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INJURIES TO DUTCH SPORT PARACHUTISTS

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ABSTRACT

From 1981 to 1985 193,611 jumps were made by sport parachutists in the Netherlands. Of these 267 (0.14%) resulted in injuries including 4 fatalities. In this report the different types of injuries and their causes are discussed and comments are given in relation to training, selection, precautions and equipment, as well as upon accident registration and possible modifications.

Key words: Parachuting, Skydiving, Sports injury

INTRODUCTION

Sportparachuting is increasingly popular in the Netherlands as well as in most European countries and America, which is emphasised by the fact that recently the sport obtained Olympic status. Every incident related to parachuting that either results in injury or from an educational point of view is worth mentioning must be reported within 72 hours to a special committee under the Department of Sport-parachuting of the Royal Netherlands Aeronautical Association (RNAA) with which fourteen sportparachuting-clubs are associated. In this article the incidents resulting in injury reported in a five-year-period are presented and commented upon.

TECHNICAL CONSIDERATIONS

In parachuting several disciplines exist in which two basic directions can be recognised: flying under a parachute (canopy), either to make precision-jumps or to make formations with other parachutists under canopy (CRW = canopy relative work) or using the parachute 'only' as a means of safe return to the ground after freefalling during which several so-called skydivers together may have formed patterns (RW = relative work, this being the most popular discipline in the sport). Deployment of a canopy basically can be effected in two ways: automatic deployment of the canopy by a static line which is attached to the plane and manual deployment after a certain time of freefalling, at the latest at an altitude of approximately 2,500 feet (800 metres).

Static line-jumps are almost exclusively made by novices, whereas freefall-jumping requires a certain amount of experience unless it is part of an accelerated freefall-course (AFF): after a rigorous groundtraining the novice starts immediately with freefall and is accompanied by two instructors all the way. As this type of training in the Netherlands has only developed in the last two years AFF is not referred to in this report.

For novices, apart from a main and a reserve parachute which are obligatory for every parachutist, the following equipment is also obligatory: high boots to protect the ankles, a hard helmet to protect the ears from injury by the risers (attachments of the suspension-lines of the canopy to the harness) during deployment of the canopy and to protect the head from injury while landing. Gloves have to be worn when the temperature at exit-altitude is zero or below zero °C. Goggles must be worn when spectacles or contact lenses are used while jumping. Freefall jumpers also carry an altimeter.

As long as a parachutist has not reached the B-license-level use of an automatic activation device (AAD) is obligatory. An AAD will indirectly deploy the reserve-canopy when a certain altitude (usually 1,000 feet, calibrated on the AAD) is passed at a certain speed. This speed will only be reached when malfunctions of the main canopy are not followed by proper action which should result in deployment of the reserve-canopy above 1,000 feet, or when because of, for example, unconsciousness the main canopy was not deployed at all.

Two basic types of canopies are used in parachuting: the round (novice) canopy and the square (ram-air) canopy as used by freefall-jumpers. Round canopies are characterised by a relatively high descent/forward-speed rate and low manoeuvrability; squares have a high forward speed and a low descent-speed and are very manoeuvrable.

Novices receive a thorough training before being allowed to make their first jump. Apart from malfunction procedures they are extensively drilled in landing procedures and the paralanding fall (PLF). This PLF is of utmost importance for safe landings under a round canopy: landing has to be done facing into the wind and because of the low forward speed of round canopies most landings are made backwards. To absorb the landing shock feet and knees are held together tightly, knees and hips are slightly bent and the body should be held in a 'banana-position' in which the convexity of the banana is pointing in the direction of movement. The parachutist lands on his feet, rolls over the downwind knee, hip and shoulder and smoothly rotates his body to the other side flipping over his legs and as a result looks directly in the direction of his canopy so no entanglement in its suspension lines can occur. This sequence of actions absorbs most of the landing-shock and even relatively hard landings performed in this manner do not result in injury.

When landing under a square-type canopy, which is also done when flying into the wind, the high forward speed of this canopy induces a forward directed landing. By flaring the tail of the canopy all forward and descent speed can be reduced to zero during the transition to stall (i.e. lift disappears and the canopy falls away backwards); this makes it possible to land very softly "on the toes".

