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ONDERSTEPOORT TODAY, YESTERDAY AND TOMORROW COMMEMORATIVE LECTURE

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ABSTRACT

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This lecture commences with a synopsis of the present activities and organization of the world-famous veterinary research institute in South Africa, colloquially and internationally known as Onderstepoort. Some of the major historic features which contributed to the origin, firm establishment and excellent reputation of Onderstepoort are subsequently outlined. Finally, the future of the institute is considered in terms of existing and expected scientific challenges.

INTRODUCTION

It is a great honour to address such a select gathering on an occasion as important as the 75th anniversary of this world famous institute.

As a scientist I believe that scientific progress cannot be made without absolute honesty and objectivity. I am therefore not going to speak only about successes, but also about weaknesses, and of developments which will be required to meet the challenges of the future. I am also going to throw down the gauntlet occasionally, because I believe that challenge is a sure method of exciting interest and stimulating discussion in order to arrive at the truth.

ONDERSTEPOORT TODAY

For the purposes of this address I have used some licence and have decided to regard "today" as that fleeting moment in time which it is. I shall try to paint a picture of Onderstepoort as I see it at this moment.

Location

The Veterinary Research Institute, Onderstepoort, is situated on the northern outskirts of Pretoria in an area of residual state-owned land which is attractive from the scenic and interesting from the naturalistic points of view. Onderstepoort has a tranquil, attractive campus with an assortment of imposing old and more recent buildings and well-managed gardens and lands, the majestic trees accentuating the presence of a vintage government establishment.

The Faculty of Veterinary Science of the University of Pretoria, historically also known as Onderstepoort, is situated close by. The result is a unique and potentially very valuable concentration of veterinary manpower and expertise. Consequently, there is a continuous flow of information and some valuable collaboration between the 2 institutions. The physical proximity of the Faculty also facilitates post-graduate training of veterinary scientists working at Onderstepoort.

Personnel and scope

Onderstepoort has a total staff complement of approximately 1 000 people. As can be seen in Table 1, it has grown considerably during its 75 years of life. It is larger now than it was 25 years ago, despite the loss to the Faculty of 45 scientists and 20 technicians in 1973 when the Veterinary Faculty became independent. The top management has also been extended to cope with the increased activity and greater responsibility (Table 2). There are almost as many non-veterinary (43) scientists as veterinarians (51), the former being graduates who have specialized in subjects such as chemistry, biochemistry, microbiology, zoology and entomology. All but 15 of the research scientists are South African graduates, and Table 3 indicates that most scientists have post-graduate qualifications. The scientists are assisted by 105 technicians, 46 of whom have a tertiary qualification, and 83 technical assistants. For the purpose of future reference, the sex distribution of scientists and technicians at present employed is illustrated in Table 4.

Although Onderstepoort is probably one of the larger veterinary research institutes in the world, personnel-wise, it is the only national veterinary research institute in this country and has to serve the whole of the Republic of South Africa. Moreover, it must of necessity cover 14 scientific disciplines (Fig. 1) that are important to animal health in this country. This means that it has a wider scope than most of its counterparts elsewhere in the world. Consequently, its expertise is thinly spread and it can only give attention to the most pressing disease problems.

Organization

The accompanying diagram (Fig. 1) shows that the Institute is subdivided on the basis of the well-known disciplines of veterinary science. Most of the 14 research sections represent those disciplines that are economically important to stock in this country today, in the sense that the diseases concerned are responsible for deaths or considerable losses in production. The Onderstepoort scientists are not sitting in any ivory tower.

An analysis of the sections shows that research on infectious and parasitic disease is still a priority. Eleven sections are either completely or partially involved with these topics, 2 work on aspects of toxicology and 1 covers all the disciplines. This is confirmed by an analysis of the research projects in terms of the aetiological agents involved (*vide infra*).

Research

The organization of Onderstepoort is a clear affirmation that the research work which is done at the Institute is mission-oriented. Even sections such as Molecular Biology and Biochemistry, whose biotechnological research is very basic, are engaged in the study of viral diseases or disease-inducing agents with a view to eventually providing effective control measures or improving the existing ones. Research priorities are determined principally by the importance of the disease concerned, which is based on information obtained from the records of the Division of Veterinary Services and the Institute's own diagnostic work.

There are at present 108 registered research projects or facets, as they are currently called. From the breakdown in Table 5 on the basis of aetiological agents it is clear that research projects can be divided into 3 main categories. The majority (59,3 %) deal with infectious agents, of which viruses and bacteria are the most important. The sustained priority of infectious diseases is also reflected in the organization of the Institute (*vide supra*).

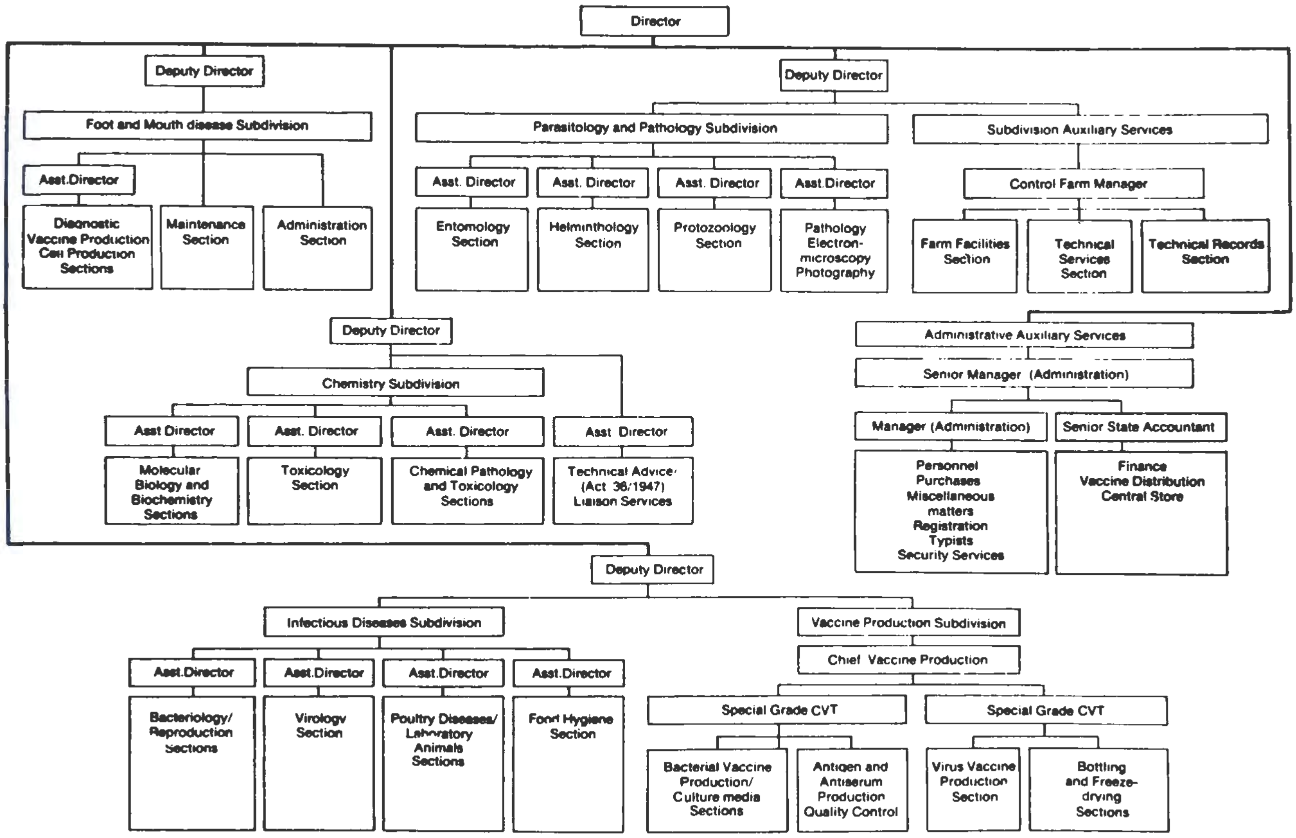

FIG. 1 Organization of the Veterinary Research Institute, Onderstepoort

Projects on parasites account for 28,7 % and toxins for 7,4 % of the total, thus underlining the importance of these disciplines to animal health in this country.

