Die Rol van die Fisiologiese Wetenskappe as deel van die Veterinêre Leerplan

deur

Prof. dr. W. L. JENKINS

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Prof. dr. W. L. JENKINS

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W. L. JENKINS

Inleiding

Gedurende 'n lewensloop van 'n verwagte sewentig jaar is daar vir die enkeling in die moderne gemeenskap blykbaar bitter weinig tyd beskikbaar om **sy** fundamentele bydrae tot die ontwikkeling van die mens op hierdie planeet te bepeins. So 'n altruïstiese oorweging is nie noodwendig so vrugteloos as wat dit by die eerste oogopslag lyk nie. Die feit bly dat ons nog geseën is met 'n Godgegewe geleentheid om te kan bydra tot die oprig van die gebou van kennis en van begrip van alle vlakke van menslike strewe. Hoe klein ook al die baksteen, die klip, hoe gering die sement of sand wat die enkeling mag byvoeg, dit bly steeds 'n positiewe bydrae. Maar al te dikwels, helaas, word die eerste kans tot moontlike wysigings in die benadering van die gholfbaan van die lewe eers dán gebied wanneer 'n mens reeds die volle baan afgelê het en 'n goeie, 'n middelmatige of selfs 'n swak telling aangeteken het. Die redes vir die uitslag kan moontlik baie duidelik wees, maar dan is die spel onherroeplik verby. Al wat oorbly, is die dikwels so moeilike en delikate taak om aan ander spelers wat volg, te wys waar die verraderlike hindernisse lê en om hulle aan te raai watter stokke om te gebruik.

Dit is in hierdie gees dat ek met dank en ootmoed gebruik maak van die seldsame geleentheid om my in 'n oopte in die bos te bevind en in 'n posisie om met u, ten opsigte van my besondere deel van die baan, my aanskouing van die bome, die takke, en bes moontlik selfs die blare, te deel. Nog in 'n groot mate in die aanvanklike opwinding van die spel sal my gedagtes hoofsaaklik toegepits word op, ten eerste, die verwagte struikelblokke en, ten tweede, die hantering van onvoorsiene ontwikkelings en die vermyding van verlies van koers en doel.

Socrates het tydens sy verhoor in die jaar 399 v.C. aangevoer dat die rede waarom hy gefilosofeer het daarin geleë was dat „die onbepeinsde lewe nie die moeite werd was nie". Sedertdien is daar oor die jare inderdaad vele lewensdieptes gepeil deur die opvolgers van die ou Griekse filosowe.

Die volgende is hierdie basiese konsepte:

1. Die put van lewensgenot.
2. Die inspan van die rede.
3. Die stukrag van vooruitgang.
4. Die strewe na die ideaal.

Hierdie vier bakens dien as basiese riglyne van my aanbieding vanaand, naamlik die put van lewensgenot uit 'n realistiese en redelike voortgang na die ideaal in terme van die rol wat die fisiologiese wetenskappe in die veeartsenykundige leerplan speel.

Wat is die fisiologiese wetenskappe?

'n Omskrywing van die fisiologiese wetenskappe is 'n noodsaaklike uitgangspunt vir verdere bespreking. Vereenvoudigde en breë stellings sal hierdie doel dien. Ek beskou Fisiologie as die studie van die normale liggaamsfunksies, en Biochemie (of Fisiologiese Chemie) as die studie van die chemiese samestelling van liggaamsweefsels en van die chemiese reaksies wat in hierdie weefsels plaasvind. Die skouspelagtige sukses waarmee fisiologiese reaksies in terme van biochemiese prosesse verklaar kon word, het daartoe gelei dat die basiese dissiplines van Fisiologie, enersyds, en Biochemie, andersyds, op vele gebiede feitlik onlosmaaklik van mekaar geword het en op andere weer in groot mate oorvleuel het. Hierdie noue verbintenis deurdrenk die biologiese wetenskappe: enige studie van een van hierdie twee gebiede sonder 'n heldere begrip van die ander moet vandag as reine ydelheid beskou word. By hierdie noodwendige en ooglopende verband tussen Fisiologie en Biochemie kan 'n mens ook Farmakologie insluit. Farmakologie, wat die studie van die werkinge en gebruike van middels omvat, is 'n spildissipline wat twee duidelik afgebakende maar nouverwante aspekte saamsnoer, naamlik dié van 'n basiese wetenskap en dié van 'n toegepaste of kliniese wetenskap. Basiese Farmakologie verteenwoordig inderwaarheid fasette van toegepaste Fisiologie en Biochemie, wat geïnduseer word wanneer stowwe van eksogene oorsprong aan die liggaam toegedien word. Hierdie bewering