MATERIALS AND METHODS

From 1981 to 1985 Dutch sport parachutists made 193,611 jumps. During these five years 267 accidents were reported by the instructor or jumpmaster in charge. For the purpose of accident reporting special forms are distributed by the

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RNAA parachuting committee. On these forms age, sex, level of experience, materials used, type of injury (preferably a medical diagnosis), cause of the accident ground wind-speed etc., have to be specified.

After comparing the annual reviews of the different clubs with the number of reported accidents it seems likely that not all accidents were reported. Because of this the figures that are mentioned in this report must not be taken at face value but must be valued in relation to each other. The number of unreported accidents seems not to be as large nor the injuries as severe that they would significantly alter the conclusions made in this report.

In most tables in this report the levels of experience of the involved parachutists are characterised by four groups:

— AO 1-2: first and second automatic opening-jumps (static line);
— AO 3-8: third to eighth automatic opening-jumps;
— AO > = 9: after eight jumps a novice ascends to 'A-level' and obtains student-status;
— FF: freefall, represented by different levels of experience from A-level up to instructor-level.

RESULTS

Accident frequencies

Of all accidents novices were involved in 56.2% and of these 66% during their first or second jump. Freefallers were involved in 38.6% of all accidents. Although in an absolute sense novices were subject to injury about as often as freefallers, in a relative sense they were injured about 4.5 times as often (Table I).

TABLE I

Rates of accidents and injuries of Dutch sport parachutists in relation to experience over a 5-year period from 1981 to 1985.

Experience	No. of accidents (%)*	No. of injuries (%)**	Accidents in AO (%)†	FF (%)‡	Total (%)§
AO 1-2	99 (37%)	109 (36.2%)	0.21%		0.05%
AO 2-8	51 (19.1%)	54 (17.9%)	0.11%		0.03%
AO > = 9	14 (5.2%)	15 (5%)	0.03%		0.007%
FF	103 (38.6%)	123 (40.9%)		0.07%	0.05%
Total:	267 (100%)	301 (100%)	0.35%	0.07%	0.14%

* of the total number of involved parachutists
** of the total number of injuries
† of the total number of AO-jumps (47,278)
‡ of the total number of FF-jumps (146,333)
§ of the total number of all jumps (193,611)

Causes of accidents

In Table II causes of accidents are presented in relation to the levels of experience. Evidently most accidents occurred because of faults made during landing-procedures (65.5%) of which incorrectly executed PLF's made up 52.4%. Eighty-two per cent of the accidents in novice-jumps were related to faults made during the landing procedure of which 80.5% were due to an incorrectly executed PLF.

The most frequent direct causes of injury in incorrectly executed PLF's were landing on one foot, landing on the buttocks because of pulling up the legs at the last moment

TABLE II

Causes of 267 parachuting accidents resulting in 301 injuries in relation to experience.

Cause of accident	Kind of jump AO 1-2	AO 3-8	AO > = 9	AO tot.	FF	Tot (%)*
Incorrect PLF	69	32	6	107	14	121 (45.3%)
Landing against/on obstacle	5	5	1	11	5	16 (6%)
Landing while turning	3	1	3	7	9	16 (6%)
Landing on uneven terrain	3	2	1	6	4	10 (3.7%)
Landing various	8		1	9	23	32 (12%)
Steering faults	4	2		6	4	10 (3.7%)
Flaring faults					12	12 (4.5%)
Unrelated to landing procedure	1	3	1	5	7	12 (4.5%)
Various causes during free fall					3	3 (1.1%)
Canopy-collision		1	1	2	4	6 (2.2%)
Canopy-collapse					4	4 (1.5%)
Canopy various		2		2	7	9 (3.4%)
Reserve-landing	1			1	5	6 (2.2%)
Malfunction/wrong procedure	1	1		2	6	8 (3%)
Drowning					1	1 (0.4%)
Unknown	4	2		6	1	7 (2.6%)
Total	99 (37%)	51 (19.1%)	14 (5.2%)	164 (61.4%)	103 (38.6%)	267 (100%)

* of the total number of parachutists involved.

before ground-contact, landing on a straight leg. Often, incorrectly executed PLF's resulted from faults made during the landing procedure (landing in a turn, landing downwind, landing on or against obstacles often because of steering faults). Apart from the already mentioned causes several accidents were caused by not heeding basic safety regulations (e.g. not wearing a life-jacket when jumping near open water, not watching for other jumpers while under canopy) and several accidents probably were stress-induced (unrecognised canopy malfunctions, faulty reserve procedures, not deploying a canopy while trying to regain a stable body-position, failing to keep track of altitude).

