General Articles

Factors associated with failure of Thoroughbred horses to train and race

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Summary

***Reasons for performing study*: The low productivity associated with training and racing of young Thoroughbreds (TBs) in the UK due to athletic inability, injury and disease requires further study.**

***Objectives:* To identify the time points and causes of losses during growth and training phases of a cohort of 1022 TB foals born in 1999 up to the end of their third year.**

***Methods:* Movement and fate of 1022 Thoroughbred foals conceived in 1998 and born live in 1999 were monitored from birth to age 3 years. Those (n = 562) that entered training age 2 and/or 3 years with one of 161 registered trainers in Britain or Ireland in 2001/2 were analysed as to their subsequent performance and the incidence of 9 common injuries or infective or metabolic illnesses.**

***Results:* Of the 1022 foals identified, 537 (52%) entered training at age 2 years, 289 (28%) were exported, 60 (6%) were kept as 'stores' for National Hunt (NH) racing, 58 (6%) died or were destroyed, 25 (2%) were waiting to enter training at age 3 years, 17 (2%) were never intended for racing and 36 (4%) were untraceable. Race records showed that 327 (61%) of the 2-year-olds in training competed one or more times, 95 (18%) won and 165 (31%) were placed. Only 28 (5%) earned enough prize money to cover their training fees. Sore shins and inflammatory airway disease (IAD) were the 2 ailments most commonly encountered. In 2002, 431 (80%) of the previous year's 2-year-olds remained in training aged 3 years and 25 entered training having not raced previously. Of the 456 3-year-olds in training, 347 (76%) raced one or more times 138 (30%) won, 218 (48%) were placed and 78 (17%) recouped their training fees. Joint problems and sore shins were the ailments most commonly suffered and, with the exception of rhabdomyolysis ('tying up'), colts and geldings suffered a higher rate of muscloskeletal injuries than fillies.**

***Conclusion:* Previous reports of high nonrun and nonplaced rates, high incidence of injury and cost-ineffectiveness of 2-year-olds in flat-race training were confirmed.**

***Potential relevance:* This study lays the basis for further studies of the facets involved in wastage.**

Introduction

There are few studies of horse wastage and financial loss associated with the racing industry. In many countries, considerable financial and physical resources are expended, despite the frequent intense disappointments associated with Thoroughbred racing. Two studies (Jeffcott *et al.* 1982; Bailey *et al.* 1997) have produced accurate figures that are of interest to the administrators of racing, owners of racehorses and those charged with maximising the health and racing potential of horses in their care.

Jeffcott *et al*. 1982 analysed the training and racecourse performances, costs and returns, and veterinary problems of 314 horses that raced on the flat age 2–6 years for the year 1980 with 6 trainers. Major causes of retirement from racing and lost racing days were, respectively, delayed maturity and poor performance for retirements, and lameness and respiratory infections for lost race days. The authors identified 246 cases of musculoskeletal lameness in 163 horses, and 53% of animals that raced experienced one or more periods of lameness. In 34 cases, the condition was sufficiently severe to force retirement. Similar results from 6 flat training yards were reported by Rossdale *et al.* (1985), confirming the significance of musculoskeletal injuries.

Bailey *et al.* (1997) ranked veterinary problems in order of incidence and importance to training and racing programmes of horses in 40 training stables around Sydney, Australia. These authors found that trainers ranked 'sore shins', coughing, inflamed joints, foot and back problems as the most commonly occurring ailments, followed by tendon/ligament strains, pulmonary epistaxis and noninfectious breathing problems and, lastly, hindlimb lameness and laryngeal hemiplegia ('roaring'). In the present study, 1022 Thoroughbred foals of known parentage were identified as the live progeny of 1369 Thoroughbred mares at stud in 1998 and foaling in 1999. After weaning, identified foals were tracked through the sales ring and various export procedures until a definitive group of 562 entered training as 2- or 3-year-olds with one of 161 registered flat-race trainers throughout Britain and Ireland. Analysis of the performance of these horses in training, their successes and failures on the racetrack, race earnings and veterinary problems that cost training and racing time were the aims of the study.