word onderskraag deur die besef dat middels geen nuwe organiese funksies kan skep nie, maar slegs in staat is om alreeds bestaande funksies te modifiseer.

Ten slotte dien daarop gelet te word dat sekere fasette van op die oog af onverwante dissiplines ook binne die raamwerk van hierdie diskoers ingesluit kan word. So vind ons dan dat aspekte van Voedingsleer en Toksikologie op fundamentele fisiologiese en biochemiese konsepte gebaseer is.

Doelstellings vir die toekoms en verwagte ontwikkelings in Veeartsenykunde

Francis Bacon het opgemerk dat dit nie moontlik is om 'n vaste koers in te slaan as die doel self nie presies beplan is nie. Dit is dus op hierdie tydstip gepas om die bydraes wat vandag deur veeartse gemaak word, te evalueer en, nog belangriker, om te voorspel wat die rol van toekomstige gegraduëerde veeartse sal moet wees in die volgehoue evolusie van die menslike ras en van die diereryk. Die volle betekenis van laasgenoemde oorweging blyk wanneer daar rekening gehou word met die feit dat meeste van ons huidige veeartsenykundige graduandi teen die jaar 2012 waarskynlik nog aktief, en die leiers in die beroep, sal wees. Laat ons dan kortliks 'n blik op die toekoms werp voordat ons tot die hooftema terugkeer.

Die Fakulteit Veeartsenykunde het verlede jaar sy goue jubileum gevier; gedurende hierdie tyd is die luisterryke loopbaan van ons eerste dekaan, die beroemde sir Arnold Theiler, dikwels aangehaal. Loftuigings was op hierdie tydstip baie gepas, maar die beklemmende besef het my beetgepak dat ons die punt bereik het waarop skeiding gemaak moet word tussen een era en 'n nuwe fase van ontwikkeling — 'n periode waarin dit gebiedend sal wees om nie op die louere van vergange prestasies te rus nie, maar om alles in die stryd te werp vir die volgende vyftig jaar. Dit het deur my gedagtes geflits dat, as dr. Theiler vandag hier was, hy die eerste sou gewees het om te erken dat dit wel die geval is; bowendien, siende die groot en dinamiese figuur wat hy was, sou hy waarskynlik die uitdagings wat ons nou konfronteer, erken het as van 'n ander aard en seer sekerlik van wyer omvang as dié wat hom in die eerste deel van die eeu in die gesig gestaar het. Stanislavsky het opgemerk: „Aan die einde van elke antwoord is daar 'n vraag". In die geskiedenis van die veeartsenykundige wetenskap in Suid-Afrika het sir Arnold Theiler en baie ander, waaronder ek twee van my voortreflike voorgangers moet noem, naamlik professor J. I. Quin en professor R. Clark, baie antwoorde verskaf: hul erfenis aan ons is om ons besig te hou met baie van die daaruit voortspruitende vrae.