Injuries

The reported 267 accidents resulted in 301 injuries. Most injuries were inflicted upon the lower extremities (69.8%) of which 44.5% occurred during novice-jumps and 23.6% during freefall-jumps (Table III). Injuries of the upper extremities including the shoulder girdle occurred in 10.9% of which 12.1% occurred during novice-jumps and 78.8% during freefall-jumps. Injuries of the pelvis and spine accounted for 11.6% of all injuries of which 54.3% occurred during novice jumps and 40% during freefall jumps.

TABLE III

Distribution of 301 injuries according to experience and anatomical site.

	Kind of jump					
	AO 1-2	AO 3-8	AO > = 9	AO tot.	FF	Tot. (%)*
Head	3	1	2	6	4	10 (3.3%)
Shoulder	2		1	3	4	7 (2.3%)
Arms/hands		1	2	3	20	23 (7.6%)
Thorax		1		1	2	3 (1%)
Spine	8	7	2	17	11	28 (9.3%)
Pelvis	1	3		4	3	7 (2.3%)
Legs†	48	15	4	67	27	94 (31.3%)
Ankles	36	21	4	61	21	82 (27.2%)
Feet	4	3		7	11	18 (6%)
Soft tissues	7	2		9	15	24 (8%)
Multitrauma					1	1 (0.3%)
Dead					4	4 (1.3%)
Total	109 (36.2%)	54 (17.9%)	15 (5%)	178 (59.1%)	123 (40.9%)	301 (100%)

* of the total number of injuries.
† including 38 fibula-fractures that might be ankle-fractures (see Discussion).

Four parachutists (all freefallers) were killed: one drowned because he did not wear a life-jacket when landing in water, one was killed by impact because of entanglement of his body in the suspension lines of his reserve canopy after an incorrectly executed reserve procedure, one was killed without having deployed a canopy at all because of trying to correct his unstable body position until impact and one parachutist died on impact after having cut away his malfunctioning main canopy and not being able to deploy his reserve canopy because of a flag, carried incorrectly, obscuring the reserve ripcord from view and touch.

DISCUSSION

As 82% of all accidents among novices were faults made during the landing procedure as well as the fact that 80.5% of those faults were incorrect PLF's (whether in combination with steering faults or not) it would seem that the basic training and/or the selection procedure of novices is inadequate.

The use of round canopies might well play a role in creating circumstances that enhance the possibility of getting injured when making mistakes in the landing procedure or PLF because of their low forward and relatively high downward speed and low manoeuvrability. Although the faults were made in the reported accidents, it is not known how often identical faults were made without resulting in injury.

Another factor that seems of importance for inducing circumstances that may lead to injury is ground-wind speed. In Table IV a review is given of the relationship between ground-wind speed of 3.5 metres/second (7 knots) and less and the occurrence of accidents at different levels of experience of the involved parachutists. This speed was chosen because it is about the same as the forward speed of round canopies. This means that these ground-wind speeds result in either vertical landings or forward landings. Vertical landings hamper a correct execution of the PLF because it is based on a horizontal speed component. Forward landings are uncommon and therefore induce uncertainty and reactions like straightening the legs, extending a foot, pulling up the legs or trying to absorb the shock with outstretched arms.

When ground turbulence is evident this may lead to oscillation of round canopies which might induce the same reactions in novices as do forward landings. Square-canopies might (partially) collapse when flying in turbulent air and so cause erratic landings with increased descent speed. Injury because of an incorrectly performed PLF is much less common in parachutists who jump with a square-type canopy. As described above under a square, one can land very softly. Because of the high manoeuvrability one can choose to land on obstacle free terrain.

Hazards when landing a square are flaring too late which results in a relatively high forward speed and a hard landing or flaring too early which results in stalling of the canopy and falling backwards. This accounts for the larger number of injuries of the upper extremities (especially wrist fractures: 10 out of 11) in freefallers. Several of these injuries could have been prevented by a proper PLF but because of the soft landings under a square, many square jumpers may have lost the technique.