An analysis in terms of a particular disease shows the most attention is being given to mastitis, bluetongue, heartwater and jaagsiekte.

An analysis of the animal species involved in research (Table 6) shows a clear preponderance of cattle (47,2 %) and sheep (29,6 %). If one considers the annual animal production figures of South Africa (Table 7), it is clear that, with the exception of poultry, most attention is given where attention is due. I must point out, however, that an analysis of the number of man-hours spent on research and diagnostic work would probably reveal that poultry is third in line, after cattle and sheep, in terms of the time spent on a particular species.

Evaluation of progress with research and research productivity (subjective as it may be) is based on annual progress reports, scientific seminars, interviews with scientists and scientific publications. Most of the latter are published in the "Onderstepoort Journal of Veterinary Research". This periodical evolved from the "Onderstepoort Journal of Veterinary Science and Animal Industry" and that in turn from Theiler's famous "Reports of the Director of Veterinary Research". These were first published in 1911, and "Reports of the Government Veterinary Bacteriologist of Transvaal", first appeared in 1903. The Onderstepoort Journal of Veterinary Research is currently read in 60 different countries.

From Table 8 it is clear that there was no clearcut growth or decline in the number of scientific publications produced annually by Onderstepoort staff over the past 10 years. This reflects the relatively stable character of the staff numbers and organization. An average of less than 1 publication per scientist per annum perhaps sounds less than satisfactory, but if the burden of diagnostic work and administrative duties together with the high turnover of personnel are taken into consideration, the productivity is not unsatisfactory.

TABLE 1 Staff position

Item	1908	1958	1983
Professional	6	66	94
Technical	5	88	188
Clerical	8	52	77
Other	4*	569	675
Total	23	775	1 034

* Black labourers not included

TABLE 2 Top management of Onderstepoort

Item	1909	1958	1983
Director	1	1	1
Deputy Directors	0	1	4
Assistant Directors	0	3	14
Chief: Vaccine Production	0	0	1
Assistant Director (Administration)	0	0	1
Chief clerk (or equal rank)	1	1	2
Total	2	6	23

TABLE 3 Qualifications of graduate staff

Qualifications	Graduates
Bachelors degrees	92
Post-graduate diplomas	4
Honours degrees	25
Masters degrees	36
Doctorates	17

A standing research committee, consisting of the directorate and senior scientists, with co-opted members when necessary, presides on the ethical aspects of experiments, and evaluates all applications for the registration of new research projects before they are formally approved.

Vaccine production

Onderstepoort's vaccine factory currently produces 50 different vaccines for use in stock. Its policy hitherto has been to produce, if possible, every vaccine that is required by stock farmers in this country, no matter how small the requirement. Bacterial vaccines account for 27, viral vaccines for 18, rickettsial vaccines for 3 and protozoal vaccines for 2 of the total (Table 9).

TABLE 4 Sex distribution of scientists and technicians*

Item	Male	Female	Total
Veterinarians	37(79%)	11(23%)	48
Veterinary researchers	20(51%)	19(49%)	39
Technicians	63(64%)	35(35%)	98
Total	120(65%)	65(35%)	185

* Only filled positions taken into account

TABLE 5 Research projects: Aetiological categorization

Aetiology		No. of projects	Total	%
Infectious agents	Viruses	30	64	59,3
	Bacteria	25		
	Rickettsiae	8		
	Mycoplasmas	1		
Parasites	Ectoparasites	8	31	28,7
	Helminths	16		
	Protozoa	7		
Toxins	Plant	4	8	7,4
	Mycotoxins	1		
	Chemicals	1		
	Other	2		
Non-aetiological			5	4,6
Grand total			108	100

TABLE 6 Research projects: species categorization

Species	No. of projects	%
Cattle	51	47,2
Sheep (and goats)	32	29,6
Pigs	4	3,7
Horses	3	2,8
Poultry	2	1,9
Game	2	1,9
Fish	1	0,9
Pets	0	0
Miscellaneous animals*	13	12
Total	108	100

* Projects involving more than 1 animal species

Since April 1981 the vaccine factory has been operating on a "trade account", which means that it is obliged to finance itself, albeit on a non-profit basis. To replace worn out, outdated equipment, however, the prices of vaccines have had to be considerably increased during the last 2 years. The income from the sale of vaccines is compared with the expenditure of the Institute for the years 1908, 1958 and 1983 in Table 10.

The factory is run virtually entirely by technicians, with professional management only at the very top (Fig. 1). Basically, the factory consists of a kitchen which produces the nutrient media, a production unit where the different categories of vaccines are produced, a bottling and storage section, an evaluation unit where vaccines are tested for efficacy and safety, and a distribution section.

Twenty-one of the bacterial vaccines are inactivated vaccines in the form of either toxoids or bacterins, with aluminium hydroxide or an oil as adjuvant, and the balance attenuated vaccines. The viral vaccines (15) are lyophilized, 2 being inactivated. There are 3 blood vaccines, 1 of which is issued in the frozen form and 2 as fresh blood. One protozoal vaccine is live, but naturally non-pathogenic, and is grown in tissue culture. The other is one of the blood vaccines.

The annual total sales of vaccine over the last 25 years are given in Fig. 2, while Table 11 gives the actual figures for the years 1908, 1958 and 1983. It will be noticed that the sales of vaccine reached a peak in 1976/77 and have since dropped slightly. A particularly pronounced drop in the use of viral vaccines occurred during the past year when South Africa experienced one of its worst droughts. Particularly hard hit was the demand for bluetongue vaccine, an evidence of how vulnerable the vaccine factory is to factors affecting the economic position of the farmers.

It is important to appreciate that 30 vaccines have a turnover of fewer than 1 million doses per annum. Many of these vaccines are sold below cost and are subsidized by those vaccines with a large turnover. In an ordinary business enterprise such vaccines would not be manufactured, but they are essential for farmers in this country with its many infectious diseases, and its divergent ecosystems and managemental practices. The manufacture of stock vaccines which are strategically important is one of the functions of this institute.

Diagnostic work

Diagnostic work has always been one of Onderstepoort's functions. It is done at present by the section dealing with the discipline concerned. As the diagnostic laboratories of the Division of Veterinary Services have developed, there has been some shift in emphasis from the examination of field material only to processed specimens which are referred to Onderstepoort for in-depth investigations. Lately, most specimens derive from livestock rather than companion animals.