Laat ons probeer peil hoe ons wêreld moontlik in die jaar 2 000 sal lyk, mits geen natuurlike of mensgemaakte rampe die wêreld tref nie. Statistiek is gewoonlik interessant, indien nie prikkelend nie, maar dié wat geprojekteer is vir die einde van die eeu en wat Veeartsenykunde, hetsy direk, hetsy indirek, raak, is eenvoudig ontstellend. Die wêreldbevolking sal teen daardie tyd waarskynlik 6 000 miljoen, en die verwagte bevolking van die Republiek van Suid-Afrika vyftig miljoen, beloop. Dit beteken dat die bevolking op aarde binne dertig jaar soveel keer sal vermeerder as wat oor die afgelope dertig duisend jaar die geval was. 'n Paar maande gelede het White-Stevens hierdie fenomeen in die volgende woorde beskrywe: „Hierdie fantastiese aanwas van die mensdom is die betekenisvolste biologiese gebeurtenis sedert lewe die eerste keer op aarde verskyn het. Dit is 'n kataklisma van reusagtige omvang en vereis die ten volle toegewyde pogings van alle intelligente mense oral op die aardbol indien dit effektief versag moet word".

Vandag sterf meer as twintig miljoen mense jaarliks 'n hongerdood en die Paddock-broers het voorspel dat hierdie syfer, slegs as gevolg van hongersnood, moontlik tienvoudig tot 200 miljoen per jaar kan vermeerder in die nie al te verre toekoms nie. Daarby lewe 'n groot deel van die mensdom, in die lande met 'n voedseltekort, op 'n ongebalanseerde dieët en is hulle dus ondervoed. In die verbygaan dien daarop gelet te word dat daar geen werklike hoop is vir die oortollige hoeveelheid mense van hierdie aarde om na ander planete te emigreer nie. Daar is bereken dat dit meer energie vereis om 'n man van 80 kilogram uit die aarde se aantrekkingskrag te lig as om hom 2 000 kalorië per dag vir tien jaar te voer en hom teen 20°C vir sy lewens-

duur te huisves. Dit sal ook meer kos as die wêreld se huidige bruto produk om van die oortollige bevolking van een lopende dag, t.w. 200 duisend, op hierdie manier ontslae te raak. Ons moet die waarheid in die gesig kyk dat, tensy menslike voortplanting verminder en buitengewone pogings aangewend word om voldoende voedsel te verskaf, die mens gedoem sal wees, soos Thomas Malthus reeds amper 200 jaar gelede voorspel het. Die betekenisvolle feit moet onderstreep word dat die bevolkingsontploffing homself hoofsaaklik in die ontwikkelende lande voltrek, terwyl bevolkingsgrootte in die gevorderde gemeenskappe van die wêreld geneig is om te stabiliseer. Die deurslaggewende rol van opvoeding en die noodsaak vir sosiale verandering onder die onontwikkelde volkere is dus vanselfsprekend.

Tekort aan eiwit is die grootste probleem van ondervoeding. Die minimum eiwitvereistes van die mens en sy plaasvee is alreeds kwalitatief en kwantitatief bepaal en daar kan geredelik aanvaar word dat die hedendaagse tegnologie in landbou en voedselwetenskap in die behoeftes van die bevolking in hoogs ontwikkelde lande tot die jaar 2025 sal kan voorsien. Die vooruitsig bly dus uiters skraal, ten spyte van die moderne vordering in die gebruik van natuurlike koolwaterstowwe, om genoegsame verteerbare aminosure en polipeptiede te produseer.

Daar is geweldige uiterstes in die gebruik van dierlike eiwit in die wêreld vandag. 'n Lid van 'n welvarende gemeenskap verbruik tot sewe keer die minimum hoeveelheid dierlike eiwit wat vir sy onderhoud nodig is. As sodanig word hierdie dierlike eiwit van plantaardige eiwit geproduseer teen 'n verlies van ongeveer 7:1. Daar is dus 'n oormaat verbruik van plantaardige eiwit deur die mens, veral in die westerse lande, wat tot 50 keer bo sy minimum vereistes kan beloop. Ons is maar al te bewus van die teenoorgestelde uiterste en die gevolge daarvan. Op een of ander manier moet hierdie wantoestand reggestel word.