The most frequent injuries of the lower extremities are ankle-fractures as were reported in 64 cases. The reported fibular fractures are not likely to be isolated fractures because those are caused by direct trauma which is not very often seen in parachuting. In most cases the nature of the injury was reported in layman's terms ("splint-bone" fracture) which might account for not classifying these fractures as ankle-fractures. When added to the ankle fractures those would total up to 102 (33.9% of all injuries).

When gathering the information for this report no X-ray films were available and the descriptions of the way in which the injuries occurred were often not very detailed. As a result the nature of certain injury mechanisms is difficult to assess. Nevertheless an attempt to do so was made.

As described in international literature several injury mechanisms in parachuting are quite clearly understood. For example, the external rotation-eversion trauma of the ankle resulting in a Weber C type fracture is often assumed

to be the most frequently occurring mechanism in ankle fractures in parachuting (Ciccone et al, 1948; Gerngross et al, 1984; Leger et al, 1977; Lord et al, 1944; Petras et al, 1983; Siffre et al, 1951). Most of these authors (Table VI) refer to military static-line jumps to which the parachutists landed facing downwind under a non-steerable round canopy. Tobin (1943) on the other hand mentioned the fracture of the lateral malleolus to be the most common and the result of adduction and inversion of the foot.

Dutch novices and students are trained to land facing the wind thus moving in an oblique backward direction which facilitates the PLF. Because of the angle and direction of landing speed, which are distinctly different from those in forward landing, inversion and internal rotation of the ankle might be the injury mechanism and induce for example Weber A and B type fractures or ruptures of the lateral ankle ligaments. Most novices and students that sustained an ankle injury when landing reported verbally that they 'sprained' their ankle because of an inversion stress.

Other injury mechanisms that might have been involved in the reported injuries are listed in Table V in relation to possible causes and resulting injuries.

TABLE V

Most frequently occurring injury mechanisms in Dutch sport parachutists in relation to their cause and the resulting injuries.

Mechanism	Cause	Resulting injuries
Inversion/internal rotation of an ankle.	Landing on one foot. Landing on uneven terrain.	Weber A/B-type fractures, ligament injuries.
Torsion of a leg.	Landing on stretched legs and/or while in a turn.	Lower leg fractures, knee ligament injuries.
Acute vertical deceleration.	Landing on buttocks, on stretched legs, on a heel.	Fractures of vertebrae, pelvis, lower leg, calcaneum.
Fall on outstretched hands.	Flaring too early, (high speed) forward landing.	Fractures of clavicle, forearm, wrist.
Fall on the head.	Landing straight backwards.	Concussion.

One severe accident (a collision of two jumpers each under their own square canopy) caused a transection of the spinal cord at L4 in one jumper and multiple pelvic and femoral fractures in the other. Together with the already mentioned four fatal accidents these were the six most severe accidents of the five-year-period under consideration.

At least two accidents were caused by unstable body positions while the main canopy was being deployed: because of entrapment of the upper arm between the risers on line stretch the forces being exercised on the arm are so great that they can cause fractures or dislocations. In one case the unstable opening caused a malfunction of the main canopy and resulted in a vertebral fracture on landing.

CONCLUSIONS

In general most accidents were the result of basic faults related to landing procedures, disregard of safety precautions (either deliberately or because of ignorance) and possibly problems due to stress. Some parachutists were unlucky in sustaining injuries because of landing on uneven terrain. Adherence to the safety regulations seems largely to depend on individual responsibility; efforts should be made to improve enforcement of the rules.

In relation to reports of parachuting injuries in the literature, some observations must be made. Most reports deal with military parachuting; the physical condition of military parachutists, their techniques and their equipment differ considerably from those in sport parachuting. In many reports no clear descriptions are given of landing techniques, equipment or levels of experience. In several reports only fractures or 'severe injuries' (which are not clearly defined) are referred to. Some authors relate only to a group of injured parachutists without taking into account the total number of jumps during which the injuries occurred, the experience of the jumpers involved or the causes of the accidents. Taking all this into account as well as the fact that standardisation of data and data-processing on the underlying subject does not (yet) exist, it will be clear that comparing rates and percentages as reported in the literature can only be of relative value.