TABLE 7 Animal production (to nearest million tons) (adapted from Anon., 1984a)

	Red meat				Poultry	Wool	Mohair	Milk[1]
	Beef	Sheep & Goat	Pig	Total				
1908	?	?	?	?	?	?	?	?
1958	0,41	0,13	0,06	0,6	0,03	0,13	0,003	2 600[2]
1983	0,62	0,23	0,1	0,95	0,46	0,1	0,008	2 067

[1] In million litres (figure reflects total utilization of milk and milk products)
[2] Figure for 1961

Diagnostic work has several advantages. It always provides a wealth of information about what is happening in the field, and thus assists Onderstepoort to keep its finger on the pulse of the disease position, and to determine research priorities. It also often gives rise to research work and can, in a sense, be regarded as research. Lastly, it is an excellent training ground in certain disciplines for recently qualified veterinarians.

Involvement in statutory control over stock remedies

The use of therapeutics and pesticides to promote plant, animal and human health still shows no sign of abating. Currently, however, there are ominous signs, as far as veterinary remedies for the control of ecto- and internal parasites are concerned, that there is a decrease in the development by the pharmaceutical industry of new remedies to replace existing ones to which these pests are becoming increasingly resistant.

Certain remedies, many of which are ethical products in developed countries, are sold over the counter to stock farmers in South Africa, and statutory control is therefore essential. Ten of Onderstepoort's senior research workers are currently involved, to a greater or lesser degree, in the administration of the Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act 36 of 1947). They are serving as specialist advisers to the Registrar appointed under the Act to ensure that farmers are buying effective and relatively safe products.

Equipment and technology

The research sections at Onderstepoort are reasonably well equipped to carry out their investigations. Although the equipment which is available cannot be quantitatively compared with, for example, that of American, German and Swiss laboratories, the quality is comparable.

The electronic era is clearly visible at Onderstepoort. Although we are still making good use of the conventional light microscope, our electron microscopes are in constant use. As regards equipment used for chemical analyses, cell counting and measurement of the dimensions of helminths, for example, we have also moved into the electronic era. The computer is not only an integral part of such equipment; it is also being used more and more often for the storage and rapid retrieval of scientific and other data.

TABLE 8 Scientific publications

Year	No.
1974	33
1975	44
1976	37
1977	40
1978	50
1979	63
1980	53
1981	49
1982	50
1983	66
Mean	48,5

TABLE 9 Number of vaccines and other biologicals manufactured

		1908	1958	1983
Vaccines	Bacterial	2	10	27
	Viral	4	7	18
	Rickettsial	0	2	3
	Protozoal	0	1	2
	Total	6	20	50
Diagnostic antigens		2	4	10
Antisera		0	0	3

TABLE 10 Expenditure and income

	1908	1958	1983
Expenditure	R57 644	R1 349 000	R10 222 447
Income	R17 294	R1 285 000*	R4 703 698

* Includes student tuition fees

TABLE 11 Doses of vaccine manufactured

	1908	1958	1983
Bacterial	13 997	29 954 520	104 891 816
Viral	367 262[1]	25 051 081	34 054 825
Rickettsial	0	425 360	3 890 400
Protozoal	0	44 720	207 624
Total	390 259	55 475 681	143 044 665

[1] Includes 299 455 tubes of smallpox vaccine

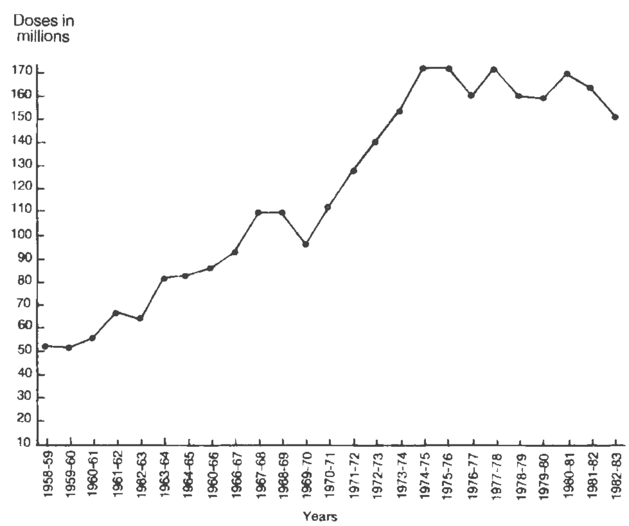

FIG. 2 Annual total sales of vaccines over the last 25 years

TABLE 12 Contact with foreign countries

	'73/74	'74/75	'75/76	'76/77	'77/78	'78/79	'79/80	'80/81	'81/82	'82/83	Mean
No. of scientists overseas	5	6	8	5	6	8	8	7	12	9	7,2
No. of scientists visitors	57	56	46	42	35	37	52	64	65	46	50
Doses vaccine exported (to nearest million)	8×10^6	14×10^6	11×10^6	8×10^6	11×10^6	$6,8 \times 10^6$	$12,3 \times 10^6$	$7,9 \times 10^6$	$3,6 \times 10^6$	$5,4 \times 10^6$	8,8
No. of specimens examined	1 461	826	1 907	2 064	2 477	1 129	1 837	335	1 215	2 129	1 538

TABLE 13 Estimated annual losses due to some important diseases

Disease	Estimated loss/annum*
Ticks and tick-borne diseases	R70 000 000–180 000 000
Mastitis	R180 000 000–270 000 000
Internal parasites	R80 000 000–100 000 000
Plant poisoning	R20 000 000– 30 000 000
Poultry diseases	R20 000 000– 30 000 000
Total	R370 000 000–610 000 000

* Figures represent the lowest and highest estimates encountered in publications and other documents in recent years

TABLE 14 Estimated losses from disease before and shortly after 1908

Disease	Date	Species	Estimated No. died
Lungsickness	1884–1886	Cattle	200 000
Horse sickness	1884–1885	Horses	64 850
Rinderpest	1896–1903	Cattle	2 500 000
East Coast fever	1902–1955	Cattle	5 500 000
Lamsiekte	1909	Cattle	8 000
Geeldikkop	1926–1927	Sheep	600 000
Vermeersiekte	1929–1930	Sheep	1 000 000

TABLE 15 Recorded deaths 1981/2

Disease	No. of animals	Total value
Blackquarter	1 605	R401 250
Heartwater	2 324	R464 800
Redwater	2 691?	R807 300
Anaplasmosis	872?	R261 600
Total	7 492	R1 934 950

Onderstepoort is, however, far from being over-mechanized, an important aspect in a country where untrained manpower is freely available and has to be utilized.

The present facilities, equipment and technology of the vaccine factory compare less favourably with those of similar institutions in the Western World where the standards are often extremely high. The fact that the factory now has to finance itself makes it even more necessary to be able to compete with the quality of products of the private sector.

Contact with the scientific world in foreign countries

Onderstepoort is still in relatively close contact with the world scientific community. Table 12 is a summary of the situation over the last decade. Regular short visits to western European and other developed countries, financed fully or partially by the government, have enabled Onderstepoort researchers to see for themselves what their colleagues overseas are working on and how they go about their tasks. A small number have spent longer periods overseas on post-graduate training courses.

Ondertstepoort's excellent and sustained world-wide reputation has ensured a steady stream of scientific visitors from developed and developing countries (Table 12). The Institute has opened its doors to trainees from neighbouring and other countries alike, who come for shorter or longer visits to study techniques which are being used for diagnosis and research.