Ons moet ook aandag skenk aan die toekomstige rol van die huisdier-herkouer. Daar is 'n moderne neiging om hoëenergierantsoene aan herkouers te voer wat tot 'n gewisse mate van kompetisie met die mens lei. Dit skyn asof die volste voordeel nie uit die inherente vermoë van die herkouer getrek word om lae-energieruvoer te benut nie.

Die veearts het 'n onontkombare verpligting in hierdie lewensbelangrike poging om voedselproduksie te verhoog. Nog nooit tevore in die geskiedenis is dié beroep met 'n taak van so 'n omvang gekonfronteer nie: die veearts moet meehelp om die produksie van dierlike eiwit te verseker, om hongersnood te bestry en om die gesondheid van die mensdom oor die hele wêreld te verbeter. Aandag sal aan etlike aspekte van die veeartsenykundige wetenskap gegee moet word ten einde produktiwiteit te verhoog. Die vernaamste hiervan is: die bestryding van diersiektes; die ontwikkeling van middels en biologiese agense vir die onderhoud van dieregesondheid en vir moontlike versnelling van groei; die studie van parasitologie en kunsmatige inseminasie; die vermindering van steriliteit; en die fisiologie van voeding en reproduksie. Professor Robert Ornduff het in 'n lesing voor die 1970-kongres van die Suid-Afrikaanse Vereniging vir die Bevordering van die Wetenskap gesê: „Die toekoms van **Homo sapiens** op aarde is nie hopeloos nie. Watter toekoms ons het, lê in die hande van die wetenskaplikes; hoe gouer dit algemeen deur die gemeenskap erken word, hoe groter is die kans dat ons iets van waarde vir die nageslag kan red". Professor Meiring Naudé het 'n soortgelyke voorspelling gemaak en daaraan toegevoeg: „Ons moet wetenskaplike navorsing 'n honderd jaar vooruit beplan". Hierdie woorde het 'n gewigtige betekenis.

Benewens die swaar verpligtings van die veearts wat hom op voedseldiere toespits, moet ons ook voorspel watter ander loopbane vir veeartsenykundige graduandi beskikbaar sal wees namate die menseras na 'n periode van krisis snel. Die huidige opleiding van 'n student verskaf 'n akademiese basis wat hom in staat stel om tot 'n aantal beroepsfere toe te tree. Hieronder kan ons ten minste die volgende insluit: grootdierpraktyk, opgedeel in voedseldierpraktyk en perdepraktyk; kleindierpraktyk; proefdiergeneeskunde; beherende veeartsenykundige geneeskunde; veeartsenykundige openbare gesondheid; insluitend vleis- en

voedselinspeksie; militêre veeartsenykunde; diergeneeskunde toegepas op wildbewaring en dieretuin- veeartsenykundige praktyk; basiese en toegepaste veeartsenykundige en mediese navorsing; en, ten slotte, onderwys, insluitende veeartsenykundige, mediese en biologiese onderwys.

Ek glo dat relatiewe klemverskuiwings met die verloop van tyd op al hierdie gebiede sal plaasvind, alhoewel elkeen op sigself sal ontwikkel.

Dit skyn tog of baie meer veeartse hulle op voedseldierproduksie sal moet toespits en of spesialisasie in hierdie, net soos in al die ander moontlike aktiwiteite, in beide vakrigting en in 'n betrokke spesie onvermydelik sal moet plaasvind. Dit is 'n feit wat ons sal moet erken.