This should be kept in mind when making the following deductions from comparison of the reports in the literature (Table VI): most injuries are inflicted during landing; landing down-wind under a round canopy (the standard procedure according to most military reports) even with the feet held together as is current in training in the United States Parachute School since 1943 (Lord et al, 1944) more often leads to injuries than when facing the wind (as nowadays is customary in most sport parachuting training); sport parachutists more often suffer injuries of the upper extremities than military parachutists, which may very well be due to the more frequent use of squares in sport parachuting; sport parachutists sustain less injuries overall. Also it seems that the injury frequency and especially the fatality rate, as presented in this report compare favourably with those in most other reports.

Because of the high percentage of accidents in novice jumps as a result of incorrectly performed landing procedures and PLF's it seems that improvement of basic training is called for. On the other hand employment of more rigid selection criteria for novice parachutists might add to safety. One of those criteria might well be the ability to cope with stress. In this regard research is in progress (Johnsen, 1987) in which the main problem is how to assess stress-coping abilities objectively.

As mentioned above the use of round canopies for novices might well add to the number of injuries when mistakes are made because of its speed and steering-characteristics. The use of special novice square canopies might reduce the number of accidents (Ellitsgaard, 1987) because those larger and relatively slow canopies do not malfunction easily, are quite manoeuvrable and, when properly rigged, cannot accidentally stall. For about one and a half years these canopies have been in use in the Netherlands though not yet on a wide scale. When using round canopies it seems unwise (as indicated above) — at the current training level — to have novices jump at ground-wind speeds of 3.5 metres per second or less.

The obligatory use of high (often military) boots to protect the ankles from fractures seems inadequate because of the very low number of ligament ruptures of the ankle (18) in comparison with that of ankle fractures (102). The forces that induce these injuries are so large and act so fast that it would take footwear with the stiffness of skiboots to counteract them (which might result in more lower leg fractures). Apart from preventing bruises and possibly mild

TABLE VI

Injury rates in parachuting in international literature.

Form	Author/year		Injury rate in: AO only (/100 AO)	Overall (/100)	Injuries of Extremities Upper* (%)	Lower† (%)	Death per 100 injuries	Death per 100 jumps	Cause related to landing	Injuries to experienced vs novice
Military	Greifer‡	1939		0.7						
	Tobin‡	1942		2.69						
	Tobin	1943		1.77						
	Lord	1944		1					"most"	
	Husson‡	1946		3						
	Ciccone	1948	< 1	< 1	7.7	81			"most"	
	Siffre	1951	1.05	1.05	2.5	80.8	0.6	0.006	"most"	
	Richaud	1967	1.14	1.14						1 : 1.6
	Vannoni	1971		0.9	3.88	27.65			"most"	
	Hallel	1975	0.88	0.62	2.5	47			> 90%	1 : 2
	Leger	1977			3.88	69.55				
	Petras	1983	0.68	0.68	8.5	70.4			"most"	
Sport	Schlitt	1976	0.45	0.23	20	41	3.9	0.007	"most"	1 : 3
	Leger	1977			14.6	66.30				
	Alexander	1985		0.02§	10	40			"most"	
	Amamilo	1987	0.43	0.36	12	78			87.7%	1 : 3
	Ellitsgaard	1987		0.14	17	60	3.7	0.005	83.8%	
	Steinberg	1987	0.35	0.14	10.9	69.8	1.3	0.002	81.2%	1 : 4.7

* Shoulder girdle, upper arm, elbow, forearm, wrist, hand.
† Upper leg, knee, lower leg, ankle, foot.
§ As claimed by Alexander: ". . . this may also be an underestimation."

Authors marked with '‡' were referred to by Richaud, 1967.

ligament sprains one useful function of high boots might be prevention of severe dislocation (Tobin, 1943).

Preliminary research by the author (unpublished) showed very little difference in relation to sudden inversion of the ankle (which is considered to be the most frequent cause of ankle injuries in Dutch sport parachutists) wearing different kinds of high sporting shoes, military boots and para-boots. Not wearing shoes or boots at all did not seem of much consequence. As mentioned by Gerngross (1984) additional bandaging of the ankles might enhance protection against ankle injuries. Further research on this matter might be worthwhile.