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TABLE 1: The status of 1022 Thoroughbred foals, born in 1999, at the beginning of their 2-year-old year in 2001, as determined by a questionnaire sent to their owners

	No.	%
Born live in 1999	1022	-
Entered training as a 2-year-old	537	52
Known to have been exported	289	28
Died or destroyed, age 0–2 years	58	6
'Stores' for National Hunt racing	60	6
Waiting to race as a 3-year-old	25	2
Not intended for racing	17	2
Untraceable	36	4

Materials and methods

Data collection

The 1022 foals born in 1999 were from Thoroughbred mares mated by one of 41 stallions standing at 25 public studfarms in and around the Newmarket region in 1998, and were identified from a studfarm efficiency survey (Morris and Allen 2002). Follow-up data during their first 2 years was obtained from The Bloodstock Sales Review, published annually by Messrs Weatherby, and from telephone conversations with mare owners. Horses (n = 562) from the original cohort were followed during their 2- and 3- year-old racing careers. Trainers were sent a questionnaire for each horse requesting details of training and racing performance, money won and occurrence of a list of specified veterinary problems throughout the previous year. High levels of compliance (94%) were achieved through repeated telephone conversations and visits to less responsive training yards. Information about racing performance and prize money was also recovered from The Racing Post's online database (www.racingpost.co.uk) and information from completed questionnaires entered onto a database (Microsoft Access)[1].

Data acquired

Foals were classified into 7 categories at the end of their second year (Table 1) from a one-page questionnaire sent to trainers. Questions included 1) how many races completed; 2) how many wins or places and total prize money won; 3) had the horse suffered one or more of 10 specified veterinary problems (Tables 6 and 7); and 4) what happened to the horse at the end of its 3-year-old racing year.

Statistical analysis

Mean ± s.e. values are presented throughout. Statistical analyses were performed using one-way ANOVA with Tukey's *post hoc* test. Data that did not pass a normality test and showed a 'skewed' distribution were analysed using a one-way ANOVA on ranks with Dunn's *post hoc* test (Dunn 1964; Sigma-Stat v. 2.0)[2]. Comparisons of the proportions of colts vs. fillies were performed using the *z*-test. Differences were considered significant when $P<0.05$. Percentages were rounded to the nearest whole number.

Results

Original cohort (n = 1022)

Table 1 shows the status of the original cohort of 1022 foals in 2001 at the beginning of their 2-year-old year. The sales-ring appearances and price range of animals as foals, yearlings and 2-year-olds are detailed in Table 2. Significantly ($P<0.001$), more colts than fillies were sold as both foals (80 colts vs. 33 fillies) and yearlings (238 colts vs. 152 fillies). In addition, more colts than fillies were purchased as foals to be sold again as yearlings (60 colts vs. 14 fillies; $P<0.001$).

Two- and 3-year-olds

Of the 537 two-year-olds that entered training in 2001, 48% were colts or geldings and 52% fillies. The number of appearances on the racecourse for both 2- and 3-year-olds is presented in Table 3. Nonrunners represented 39% of 2-year-olds and 24% of 3-year-olds in training. Colts and geldings were nonrunners as often as fillies ($P = 0.27$). The gender of a 2-year-old made no difference as to the likelihood of it running in, or winning, a race ($P>0.05$ in all cases). However, 2-year-olds born between January and March were more likely to run at least once compared with those born April–June ($P = 0.04$). The birthdate of a 2-year-old made no difference to the likelihood of it winning a race if it actually ran (Jan–Mar vs. April–June, $P = 0.7$).

Mean ± s.e. number of starts for 2-year-olds was 1.97 ± 0.10, increasing to 3.24 ± 0.10 for horses that actually ran. The maximum number of starts recorded was 14. Mean ± s.e. number of starts for 3-year-olds was 4.02 ± 0.20, (5.29 ± 0.20 for those that actually ran). The maximum number of starts was 17. Successes in terms of wins and places achieved by the 327 two-year-olds and 347 three-year-olds that ran in 2001 and 2002, respectively, are shown in Table 4.

Eighty percent of 2-year-olds remained in training as 3-year-olds, with 15% changing trainer. Of the 106 two-year-olds that did not continue racing in Britain or Ireland as 3-year-olds, 40% went abroad and 30%, exclusively fillies, retired to stud. The remaining horses either died or were destroyed due to accident,

TABLE 2: Proportions and prices realised of 1022 Thoroughbreds born in 1999 that were subsequently sold through bloodstock sales as foals, yearlings or 2-year-olds

	No.	%	Price range (Gns)†
Sold as foals	113	11	600–220,000
Sold as yearlings	390	38	500–320,000
Sold as 2-year-olds	89	9	500–160,000
'Pin-hooked'*	74/113	65	Foals: 600–95,000 Yearlings: 800–320,000

*Sold as foal and resold as yearling; *'pin-hook' profits (gns): mean 12,124; maximum 140,000; minimum -34,000; median 5050. †Gns = Guineas (£1.05).