Ek verwag ook dat al hoe meer veeartse hul loopbane sal vind op die terrein van navorsing in die menslike geneeskunde, veral in die basiese wetenskappe, waartoe hul opleiding hulle in staat stel. Na my mening sal veeartsenykunde altyd aan beide die mediese en die landbouwetenskappe verbonde bly; dit vorm inderdaad 'n baie geskikte skakel tussen hierdie twee gebiede. Laboratoriumdiergeneeskunde is 'n terrein wat vinnig uitbrei en waarop daar vandag slegs 'n paar spesialiste in die Republiek is. Hierdie toestand sal reggestel moet word. Eweneens is moderne militêre veeartsenykunde in Suid-Afrika nog in 'n vroeë stadium van ontwikkeling.

Dit is te hope dat die aantal veeartse wat 'n rol in wildbewaring speel, sal toeneem, indien daar aangeneem word dat die wildreservate die druk van buite waaraan hulle onderhewig is, sal kan weerstaan en sal aanhou om te floreer. Na my mening is die toekoms van wildboerdery nog baie vaag, en ek sou nie graag voorspellings hieroor wou waag nie.

Die praktiserende veearts van die toekoms sal moontlik geroepe wees om werkdiere soos waghonde, speurhonde, gidshonde en trek- en patrollieperde, eerder as troeteldiere, te versorg. Nogtans sal die mededinging om voedsel 'n groot vermindering in die aantal geselskapsdiere teweegbring, veral wat die karnivore betref.

Ten slotte voorsien ek, wat opvoeding betref, baie nouer interdissiplinêre skakeling op die basiese en selfs op die toegepaste vlakke. Trouens, in dié opsig, waar sir William Osler die stelling gemaak het: „Daar is slegs een geneeskunde", is dit moontlik nader aan die waarheid om te sê: „Daar is slegs een biologie".

The role of the Physiological Sciences in future Veterinary education

Having initially presented and examined our arrows — the physiological sciences — and having outlined a series of targets — the potential veterinary careers of the future — we must now evaluate how best we can utilize our bow — the veterinary curriculum — to speed the arrows on their way.

In 1962, Dr. George Berry, a physician associated with a medical school in the United States, made the following observations: "What are the enemies that we as teachers face as we work to improve medical education? Surely our enemies include: habit and simple inertia, contentment with the **status quo** and self-satisfaction, fear of change, slavish adherence to orthodox and conventional habits and procedures, failure to understand the significance of social evolution and the consequent expansion of the responsibilities of and opportunities to the physician". These remarks are equally appropriate to veterinary education, and we must investigate some of the possible measures to overcome these factors hostile to the objective teaching of both undergraduate and postgraduate students.

Today we are confronted in almost every academic sphere with a prodigious expansion of knowledge, which is rapidly approaching an exponential rate. This holds particularly true for the field of biology, as applied to the medical and veterinary sciences. An additional problem is that the complexity of the interrelationships in biology are much greater than those between the various branches of the pure sciences. Furthermore, because of the dependence of biology on the pure sciences, advances in the latter invariably have an effect on the former. Regular visits to the library bear ample testimony to this phenomenon. We are now well and truly beyond the point of being able to transfer this knowledge in its entirety to students. About **60 years ago** Welch stated: "It is impossible to impart the entire content of medical and surgical science to the student . . . or even

to impart the content of a single subject of the curriculum. The utmost to be expected is to give the student a fair knowledge of the principles of the fundamental subjects of medicine and a power to use the instruments of his profession . . . and above all to put him in a position to carry on the education which he has only begun in medical school". How infinitely worse is the situation today!

The final phrase of the above quotation is of profound importance, namely, "to carry on the education which he has only begun". It was mentioned earlier that our 1972 graduates will be the senior men of the profession in 2012. What proportion of the basic factual knowledge acquired during their veterinary course will these students recall in forty years' time? It may well be very limited, if not infinitesimally small; but what is far more significant is how much of this "factual knowledge" will still be valid or have any bearing whatsoever at that time. Thus, as teachers, we are obligated to cultivate fertile and receptive minds which will be able to accept and adjust to the radical sociological changes which we anticipate within their professional lifespans. We must be conscious of this duty at all times and must avoid any tendency to curb or impair these inherent mental abilities — they represent our hope for the difficult times to come. Moreover, it is not only **what** a student is taught but **how** he is taught which exercises a tremendous influence on the development of his preparedness for his future career. A paragraph in an address of the late Dr. Stokes perhaps best illustrates the pith of my remarks: "Let us emancipate the student, and give him time and opportunity for the cultivation of his mind, so that in his pupilage he shall not be a puppet in the hands of others, but rather a self-relying and reflecting being".

