultural Research Institute (AARI and FFF)
Alberta Cattle Commission
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Saskatchewan Pork Producers Marketing Board
Saskatchewan Turkey Producers' Marketing Board
Swine Improvement Services Co-operative (SISCO)
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VIDO SCIENTIST WINS SASKATCHEWAN HIGH TECH ENTREPRENEUR AWARD

In May 1991, Dr. Andy Potter won the prestigious Saskatchewan High Tech Entrepreneur Award for innovation and scientific breakthrough. His comprehensive research led to the development, scale-up and production of one of the first genetically-engineered animal health vaccines in the world. This innovative vaccine is effective in preventing infection by the bacterium *Pasteurella haemolytica* which is the major cause of shipping fever pneumonia in cattle. Shipping fever is a costly disease complex estimated to cost cattle producers $500 million annually in North America. In addition to cattle, Pasteurella also causes pneumonia in sheep and this vaccine will be useful in countries where sheep are raised in large numbers.

Professional History - Dr. Potter is a native of Winnipeg who joined VIDO in 1985 as a Research Scientist. In 1987 he became Program Manager (Bacteriology) and currently heads a team comprised of five PhD-level scientists and an equivalent number of technicians. Prior to coming to VIDO, Dr. Potter held a number of positions including that of Research Scientist in the Environmental Health Center of Health and Welfare Canada, Research Scientist and Consultant in the National Institutes of Biotechnology and Applied Microbiology (Philippines), Adjunct Professor at the University of the Philippines, and Research Associate at Carleton University in Ottawa. He is a member of the American Society for Microbiology, the Canadian Society of Microbiologists, and the Genetic Society of Canada. Dr. Potter is also a member of the Canadian Bacterial Diseases Network (CBDN) Center of Excellence.

Background to the Scientific Breakthrough - The field of the scientific breakthrough for which the award was given to Dr. Potter is in genetic engineering of disease-causing bacteria. The bacterium *Pasteurella haemolytica* is the cause of shipping fever pneumonia of cattle. This organism invades the lungs where it produces a toxin which kills the white blood cells (leukocytes) which are a primary defense mechanism. Since the leukotoxin kills the immune cells, the bacteria multiply causing a severe, often fatal pneumonia.

Other scientists had hypothesized that the use of the leukotoxin in a vaccine would stimulate the development of immunity which would prevent pneumonia. However, *P. haemolytica* produces the toxin in relatively small amounts, and therefore it was difficult to produce enough of it to make commercial vaccine production economically feasible. Starting in 1985, Dr. Potter undertook a comprehensive research project which has now made large-scale vaccine production a possibility. The major commercial achievement was the development of a genetically-engineered bacterium which produces the leukotoxin in large amounts.

Technological Sophistication of the Achievement - The location of the leukotoxin gene within *Pasteurella haemolytica* chromosomes was known. Dr. Potter's achievement was in removing it from *P. haemolytica,* modifying it, and inserting it into a host bacterium in a form which would instruct the host organism to produce leukotoxin in much larger amounts than the parent *P. haemolytica* organism. He did this by modifying the leukotoxin gene itself and by combining it with other genes which regulate its production within the bacterial cells. These new genetic constructions were then inserted into *E. coli* bacteria which produced a version of the leukotoxin which stimulates protective immunity but which is not toxic to white blood cells. The *E. coli* bacteria can be grown easily in large-scale fermentation equipment. Dr. Potter also developed the techniques to extract and purify leukotoxin from the bacterial cells grown in culture.

Commercialization - The commercialization of this breakthrough was done in Saskatchewan by BIOSTAR Inc. which holds the international manufacturing and marketing rights. The recombinant DNA leukotoxin has been incorporated into two new vaccines sold by BIOSTAR in Canada this year. The two vaccines are Pneumo-Star™, for the prevention of shipping fever pneumonia, and Somnu-Star Ph™, a combination of the shipping fever vaccine with other components to prevent *Haemophilus somnus* infection in cattle. BIOSTAR is currently negotiating with multinational companies that wish to sell the vaccine internationally. Patents on this genetically-engineered form of leukotoxin have been filed worldwide.

Application to Other Industrial Sectors - The approach of producing genetically-engineered subunit vaccines has wide application to a variety of bacterial diseases in both animals and humans. Dr. Potter and his team at VIDO are currently developing similar genetically-engineered vaccines for other bacterial diseases of livestock including *Haemophilus somnus* of cattle, Actinobacillus of swine, and *E. coli* infections of poultry.

CONGRATULATIONS ANDY ON A TERRIFIC ACHIEVEMENT!

DR. ANDREW A. POTTER – BSc, PhD