TABLE 3: Appearances on the racecourse of 537 two-year-olds and 456 three-year-olds during 2001 and 2002, respectively

	2-year-olds*		3-year-olds†	
No. runs	No. horses	%	No. horses	%
0	210	39	109	24
1	71	13	33	7
2	72	13	33	7
3	71	13	51	11
4	44	8	38	8
5	28	5	51	11
6	19	4	38	8
>6	22	4	103	22

*2-year-olds: 258 colts/geldings (48%), 279 fillies (52%). †3-year-olds: 218 colts/geldings (48%), 238 fillies (52%).

TABLE 4: Win and place rates achieved by 327 two-year-old Thoroughbred racehorses that ran in 2001 and 347 three-year-olds that ran in 2002

		2-year-olds		3-year-olds	
		No. horses	% of runners	No. horses	% of runners
No. wins	0	234	72	209	60
	1	67	20	80	23
	2	21	6	40	12
	3	5	2	12	3
	4	-	-	5	1
	>5	-	-	1	<1
No. times placed	0	162	50	129	37
	1	98	30	80	23
	2	39	12	59	17
	3	19	6	32	9
	4	9	3	26	7
	5	-	-	21	6

Chance of a 2-year-old runner winning a race = 28%; chance of a 3-year-old runner winning a race = 40%.

injury or problems of temperament (10%), or were used as riding horses (20%).

Financial returns

Prize money won at ages 2 and 3 years is listed in Table 5. The cohort of 537 two-year-olds in training won a total of £1,421,114 (mean ± s.e. £2646 ± 543, median £0); and 3-year-olds £3,364,472 (mean ± s.e. £7378 ± 1097, median £285).

Published nomination (mating) fees for stallions that sired the 562 horses were £1000–45,000. A further 21 were sired by one of 3 stallions for which the quoted nomination fee was 'by private treaty' and therefore probably >£80,000. Mean ± s.e. and median (25:75%) nomination fees (excluding horses sired by private treaty stallions) were £12,507 ± 458 and £8000 (£4500:15,000), respectively. When stallions with the same nomination fee were grouped, including at least 3 sires and a minimum of 10 of their offspring in training, no significant relationship between the stallion nomination fee and mean or median prize money earnings of foals was evident (ANOVA on ranks P = 0.061). However, when stallions were considered individually, a significant correlation was revealed between sire price and prize money won by progeny (P = 0.022).

Dam age and parity

In the 562 horses surveyed, no significant relationships were found between dam age and parity and any of the following measures of racing performance (P>0.05): 1) likelihood of running as a 2- or 3-year-old; 2) winning a race; and 3) overall performance on the racecourse as assessed on the basis of Timeform rating.

Veterinary problems

Veterinary problems encountered in the 514 two-year-olds and the 424 three-year-olds for which completed questionnaires were returned are summarised in Tables 6 and 7, respectively, along with the proportion of males and females affected. Overall, 62% of the 2-year-olds and 50% of 3-year-olds suffered one or more ailments that required veterinary intervention. Only 4% of the 2-year-olds and 9% of 3-year-olds were reported to have suffered a veterinary problem that ended their racing career. Comments volunteered by trainers that horses 'lacked ability' were given for 18% of 2-year-olds and 28% 3-year-olds.

The status at age 4 years for all 562 horses in training as 2- and/or 3-year-olds is detailed in Table 8. A sizeable majority (40%) remained in training as 4 year-olds, made up of appreciably more colts and geldings than fillies (P>0.01). Of the 27% that retired to stud 99% were fillies, with only 1 colt taking up stallion duties. Sixteen percent were exported, with a predominance of males over females (P = 0.004).

One hundred and forty-eight of the 295 fillies (50%) retired to stud. Of these, 116 had been in training at both age 2 and 3 years, while the remaining 32 had retired after being trained only during year 2. Twenty-eight percent of the fillies had won a race and 38% had failed to run at all while in training. A comparison of fillies that retired to stud with those that did not revealed no significant differences in the number of times they ran, races won, mean or median amounts of prize money won or Timeform rating (P>0.05 in all cases). However, nomination fees of sires of fillies that went to stud at age 2 or 3 years were significantly higher than for those of the fillies that did not retire to stud (median £12,500 vs. £7000, P<0.05).

Discussion

This is the second comprehensive survey of the incidence and causes of wastage in British Thoroughbred flat racing and follows the seminal study of breeding and racing wastage rates published 2 decades ago by Jeffcott *et al.* (1982). In that earlier study the authors made a detailed analysis of training and racing records, prize money won and the veterinary and other causes of failure to race in one particular year (1980). In contrast, the present study followed 1022 Thoroughbred foals and tracked the proportion that raced at age 2 or 3 years to determine their racecourse success or failure and veterinary problems during training. Therefore, despite differences in

TABLE 5: Prize money won by 537 two-year-olds in 2001 and 456 three-year-olds in 2002

	2-year-olds			3-year-olds		
Prize money won (£)	No. horses	% of those in training (n = 537)	% of those that ran (n = 327)	No. horses	% of all those in training (n = 456)	% of those that ran (n = 347)
0 (all horses)	348	65	-	220	48	-
0 (horses that ran)	138	-	42	111	-	32
100–1000	53	10	16	45	10	13
1001–5000	72	13	22	66	14	19
5001–10,000	36	7	11	47	10	13
10001–100,000	26	5	8	71	16	20
>100,000	2	<1	<1	7	2	2

Assuming a basic training fee of £10,000 per horse *per annum,* 28 two-year-olds (5%) and 78 three-year-olds (17%) met these costs.