As with any discipline, in Physiology and its related subjects there is a need to impart basic facts, and of necessity in some detail. This knowledge can only be built up by careful and logically consistent progression. It must commence not only with an introduction to biology in high school and the first year spent at university but, of even greater importance, must also commence with an understanding of the mathematical, chemical and physical sciences. The reason for my emphasis on the pure sciences is simply that biological concepts are dependent upon the pure sciences. Furthermore, applied biological facts are constantly reinforced throughout the veterinary curriculum, whereas the pure sciences hardly receive any attention during the balance of the undergraduate course. This may well be no loss to the veterinarian who will remain engaged in a practising career. Nevertheless, modern research is rapidly closing the gap between the pure sciences and the biological sciences and the graduate veterinarian who becomes involved in basic research will soon recognize his shortcomings in the former disciplines.

I should like to illustrate this point with examples encountered in Physiology, Biochemistry and Pharmacology.

In the study of biological membrane function, it is frequently possible to represent physiological phenomena by the use of mathematical models. This is particularly true of transport mechanisms. The validity of these models is often confirmed following appropriate and well controlled investigations both **in vitro** and **in vivo.** Furthermore, the interpretation of this type of study requires considerable mathematical acumen.

The tremendous strides made during recent years in the technology of analytical instrumentation has permitted detailed investigation into the absorption, distribution, biotransformation and excretion of foreign compounds in the body. The results of these studies have indicated that the majority of the interactions which occur between the relatively small drug molecules and the intracorporeal macromolecular systems are based entirely on well-defined physicochemical concepts.

Similarly, many of the mechanisms involved in enzyme-mediated biochemical reactions have been elucidated. Thus the electron shifts, dipole and induced dipole moments, and the ionization processes which are responsible for the creation of the electrostatic forces which lead to ideal enzyme-substrate "fit" have come under close scrutiny, and their contributions in specific reactions have been defined. Furthermore, the energy requirements or the

energy release associated with the subsequent formation or cleavage, respectively, of the chemical bonds have also been determined in many cases. The forces involved and the laws governing these reactions, for example the laws of thermodynamics, are identical to those encountered in the study of Physical Chemistry. This is not really surprising when one considers that all biological systems simply represent aggregates of atomic particles whose behaviour is governed by universal principles.

These three examples emphasize how important it is to maintain the link between the physiological sciences and Mathematics (especially the Calculus), Chemistry and Physics. Although this link tarnishes during the course of undergraduate training, it is often an essential facet which must be revived and developed at the postgraduate level. In fact, if significant advances in many aspects of basic veterinary research are to continue, it is vital to retain a sound foundation in the pure sciences — the chasm which has developed must be regarded as a threat to future progress.

This dissociation between disciplines has also become a problem of increasing magnitude even within limited biological fields. Many current research areas have originated as offshoots of broader disciplines and ultimately have developed into specialized fields in their own right. This in itself is natural and healthy progress but there has been an unfortunate consequence, namely, that the parent and offspring no longer communicate with each other and, what is more, often no longer speak the same language. Let us take the study of the single cell as an example. What used to be a relatively small section within the province of Histology and Physiology is today the realm of a number of dynamic emergent research fields such as Cytology, Cellular Physiology, Biochemistry, Biophysics, Biochemical Pharmacology, Molecular Biology and Electronmicroscopy. All study the structure and function of cells but each has its own scientific journal, its own scientific society with its own meetings, and each has developed its own terminology. Unfortunately, with the passage of time, dialogue between the different groups is lost as is the synergistic effect of close co-operation. Needless to say, a student has very little chance of fruitfully correlating and understanding the advances in such closely related fields without the assistance of discriminative interpretation by his mentor — a difficult but essential task!