We also regularly receive specimens for diagnosis (Table 12), particularly from immediately neighbouring countries. Since 1966, the Institute has served as the international reference centre of the "Office International de Épizooties" for the diagnosis of bluetongue and African horse sickness.

Onderstepoort vaccines, if produced in sufficient quantities, are available for export to other countries. Although it is not possible to determine exactly how much vaccine is exported, because the marketing of vaccines is done largely by private pharmaceutical companies, it is estimated to be in excess of 10 % of the total sales. Details of the number of doses of Onderstepoort vaccine known to have been exported over the past 10 years are given in Table 12. The fact that Onderstepoort exports its vaccines promotes regular contact with foreign countries, particularly the neighbouring African states.

Current impact of diseases on Onderstepoort's activities

It is most difficult to determine the cost of livestock diseases to the country. Estimates have been made which are usually subjective in the sense that the person or institution from which they originate has some message to convey and uses the monetary loss to make a point. Estimates that are available of the most costly diseases or syndromes are given in Table 13. Although these figures are not exact, they underline the fact that some of the killer diseases, which have taken their toll for many decades, are still with us. The result is that considerable research is still being done on some of them in an attempt to find better control methods.

Limited staff numbers in relation to the magnitude of indigenous disease problems confronting Onderstepoort makes it difficult to keep pace with the development of research technology in the Western countries. Despite this handicap, the Institute has succeeded in keeping abreast of research in biotechnology, using diseases such as jaagsiekte and bluetongue as tools to apply these ultra-modern techniques. Other research projects have already benefited from the spin-off from this research work, and the Institute is perhaps better prepared for future challenges in this regard than many similar South African institutions.

Advisory activities

Onderstepoort has an important advisory function which takes up much of its time, for its advice is much sought after both within the borders of this country and internationally. Moreover, it is essential that the results of veterinary research should reach the potential users of this new information, namely, local veterinarians and farmers in particular. This information is, however, also furnished freely to interested parties in other countries.

Various channels are used for fulfilling this function. Our liaison officer is principally responsible for this function, and he communicates with farmers, the public and veterinarians mainly by the spoken and written word. This is also the function of virtually every research worker at Onderstepoort, although veterinarians naturally carry the heavier burden. There is also a steady stream of local and foreign lay visitors to the Institute, which is handled mainly by the liaison officer.

Semi-scientific and more popular publications in departmental newsletters, pamphlets or the lay press present research results in a digested and useful manner from time to time. Onderstepoort recently initiated its own newsletter in which the most important results of research are published in an abbreviated form.

The Institute also makes contributions to radio and television programmes from time to time. The Department of Agriculture's own radio programmes for farmers, for example, are serviced fairly regularly.

ONDERSTEPOORT YESTERDAY

The pre-Onderstepoort era

Africa has been notorious for its multitude of devastating "tropical diseases" for as long as pioneers have been able to record their observations in some way for posterity. Southern Africa, being part and parcel of the "dark continent", had its fair share of this burden.

Except for the Bushman, stock farming was the main means of livelihood for all the peoples of southern Africa prior to the advent of the whites. As soon as they were allowed to do so by the authorities, the white settlers started farming with stock on an increasing scale as they moved into the interior of the country. It stands to reason that the many diseases that ravaged their stock, records of which appear in official reports and in the writings of early travellers, affected these farmers severely (see Gutsche, 1979, for a vivid description).

The horse, being the main mode of civil and military transport in urban and rural areas in those days, was a very important animal in everyday life. A disease such as African horse sickness, which decimated the horse population even as far south as the Cape from time to time, affected everybody, and therefore caused considerable consternation and received much attention. The statistics of a particularly severe outbreak appear in Table 14.

As the "Trekboere" moved further and farther northwards and settled down to farm, more and more diseases were recorded. Diseases such as lungsickness, bluetongue, "brandziekte" (sheepscab), redwater, "lamziekte" (botulism), blackquarter and anthrax were often mentioned. Vermeersiekte and nenta were also known in the 19th century (Gutsche, 1979).

From Louis Trigardt's diary (cited by Henning, 1949) it is clear that the deadly disease associated with tsetse flies, and now referred to as nagana, was recognized in the Transvaal early in the 19th century. Much later in the century the fly had an important influence on the early goldmining industry in the Eastern Transvaal. The traumatic effects of nagana on transport riding by ox waggon through the Eastern Transvaal Lowveld are vividly described by Sir Percy Fitzpatrick in his well-known book, "Jock of the Bushveld" (Fitzpatrick, 1907). From the few figures which are available (Table 14) it is clear that farming was an extremely hazardous enterprise even in those early pre-rinderpest and pre-East Coast fever days.

Into this scene came the first veterinarians. One of them was the famous Duncan Hutcheon, who was appointed as Colonial Veterinary Surgeon in the Cape Colony in 1880 on the remarkably high salary in those days of £700 a year (Gutsche, 1979). It is interesting to note that seventy years later the starting salary of a newly qualified government veterinary officer was well below that mark. This remarkable man laid the foundations of veterinary science in southern Africa. Naturally, he investigated and described all the important diseases that he encountered in the Cape Colony.

To appreciate fully the magnitude of his contribution and that of his contemporaries to veterinary science in this country, one should be reminded of the puacity of knowledge and the poor quality of equipment which were available at the time. The light microscope, as we know it today, was available, but it was a primitive instrument with relatively limited powers of resolution and magnification. The diagnostician had to rely heavily on his eyes and his talents as an observer. It was a matter of macroscopic pathology aided by a hand lens rather than histopathology, and smear examination rather than microbiological examination at a well-equipped laboratory.

Hutcheon's achievements were remarkable. He even came very close to surmising as early as in 1884 what the cause of lamsiekte and stywesiekte was, only to be scoffed at by his superiors (Gutsche, 1979).

Conception and birth of Onderstepoort

Arnold Theiler, the founder of Onderstepoort, arrived in the Transvaal from Switzerland in 1891 as a newly qualified veterinarian (Gutsche, 1979). He had great difficulty in making ends meet initially, and in that early struggle he severed his left hand in a chaff-cutter whilst working as a farm-hand in Irene. Despite this severe, permanent handicap, he tried to make a living as a private practitioner, but a government appointment to make smallpox vaccine proved to be more lucrative. In his spare time he studied horse sickness in an attempt to determine its cause and find a cure for the scourge. A turning point in his career as a scientist was brought about by the invasion by rinderpest into the Transvaal in 1896. Impressed by his obvious competence, the government of the Zuid-Afrikaanse Republiek appointed Theiler as "state veterinarian" and he was given primitive laboratory facilities at Daspoort to study this devastating disease which swept through the entire country killing almost half of the cattle population (Table 13). Theiler, together with Watkins-Pitchford from Natal, developed the serum-virus method of immunization for rinderpest, a procedure which was safer but more cumbersome than the bile method developed by Robert Koch, and his fame was firmly established.

After a short spell as a horse doctor with the Boer armed forces during the Anglo-Boer War, Theiler returned to his laboratory at Daspoort to continue his activities of vaccine production and research. The post-war government appointed him as government veterinary bacteriologist, still in the same laboratory. His activities included continued production of smallpox and lung sickness vaccines, and much research on African horse sickness.