Use of an automatic activation device (AAD) is not obligatory for jumpers with a B-license and upwards. Most parachutists do not use one for a variety of reasons, including the fact that they are quite expensive. Other reasons are fear of premature firing of the AAD, forgetting to calibrate the AAD or to switch it on or off (once under canopy). In the Netherlands AAD's saved lives on at least 61 occasions in the past six years, whereas malfunctioning of an AAD was never reported to have led to injury or narrow escape situations. The use of an AAD might in two of the reported accidents have saved the lives of the involved parachutists. It was reported by the United States Parachute Association (Sitter, 1987) that in 1986 18 fatal accidents (60% of the total of 30) might have been prevented if an AAD had been used. It would seem sensible to stimulate the use of AAD's especially by freefall jumpers.

The total number of accidents resulting in injury in sport parachutists seems rather low when compared with the number of injuries in other sports like soccer (Dutch Ministry of Health, 1985). To make such a comparison valid attempts have been made to define a formula in which the number of injuries sustained is related to the time of exposure to the risks of the sports involved (Schlatmann et al, 1985). This is called "incidence". For example, the injury-incidence of soccer can be represented by the following formula:

$$\text{Incidence} = \frac{\text{number of fresh injuries}}{\text{1,000 sport hours}}$$

As a parachute jump lasts only about four minutes it seems impractical to use this formula; in parachuting the time period during which the parachutist is exposed to the risks of the sport can be accurately defined in units of one jump. The formula therefore could read:

$$\text{Incidence} = \frac{\text{number of injuries}}{\text{1,000 jumps}}$$

The validity of this kind of calculation and comparison depends on very clear definitions of injury and exposure time. As these have not yet been formulated it does not yet seem possible to compare the incidence of parachuting injuries with that of injury in other sports. However, to facilitate comparison of the incidence of parachuting injuries (e.g. in different disciplines of the sport) on an international level use of this kind of formula might be of value.

Registration of incidents and their consequences is of great importance for quality control of training, equipment and selection criteria. This requires precise registration of a very large number of facts not only concerning the incidents

themselves but also concerning equipment used, the way in which it is used, the shoes worn, the kind of head protection used etc. In practice the gathering of information at the site of the accident can often be described as incomplete; not only are certain facts often omitted, inaccuracies may occur. It seems advisable to try to motivate those persons responsible for reporting accidents in parachuting because faulty or incomplete registration implies that faulty conclusions might be made. A new very detailed accident form was designed by the author and will in the very near future be used throughout the country in the hope that this will encourage an improved accident registration in sport parachuting and because of this introduce a greater safety factor into the sport. On a governmental level interest exists in absenteeism from work due to sports injuries and the costs that this implies for productivity, insurances, health services etc. To be able to produce reliable figures it would be necessary to follow up all those people that were injured whilst participating in their sport. Because the parachuting community in the Netherlands is relatively small this should be possible with help from the government and/or sponsors that are interested in this kind of problem.

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BOOK REVIEW

Title: **CURRENT THERAPY IN SPORTS MEDICINE 1985-1986**

Editors: R. P. Welsh and R. J. Shephard

Publisher: B. C. Decker Inc., The C. V. Mosby Company, Toronto 1985

Price: £44.00 294 pages Hardback ISBN 0 941158 33 0

This book brings together no less than ninety different contributors in a highly selective collection of, on average, about two-page essays on a wide range of topics loosely related to the theme of exercise. The title is a misnomer, many contributions not really conforming to our usual interpretation of 'sports medicine', e.g. Microsurgical Lumbar Discotomy or Exercise Tests in Paediatric Cardiology. The link is to exercise, not sport as shown by items on, for instance, Exercise in Cystic Fibrosis, Diabetes, Hypertension, Pregnancy, Chronic Obstructive Lung Disease and in the clinical management of Obesity.

The problem with such a book is that virtually none of the contributions is comprehensive and there are no references, so that it cannot be as useful a reference source as the formidable list of top name contributors entitles it to be. There are no illustrations in most of the book when a few simple ones would be helpful and too many of the pictures are esoterically clinical — but which surgeon would turn to such a work for his operative guidance?

Naturally, any reviewer would raise his pet objections to different parts of such a book, and I have some detailed reservations about my own fields of interest, but the overwhelming impression is of disappointment that such a promising work should be so unsatisfying. It is not a basic text, it takes a lot of prior knowledge for granted, is unreferenced and highly eclectic. There are excellent parts and I enjoyed and learned much, but it should be seen as a bedside read, a stimulant to further study and a good introduction for the specialist to other specialists' fields. It is generally very readable and well produced. One for the library and for dipping, but not to buy as an essential text.

Peter N. Sperryn