It is convenient, when teaching Physiology and Biochemistry, to commence with simple basic cellular concepts and from these to develop the principles of multicellular or tissue function, and then finally to integrate and interrelate the organic functions of the body. The **modus operandi** should ideally be based on:

1. Information transfer — generally by formal lectures.
2. Information reinforcement — by practical and demonstration classes, discussion sessions, and seminars.
3. Information utilization — by practical usage, discussion sessions based on theoretical and practical problems, and investigation of clinical cases and herd problems.

The ultimate standard attained by students in the physiological sciences should permit them to answer confidently the challenging question: "Why?", with regards to a particular physiological phenomenon or response. Such a reply should commence with a discussion of grossly interrelated physiological effects and then, by reasonable and logical steps, should incorporate the relevant explanations at the cellular, subcellular and even molecular levels. An excellent illustration of this approach is encountered in the field of Endocrinology. The elucidation of the biological role of cyclic-AMP now permits one to relate the physiological and biochemical effects of a number of polypeptide and other hormones with these agents' subcellular activity, namely the activation of the enzyme adenyl cyclase and the formation of cyclic-AMP, the so-called second messenger, which mediates the alterations in cell function.

Besides an appreciation of all aspects of normal body function, the physiological sciences should fulfil other important roles. Amongst these one may include an understanding of the methods by which scientific knowledge is acquired; the assessment of scientific literature; an appreciation of

experimental design; the formulation of hypotheses; and the statistical approach to data analysis. Specific areas within the different disciplines should be utilized in this respect.

Perhaps the most important of these ancillary tasks is the evaluation of hypotheses. This is particularly true at the postgraduate level, but even the undergraduate should be made aware that in many instances it is simply the explanation which is based on the most creditable evidence which is accepted but should not necessarily be regarded as absolute fact. This approach permits a student some mental freedom of choice based on his own contemplation of the pertinent problem. Far from undermining his confidence, such meditation may be very beneficial for a student as he perceives the difficulties involved and the reasons for these obstacles. It may also be due to the joy of discovering that he is not the only one who simply does not know all the answers!

The foundation acquired by studying Physiology, Biochemistry and Pharmacology is rarely utilized **per se,** except by those graduates working in these particular fields. The majority of veterinarians require this knowledge to be in a position to understand and interpret deviations from the normal which are encountered in practical situations. Michell has recently proposed that this vitally important field of study be known as "Clinical Physiology".

Thus, in medicine, the clinical signs of disease represent the result of disturbed physiological functions and these signs should be interpreted by reference to the physiological state and by asking the question: "Why is there a deviation from the normal?". Similarly, a series of chemical pathological results which contain abnormally low or high values should be scrutinized in terms of the possible reasons for such alterations. The derangement of biochemical systems or the disruption of cellular function which could possibly be responsible for such aberrations should then be evaluated with reference to the normal physiological and biochemical patterns. In addition, many surgical conditions may best be controlled in a similar fashion — shock, anaesthetic emergencies, healing of tissues and impaired organ function represent examples in which a sound physiological and biochemical understanding is imperative for proper management.

A pathologist should not be content simply to investigate the gross lesions discovered at necropsy and then to study the histological changes associated with these lesions. In reality what he is observing in many cases are the final results of disturbed physiological and biochemical mechanisms which have led to particular structural alterations. He would be in a much better position to appreciate the entire pathogenesis by having an understanding of the physiological sciences.

The above tenets have just as much bearing when dealing with a herd or flock problem.