Another catastrophic cattle disease hit the country in 1902 (Neitz, 1957; Gutsche, 1979). It required intensive research, which involved co-operation with similarly afflicted neighbouring countries, because its cause and mode of transmission were unknown. It was Theiler who proved conclusively that "Rhodesian redwater" was a new disease, thereby resolving the mystery of its aetiology. Lounsbury helped Theiler to prove that the disease was tick-borne. The disease became known as East Coast fever and its causative organism was named *Theileria parva* in honour of the great man.

The Daspoort laboratory, an ex-military barracks, was quite inadequate for handling Theiler's increasing activities. Not only was it unsuitable but it was also unhygienic, and therefore dangerous to human health. In fact, Theiler lost several assistants from typhoid fever. Furthermore, the authorities by this time realized that they were backing a winner in Arnold Theiler. A new laboratory was therefore planned which by current standards was enormous and extremely expensive, an "Extravagant Palace of Science" (Gutsche, 1979). A suitable site, said to be notorious for horse sickness (Anon., 1961), on the farm De Onderstepoort was acquired, and on the 8th of October 1908 the new building, which cost a total sum of £80 000, was commissioned.

Beating the killer infectious diseases

It is important to appreciate that, as time went on, Theiler built up a team of excellent research workers and dedicated technicians who helped him in the many achievements which made Onderstepoort famous.

Once the aetiology, transmission and epidemiology of East Coast fever had been sorted out reasonably well, the difficult task of controlling the disease became the responsibility of the field veterinary services division. It took more than 50 years (Table 14), however, to eradicate this extremely tenacious disease, which is still regarded as the second most important cattle disease in Africa.

African horse sickness also yielded to his zealous efforts. He developed a serum-virus method of vaccination after many years of resolute and imaginative research work (see Howell, 1963, for a review). It was a laborious method and it was therefore never possible to vaccinate large numbers of animals. Horses and mules, however, were at a premium, especially in those early post-war years, and the vaccine was therefore particularly welcome. The problem of "aanmanings" (recurrences) remained to be solved, and some time elapsed before it was realized that they were due to the presence of a series of immunogenically distinct strains of horse sickness virus rather than to true relapses.

Theiler discovered the causal organism of anaplasmosis, noticed that it was devoid of cytoplasm and called it *Anaplasma marginale* (Theiler, 1910). This parasite had been observed by the renowned Theobald Smith in the USA, but he erroneously regarded it as an immature form of the redwater parasite. Theiler also developed a blood vaccine against anaplasmosis in 1911 by using the closely related, but less virulent, *A. centrale*, also discovered by him (Theiler, 1912). Apart from South Africa, Theiler's vaccine strain is now used in many countries of the world, including Australia and several South American states.

Theiler also devloped the first vaccine against babesiosis of cattle (redwater), and his method of production is likewise still in use in many parts of the world where redwater is a problem.

Lamsiekte (botulism) of cattle proved to be one of the most challenging projects. The association between osteophagia and lamsiekte had been noticed by farmers and veterinarians, notably by men such as Hutcheon (Gutsche, 1979). Lamsiekte was known to occur in areas with sandy soil deficient in phosphorus, such as in the Vryburg, Bechuanaland and North-western Transvaal environs, nowadays perhaps some of the best cattle country in South Africa, if not in the world. Moreover, lamsiekte had been produced artificially by feeding carcass material to cattle. Despite all this information, there was strong contradictory evidence which confused everybody involved.

After a premature, but temporary, retirement in 1918, Theiler was re-appointed towards the end of the same year specifically to study lamsiekte on the government farm "Armoedsvlakte" near Vryburg. Here he wandered with the grazing animals—"an expert become a cattle herd", to quote Gutsche (1979). In less than 2 months of personal study the "flash of lightning" occurred and "all the elements of the Lamziekte syndrome had fallen into place". Lamsiekte was caused by the ingestion of putrid bones and carcass material by cattle with osteophagia, the latter caused by a deficiency of phosphorus in the soil, and hence in the pasture grasses, of those regions. He realized that the toxin was produced by a saphrophyte which later was identified as *Clostridium botulinum*. Finally, a vaccine was prepared from the toxin, which means that apart from feeding phosphates and clearing the veld of carcass material, stock can now also be protected against accidental intoxication by immunization.

Theiler's lamsiekte-*cum*-phosphorus-deficiency work, with all the important implications of the latter for normal production, can perhaps be regarded as his greatest achievement.

Veterinary education and Onderstepoort

Theiler was a born teacher and enjoyed teaching (Gutsche, 1979). Since no veterinary faculty existed in Africa at that time he either had to import his veterinarians from overseas or use South Africans who had trained overseas. Irrespective of where his veterinary researchers came from, in-service training was essential to acquaint them with the local diseases and conditions. The obvious thing to do was to train veterinarians at Onderstepoort and to use the Onderstepoort staff as part-time teachers. Theiler expressed this viewpoint as early as in 1906 (Gutsche, 1979), and the idea thus conceived led to its fulfilment much later.

The concept was also backed by influential civil servants and politicians. It was the then Prime Minister, Genl. J. C. Smuts, who eventually persuaded Theiler, who had been thinking of retiring to Switzerland, to accept a dual appointment as Director of Veterinary Education and Research on 1 April 1920 (Gutsche, 1979). In this way a faculty of veterinary science came into being.

Initially the faculty was, naturally, the most proficient in those disciplines which received most research attention, such as pathology, infectious diseases, parasitology and nutrition. The clinical subjects only came into their own later as private practice slowly developed into a financially rewarding vocation. This culminated in the complete evolution of the faculty when it became independent in 1973.

Onderstepoort internationalizes

The question arises how a laboratory such as Onderstepoort, situated in a remote, developing country where scientific manpower was scarce, could become a leader in the scientific world, and hence become internationally famous.

In my opinion the answer lies, firstly, in its founder, Sir Arnold Theiler, a man of genius, courage, great scientific drive and enthusiasm, and with very strong, leadership qualities. He was in the correct place at the right moment, notably, when 2 of the worst scourges of cattle—rinderpest and East Coast fever—hit southern Africa, and he seized the unique opportunity to exercise his talents. It is also due to the shrewd perception of administrators and politicians alike, who realized the immensity of the stock diseases problem, recognized a good horse in the person of Theiler when they saw it, and backed him to an amazing extent.

Important also for the recognition overseas of South Africa as a leader in veterinary science was the quality of scientific expertise that Theiler and his early successors had at their disposal. Theiler not only canvassed and attracted good people, but private practice was in its infancy and government service was the obvious avenue of employment for veterinarians. Hence Theiler engaged some of the most talented people available at that time.

Another factor which played a role was the lack of competition elsewhere in the world in the field of tropical diseases, a situation which is completely different today. Onderstepoort was working virtually on its own, in an actual "paradise" of diseases, such as those caused by parasitic protozoa and viruses, many of which were as yet unknown in the more developed Western world.

Last but not least, the exploitation of South Africa's mineral wealth created opportunities for scientific progress unequalled elsewhere in Africa.

By writing, publishing, talking to and, particularly, cultivating and visiting the most influential scientists and other people overseas, and being visited by such people for information and training, the impressive Theiler made his institute famous at similar institutions all over the world. But more than anything else, it was the quality of the scientific breakthroughs which got across to the scientific world that "internationalized" the institution. Onderstepoort became a household name, and Theiler received the accolade and a multitude of medals and decorations.