Pharmacotherapeutics is based upon the correction of physiological and biochemical deviations by making use of exogenously derived drugs to control the adverse effects of the disease process. Today we are often able to explain entirely many favourable responses to drug therapy. This was not always the case only a few years ago. An excellent example to illustrate this point is to be found in the modern approach to the treatment of endotoxaemic shock in which each adverse reaction may be rationally and effectively counteracted by the administration of appropriate therapeutic agents.

Michell considers the importance of the contribution of Clinical Physiology to the veterinary curriculum to be threefold, namely: "Intellectually, it provides the stimulus to form a critical and imaginative attitude towards disease processes; perhaps that is the same as saying a scientific attitude. Academically, it dispatches the dragon of "symptom lists" in favour of an understanding of common syndromes. Practically, it seems evident . . . that when treatment is frequently symptomatic, the fullest possible understanding of the physiological derangements must be beneficial".

In addition to the clinical fields, however, the physiological sciences will form an indispensable part in our armamentarium to meet the challenges of the future. Consider for

one the Physiology of Production and its ramifications: Reproductive Physiology, Physiology of Nutrition, Ruminant Physiology, and the Physiology of Stress, Environmental Physiology and the problem of pollution, Behavioural Physiology, and, finally, Comparative Physiology and the interdisciplinary integration of all these fields.

We have reached a stage in the development of the veterinary course at which intracurricular integration must be regarded as absolutely essential. Many aspects of Anatomy and Physiology should be presented in an integrated fashion for the student to obtain optimal understanding of the particular system — an excellent example being Neurology. Similarly, compartmentalization between the disciplines of Nutrition and Biochemistry, as regards the biological role of nutrients, is undesirable. Once again, integrated courses would allow the student to appreciate the full significance of the dietetic requirements of the body. Amongst the numerous other possible illustrations of potentially useful integration of subjects or facets of subjects, one must mention Toxicology, Pharmacology, Physiology and Biochemistry. There are a number of aspects encountered in these four fields which lend themselves admirably to integrated presentation and study, which would permit fuller understanding and desirable reinforcement of knowledge.

I should like to make mention, **en passant,** of the very significant role of the postgraduate student within a scientific sphere and, in our particular case, within the physiological sciences. The strength of many Western nations' research programs revolves around the contributions being made by the postgraduate students working in those countries. The incentive for a postgraduate student is personal achievement and gain — both very strong motivating forces which, if carefully directed, can be of great benefit to all concerned. Moreover, it is during postgraduate training that interdisciplinary links can be forged and cultivated. This is best exemplified by considering the ideal course for a postgraduate student in Pharmacology. Besides all the biologically orientated courses, he would be expected to pursue studies in Organic and Physical Chemistry, Electronics, Calculus and Statistical Analysis.

There remains one final but worrying aspect of our theme which I should like to discuss. Of necessity one tends to orientate a curriculum in a professional faculty towards the requirements of the majority of the graduates or, more precisely, towards the occupations in which the majority of graduates will eventually engage themselves. Although this seems to be logical, there is a singularly important shortcoming inherent in the approach. One may become so engaged in preparing "relevant" courses that one may fail to stimulate the interest of a potential Claude Bernard within a group of students. By spending a little more time on the exciting and intriguing wonders of the physiological sciences, there would be a greater probability of attracting interested and enthusiastic students back to the various fields soon after graduation. One could then possibly establish a fertile lineage which would continue to produce both valuable scientific contributions and competent scientists in the mould of the great pharmacologists who were associated with the University of Dorpat in Esthonia during the last century and the early part of this century.

In summary then, the physiological sciences are vital to our understanding of normal body function and the factors which may disrupt this function. As a group they represent pivotal subjects which readily allow intra- and interdisciplinary liaison and co-operation. The physiological sciences should develop close associations with the pure sciences, on the one hand, and must play an important role in the global biological problems confronting the world, on the other.

If I have created the impression that the physiological sciences are the most important courses in our veterinary curriculum, I hasten to confirm my belief. I hope that I have provided sufficient evidence to substantiate my point of view.

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