Theiler's able successor, P. J. du Toit, was perhaps even more outwardlooking than his previous chief. He was in all respects a director of research who delegated the research projects to enthusiastic investigators (Kingwill & Schonland, 1969). The first really good vaccines against the virus diseases horse sickness and, later, bluetongue were made in his time. The same is true of vaccines for anthrax and lamsiekte. Thus Onderstepoort's reputation was further enhanced.

Onderstepoort's reputation resulted in its director being in increasing demand, both nationally and internationally. Du Toit's ability as a brilliant speaker and chairman made him the ideal person to fulfil this role. At home he was chairman, at some time or another, of almost every society with a biological theme. Outside South Africa he was particularly involved in international veterinary matters concerning the British Commonwealth and the sub-Saharan region of Africa. The Scientific Council for Africa South of the Sahara (CSA) was the most important body to emerge from his endeavours and he led it ably for 10 years. It subsequently became one of more political casualties, to the detriment of animal health in Africa. The recent, unprecedented pandemic of rinderpest (Rossiter *et al*, 1983), a disease which can be controlled quite easily by co-ordinated, well-organized vaccination programmes, is a case in point.

Despite the gradually decreasing contact with developing countries, Onderstepoort's international reputation has been maintained, to the credit of subsequent directors such as Alexander, Jansen and Weiss and their research workers. These men have continued to keep the scientific eye focussed on Onderstepoort by scientific breakthroughs, despite tremendous competition from Western countries with their virtually unlimited manpower and funds, in the now internationalized field which used to be Onderstepoort's sole domain.

A vaccine factory conceived within a research institute

I wonder what Sir Arnold Theiler's reaction would be if he were to see the Onderstepoort vaccine factory as it is today? He would probably not be greatly surprised by its presence since he initiated it when he developed and made vaccines against a variety of bacterial, viral, protozoal and rickettsial diseases at a time when the vast range of stock diseases was first being discovered (Gutsche, 1979). During the First World War, for example, he once exclaimed in desperation: "The laboratory now is just a factory, and I am the factory manager—uncongenial and ungladdening".

He was appointed to make a smallpox vaccine for humans and decided to produce a lungsickness vaccine as well long before Onderstepoort was thought of. He developed a vaccine for rinderpest before the turn of the 20th century. A basically similar vaccine against horse sickness was also already being used on a small scale shortly before 1908. Vaccines against gall sickness, redwater, blackquarter, bluetongue, anthrax and pulpy kidney were all developed during his regime.

The number of vaccines and doses of vaccine issued in 1908 at Onderstepoort's inception are compared with those issued 50 and 75 years later in Tables 9 and 11.

Most of the above-mentioned diseases were unknown anywhere else in the world. Since there were no local vaccine factories and vaccination was the only realistic and efficient way to protect stock against these highly fatal infectious diseases, Theiler's institute had no choice but to develop and manufacture the vaccines. In fact, Theiler owed his appointment to the very fact that he could make vaccines. Thus vaccine production became one of Onderstepoort's accepted functions.

As time went on, many more vaccines were added to the pharmacopeia (Table 9) to combat the host of indigenous infectious diseases that South African stock are prone to. Eventually the enterprise became so extended that centralization of activities became necessary, and a vaccine factory, run virtually entirely by technicians, was established. The new facilities are situated in the New Main Building of the Institute and were occupied in 1967.

The century of chemotherapy of infectious and parasitic diseases and pesticides

Onderstepoort was founded shortly after Ehrlich created the science of chemotherapy in 1904 by his pioneering work on the treatment of trypanosomiasis with the dye, trypan red. The activities of the Institute would understandably be influenced by the blossoming of this "mixed blessing" and by the discovery that external parasites could be controlled by toxic chemicals.

The campaign to eradicate East Coast fever rested on a corner-stone known as dipping which exposes the vector ticks to poisonous chemicals. Dipping became as much a part of the South African farming scene as cowpunching in the USA. Virtually every state veterinarian appointed before 1950 was involved in the East Coast fever eradication campaign at some stage or another.

The importance of internal parasites in animal health was another feature which emerged from the work done at Onderstepoort. Because of the non-existence of commercially produced remedies in South Africa, Onderstepoort for many years manufactured its own wireworm and nodular worm remedies, and even a blowfly remedy. Later the large international pharmaceutical companies took over this function.

As time progressed drugs were discovered which could cure protozoan diseases such as nagana, redwater, biliary fever and coccidiosis. The advent of the sulphonamides and antibiotics brought virtually every infectious disease except those caused by viruses under control, or so it was hoped. Even heartwater and gall sickness could be cured if the afflicted animal was recognized as a sufferer early enough.

The microbes, protozoa, ticks, insects and helminths were, however, one up on chemists. They either had mutating genes available and/or many billions of years of natural selection behind them and were genetically endowed with the ability to manifest resistance against the chemical onslaught.

The emergence of resistance to a variety of successive dips has been a disconcerting feature of tick control. Blowflies cannot be controlled as effectively now as in the early post-war days of the chlorinates DDT and BHC because of resistance. Resistance has long been a problem of trypanosomiasis control, and the coccidia are likewise developing resistance. The development of resistance by bacteria to antibiotics and even the transfer thereof to non-resistant ones has caused consternation and has initiated a concerted world-wide effort to halt this potentially disastrous threat.

The result is that animal scientists are going back to the drawing board. Some are following the example of their colleagues in the plant world by looking for genetically endowed resistance to a variety of diseases and parasites. Others are opting for prophylaxis by vaccination, the new biotechnological horizon offering endless possibilities.

The era of virology and molecular biology

Although Theiler investigated several virus diseases such as rinderpest, horse sickness and bluetongue with great success for his time, his successors made much more rapid progress as more sophisticated techniques for growing viruses became available.

Initially laboratory animals, including the brains of infant mice, were used for this purpose. Later, embryonated eggs became fashionable, and eventually the elegant technique of cell culture opened up much wider possibilities. These techniques enabled Onderstepoort to give a scientific lead in the identification and typing of bluetongue and horse sickness strains and the development of good attenuated vaccines. The viruses of Rift Valley fever and lumpy skin disease could be isolated and attenuated for vaccine production. Many other viruses were isolated and related to diseases of greater or lesser importance.

A particularly wise and fruitful move was to create a new discipline at Onderstepoort, namely, molecular biology. This section concentrated on the characterization of the bluetongue virus and studies on jaagsiekte, the latter a disease of sheep of which the aetiology was unknown. The research work that has emerged from this small laboratory is not only on a par with what is being done in the most sophisticated laboratories in the world, but the knowledge and technology generated has enabled Onderstepoort to take a leading position in South Africa in the field of biotechnological research.

ONDERSTEPOORT TOMORROW

Nothing is static in this world. We must either adapt to new challenges and changes or, like the dinosaurs, face extinction.

From the foregoing sections it is clear that there was not only growth to meet the increasing demand that animal health made on veterinary research and related activities, but also adaptation to changing needs and, perhaps most importantly, the anticipation of future requirements. The appointment of Theiler, the Old Main Building, monumentalized today (the "Extravagant Palace of Science" of yesterday), the vaccine factory, the foot-and-mouth disease laboratory and the discipline of molecular biology are examples of far-sightedness.

The future holds a rapidly growing human population with many more mouths to feed. It is impossible to increase our natural resources, and a policy of the optimum utilization of those we have will be even more important than it is today. Production reduced by decimation of animal numbers by, and the erosive effects of animal disease is synonymous with sub-optimum utilization of natural resources. Onderstepoort will clearly have an important role to play for many years to come.

Research on killer infectious diseases

Let us be realistic. We have too many of the killer diseases still with us. Although much can be achieved by utilizing the armament of control measures provided by our research, we still lose too many animals from diseases such as heartwater, redwater, gall sickness, and blackquarter, to mention only the more important ones. The figures in Table 15 are based on casual information submitted to the Division of Veterinary Services, not on accurate statistical data. The true losses from these diseases are unknown but they are certainly infinitely greater. A reasonably developed country such as ours cannot afford such wastage.

After all these years we are still largely in the dark regarding the epidemiology of heartwater and gall sickness. We have little information on the immune status of populations of cattle in their enzootic regions and the infection rate in ticks. The influence of vaccination with heartwater blood on both the above-mentioned epidemiological aspects still needs to be studied. The same applies to anaplasmosis. There is much room for improvement of the existing heartwater vaccine to make it really effective, nor are the other blood vaccines perfect. *In vitro* cultivation of these organisms must be a high research priority if these aims are to be achieved.

Bovine malignant catarrh is becoming increasingly important in this country with its expanding interest in game farming. A more practical solution than separation of game and cattle will have to be sought.

Killer plants

I concede that good veld management will not prevent deaths caused by the ingestion of certain plants, such as gifblaar. It is a disconcerting fact, however, that many outbreaks of plant poisoning occur under conditions where the natural grazing has deteriorated as a result of either long or short term mismanagement, particularly overstocking. In the case of the former, poisonous plants often replace the edible grasses and shrubs, whereas in the latter instance the veld is virtually denuded of non-poisonous plants. Both malpractices may leave livestock with little alternative but to consume noxious plants in large quantities.

Indeed, almost half of the poisonous plants listed in Vahrmeijer's book (1981) are so unpalatable that they are either only eaten in toxic quanitities by stock if their normal pasture grasses and shrubs are no longer available, or have replaced the latter because of mismanagement. Few poisonous plants are indeed preferred by stock if their normal grazing is available.

Many poisonous plants are weeds which take over as pioneers in damaged veld, whereas others are avoided or not eaten in sufficient quantities to cause poisoning if the preferred grasses and shrubs are available. Furthermore, the moving of animals from an ecosystem which they know to another with a different botanical composition is often an unwise decision.

Current fundamental research on the toxic chemicals in poisonous plants is necessary and needs to be extended in future in the hope that it will eventually lead to the discovery of prophylactic measures or antidotes, but the practical returns of such research to date have been small.

It is therefore ironical that an excellent method for the prevention of many kinds of plant poisoning is already available to the farmer in the form of good veld management. Good veld management means not only a decrease in losses from plant poisoning, but is also synonymous with the optimum utilization of these natural resources and their preservation for posterity.

Erosion diseases

Because we still have so many killer diseases and too few scientists to give research attention to them all, erosion diseases, such as mastitis, blowfly strike in sheep, vibriosis (= campylobacteriosis), trichomoniasis, leptospirosis, chlamydiosis, foot abscessation, besnoitiosis (elephant skin disease), a variety of poultry and pig diseases, the problem of low lambing and calving rates and abortions, to name but a few, are not receiving as much research attention as their importance as limiting factors in animal production warrants.

If the RSA wishes to compete on world markets with its animal products, the erosion diseases will have to be halted. If we do not take heed to this warning, wool and mohair, virtually the only remaining agricultural products which can be profitably exported, will be the next casualties of the increasing cost of agricultural production.

Epidemiological studies

Most diseases cannot be controlled effectively unless the epidemiology is understood. Lamsiekte is a case in point (*vide infra*). Once the links in the chain were established lamsiekte ceased to be a serious problem on farms where the recommended prophylactic measures were implemented.

It is amazing that after all these years we still know very little about the epidemiology of such important diseases as heartwater, gall sickness, foot-and-mouth disease, horse sickness and bovine malignant catarrh of sheep origin. It is only recently that we have begun seriously to study the epidemiology of African swine fever, redwater and bluetongue and the ecology of the most important ticks parasitizing our livestock and game.

The epidemiology of internal parasitism in sheep and cattle farmed extensively requires much more attention from research. The emergence of resistance to worm remedies in internal parasites of sheep makes it imperative that these drugs be used less frequently, and thus reduce the selection pressure for resistance and conserve their use for posterity. The steady stream of new worm remedies and insecticides of the past 3–4 decades is apparently slowly drying up, and this tendency underlines the importance of this philosophy. Basic studies on the epidemiology of worm infestations under different ecological and prescribed managerial and, particularly, extensive, conditions are necessary. These include the parasite in the host as well as on the pasture. Thus ecological methods to limit exposure could be provided, and worm remedies be only used strategically.

Epidemiological studies require special techniques and statistical procedures as analytical tools. The necessary education to acquire these skills is a prerequisite for more advanced investigations.

Diseases of game

Game farming is here to stay. Although it is experiencing growing pains at the moment, it will hopefully become a stable economic enterprise as time goes on. It will then make necessary more research on the diseases of wild animals. Diseases such as anthrax and rinderpest could otherwise decimate game populations and wipe out rare species. Good vaccines are available, but their efficacy in game needs to be determined and a practical method of administration found.

Game farmers and researchers alike should remember that game have many thousands of years of natural selection behind them. They can exist quite happily in the presence of a variety of parasitic and infectious agents, provided that they are allowed to live the kind of lives they are used to. Game can, for instance, be farmed in regions where cattle die out or lead a precarious existence. Let us use their genetic potential instead of remedies to combat their diseases right from the start, rather than slowly coming round to its use when all other approaches are in danger of failing, as is the case with livestock at present.

To illustrate this point, in my opinion it is much more important to determine the optimum number of antelopes of different kinds that can be kept in prime health *without medication* within a game-fenced farm of a reasonable size than to establish what worm remedies should be administered in a lick block, either prophylactically or therapeutically, when their condition indicates that there is a problem.

Disease- and parasite-resistant animals

Plant geneticists have for years used their knowledge and talents to breed "cultivars" which are, for example, drought or disease-resistant. Animal scientists have been lagging behind in this respect and it is only relatively recently that they have started making use of appropriate genes that nature has made available through centuries of natural selection.

Australia wrested the lead, lost by South Africa because of its shortsightedness, by systematic studies which led to the development of a method for measuring the degree of resistance of cattle to tick infestation. They are now specifically selecting for that trait, both on the farm and at performance-testing centres. Droughtmaster and genetically similar cattle require minimum attention as regards mustering, dipping, de-worming, etc. They are referred to as "easy care" animals, which means that they are ideally suited to that country with its shortage of labour. Australian scientists are now trying to exploit resistance to blowflies and internal parasites to create "easy care" sheep.

Trypanosomiasis-resistant cattle, long known in Africa but neglected in favour of chemoprophylaxis, are also beginning to excite more interest, and there are many other possibilities worth investigating. We are clearly passing from the time of therapeutics into the era of genetic control of diseases. The blossoming technology of biotechnology may well prove to be of great use for hastening the rather slow process or producing genetic improvement in animals.

Biotechnology

When Watson & Crick cracked the genetic code in 1953, untold fields of science were opened up for investigation. Genetic engineering was one of the choicest fruits to come forth.

South Africa as a whole was caught napping by the more recent advances in biotechnology, Onderstepoort being no exception in this regard. However, the institute was well-prepared to adapt, having a team of active molecular biologists available for whom the technology held no secrets. Hence Onderstepoort is currently one of the leaders in South Africa.

Genetic engineering holds great prospects for the manufacture of vaccines. A breakthrough in this regard would be most useful, particularly as regards foot-and-mouth disease and bluetongue vaccines, for an institute such as Onderstepoort, with its own vaccine factory. In the case of foot-and-mouth disease, an important advantage is that no live virus would be used in the production process, and the laboratory would thus be much safer. The polyvalent, attenuated bluetongue vaccine is cumbersome to administer since it involves repeated vaccination at short intervals, and it is therefore unpopular with farmers. A single inoculation once a year would be much more acceptable, particularly if it could be combined with other vaccines, such as clostridial vaccines. Furthermore, biotechnology holds some promise for the development of vaccines against parasitic infestations, such as cysticercosis, where it is difficult to obtain the large quantities of antigen required for efficient vaccination. Redwater, anaplasmosis and heartwater may also prove to be potential candidates for cloning or synthesis of protective antigens.

Other sophisticated techniques, such as monoclonal antibodies and other immunological techniques, can be used to facilitate progress in fields not responsive to older techniques. In fact, immunology and biotechnology are closer together today than they have ever been before.

Biotechnology has come to stay, and will have to receive much more attention in future, even if it means importing experts with the necessary experience.

Vaccine production

The vaccine factory at Onderstepoort has evolved from a small beginning into an enterprise which probably manufactures a wider spectrum of vaccines for use in stock than any other in the world *(vide supra)*. Stagnation means degeneration and recent developments indicate that the time is ripe for progress.

The vaccine factory was recently placed on a "trade account" which means that it must finance itself. The recent drought, however, has shown that the income of the vaccine factory is almost wholly dependent on the economic position of the farmers. Since personnel cannot be easily retrenched in the state service to keep down costs, and as the production of vaccines cannot be stopped temporarily, a programme for the replacement of wornout and outdated equipment had to be curtailed, to the detriment of both the quality and quantity of the products produced.

It seems logical to argue that, if Onderstepoort's vaccine factory is expected to finance itself and produce products of the high quality required by modern farming, it must have the necessary infrastructure, top quality personnel and relative freedom from constraints imposed by the State.

The factory will require not only efficient modern equipment, but also a building with the necessary facilities to meet the stringent modern requirements for so-called "good manufacturing practice". This would include particle free facilities.

To increase its economic viability the vaccine factory would have to diversify its range to include, for example, poultry vaccines and vaccines for pets. It might even be worth while creating a national vaccine factory which caters for both animal and human health.

The factory must also be able to compete for good personnel with the private sector, be able to retrench personnel more easily, to borrow money, to buy new equipment or cancel orders at relatively short notice, and to carry over profits and losses from one financial year to the other. It would also have to co-operate with private vaccine manufacturers when it is in the interests of the stock industry to do so.

What I am saying is that the vaccine factory cannot function within the customary confinements of a government department, if it is expected to be financially truly viable.

It would, however, have to manufacture certain highly strategic products, such as foot-and-mouth disease, rabies, anthrax and brucellosis vaccines, to name only a few animal vaccines required by the State. Limited Treasury funding would therefore be essential.

The creation of a self-supporting, statutory corporation which is either independent of or tied up with the rest of Onderstepoort in some way is in my opinion the next logical step in the evolution of the vaccine factory, with the priviso that vaccine development must be catered for. This would enable the factory to compete with private enterprise which cannot obtain vaccines against local diseases from overseas and is not interested anyway in producing the many non-profitable vaccines in South Africa. This is a function the vaccine factory would have to fulfil for many years to come, because these vaccines are essential for profitable stock-farming in this country with its extraordinarily wide spectrum of infectious diseases.

Diagnostic work

Diagnostic work has certain advantages, as has been pointed out above. It is also true, however, that diagnostic work is often a tedious task which interferes with research activities.

Perhaps the crux of the problem is that Onderstepoort has too few posts to carry the burden of research plus diagnostic work. This could be remedied either by creating more posts in the relevant disciplines or by establishing an entirely separate diagnostic unit, or possibly even by separating where separation is easy and natural and leaving well alone where separation is likely to be more traumatic.

Whither Onderstepoort

I think that after 75 years it is both wise and necessary to reconsider the position of veterinary research in South Africa. Veterinary research is going to be extremely important in this country for many years to come. The extensive non-arable areas in the RSA (about 68 % of the surface area) are best utilized by ruminants, and diseases peculiar to these conditions will continue to be an important economic factor. Greater intensification will also have to take place to provide the necessary food for the expanding human population, and the diseases of stock which flourish under these conditions will demand considerably more attention than they are receiving at present.

Onderstepoort conducts more mission orientated research aimed at providing solutions to stock disease problems than any other institution in this country. It will have to continue with these activities to meet the abovementioned challenges.

Onderstepoort has been organized on the basis of the well-known disciplines of the classical veterinary university course for many years. Since its 50th anniversary in 1958, important changes that have occurred have been the loss of 6, mainly clinical departments when the Faculty of Veterinary Science became independent in 1973 (together with posts for 45 teachers and 20 technicians) and the loss of the Nutrition and Rumen Biochemistry Sections, when the organization of the Institute was rationalized in 1982.

Rationalization has also seen the consolidation of sections such as Molecular Biology and Biochemistry, Poultry diseases and Laboratory animals, and Bacteriology and Reproduction. A section of Molecular Biology was created in 1964, and the Foot-and-Mouth Disease Laboratory in 1980.

The question arises whether the current organization is the best one to meet the existing challenge of research priorities. Formal reorganization is extremely cumbersome and takes years to accomplish. Onderstepoort has, however, managed to some extent to reorganize internally to meet the most pressing demands. Excellent research productivity, for example, can be obtained by building up teams around researchers of excellence, as sometimes happens at Onderstepoort. Greater freedom to reorganize as the need arises would, however, be extremely beneficial for research.

The Institute has been experiencing increasing difficulties in attracting and retaining researchers and technicians of high calibre. The reason, in my opinion, is not so much that service conditions are poor, for with benefits, such as an excellent housing subsidy, medical aid and a month's bonus, the average person with a tertiary qualification can live in reasonable comfort. The problem is primarily due to the inflated economy and the shortage of trained manpower in this country. Not only the private sector, but also the universities and semi-state organizations can outbid Onderstepoort every time when it comes to salaries and/or service conditions. It is imperative that Onderstepoort be able to compete for staff equally with sister institutions in the private and public sector if it is to continue to serve the country as it has done hitherto. The recent implementation of the new policy of "professional differentiation" will, hopefully, help to solve the manpower problem.

There are, however, still many insoluble problems which hamstring research work that have been created by the rigid system of administrative control, developed for the sound management of government departments concerned with regulatory services rather than with veterinary and other research activities, which hamstring research work.

In view of all these very valid arguments, the time may well be ripe for the institute to evolve into a semi-state institution. The principle is fully acceptable in South Africa. There are several examples of excellent research establishments which operate very efficiently in this fashion. In fact, most research done by the government sector in this country is currently conducted in this way (Anon., 1984b). Although it is true that there is no system without some disadvantages, the semi-state system indeed would have many advantages over the present. Veterinary research, with its undoubted impact on the conservation of South African resources, should derive considerable benefit from such a development.

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