TABLE 6: Incidence of specific ailments suffered by 514* two-year-olds during training in 2001

Ailment	No. affected	% of 514	% Male	% Female	Male vs. female P value
'Sore shins'	150	29	58	42	0.008
IAD†	68	13	54	56	0.975
Joint problem	57	11	49	51	0.996
Fractures	52	10	33	67	<0.001
'Tying-up'	27	5	22	78	<0.001
Knee chips	17	3	53	47	0.996
Tendon problem	12	2	50	50	0.683
Soft palate problem	8	2	50	50	0.614
Colic	8	2	50	50	0.614
Roaring	6	1	100	0	0.004
Other	68	13	46	54	0.393

†IAD = Inflammatory airway disease. For 537 two-year-olds, 514 (96%) completed forms were returned; n = 195 (38%) had no veterinary problems, n = 319 (62%) had one or more veterinary problems.

TABLE 7: Incidence of specific ailments suffered by 424 three-year-olds during training in 2002

Ailment	No. affected	% of 424	% Male	% Female	Male vs. female (P value)
'Sore' shins	53	12	65	35	0.002
IAD†	35	8	51	49	0.996
Joint problem	55	13	69	31	<0.001
Fractures	40	9	65	35	<0.014
'Tying-up'	17	4	24	76	0.006
Knee chips	17	3	53	47	0.996
Tendon problem	16	4	69	31	0.077
Soft palate problem	13	3	62	39	0.420
Colic	3	<1	33	67	0.987
Roaring	7	2	71	29	0.286
Other	49	12	55	45	0.419

†IAD = Inflammatory airway disease. For 456 three-year-olds, 424 (93%) completed forms were returned; n = 213 (50%) had no veterinary problems, n = 211 (50%) had one or more veterinary problems.

materials and methodology, broad comparisons can be made between the 2 surveys.

Proportions in training and exported

The proportion of youngstock that enters training age 2 or 3 years and races in Britain or Ireland appears to have reduced by some 7% during the past 20 years. Jeffcott *et al.* (1982) reported that 62% of the 1980 foal crop entered training, comparable to 55% in our study. This is largely due to an increase in the number of horses exported; Jeffcott *et al.* (1982) reported 11% of the 1975 foal crop were exported by age 4 years, whereas 28% of the 1022 foals born in 1999 had been exported before age 2 years and 16% of those that raced as 2- or 3-year-olds had been exported prior to age 4 years, i.e. 37% of the original 1022 foals went abroad in their first 4 years. It is probable that the increased presence of Middle Eastern breeders in Britain and the rapidly evolving racing industries in, for example, Turkey and the Arabian Gulf countries has fuelled this increased export of British Thoroughbreds over the past 20 years.

Mortality and nonperformance

Animals that died or were destroyed by age 4 years made up 8% of the total cohort surveyed, and the majority of these deaths (73%) occurred before 2 years of age. This overall mortality rate is double the figure of 3.5% recorded by Jeffcott *et al.* (1982) for Thoroughbreds up to age 4 years, but seems relatively modest compared to the 11% mortality rate reported by Morley and Townsend (1997) for Thoroughbred foals in western Canada during the first year *post partum.*

In the present study, only 32% of 1022 foals started in a race as a 2-year-old in Britain or Ireland. This high level of nonperformance mirrors the situation in Australia where Bourke (1995) reported that, of 1000 Thoroughbred foals born in Victoria, only 30% started in a race at age 2 years. The proportion of horses in training at age 2 years that fail to race has also increased over the past 20 years, from 33% in 1980 (Jeffcott *et al.* 1982) to 39% in 2001. On the other hand, further comparisons with the data of Jeffcott *et al*. (1982) suggest little change in the proportions of horses in training at age 2 years that win one or more races (19% in 1980 vs. 17% in 2001), are placed (29 vs. 31%), and race but remain unplaced (31 vs. 30%) (Table 4).

TABLE 8: Destination and fate at the end of 2002 of 562 horses that raced as 2- and/or 3-year-olds during 2001 and 2002

	No.	%
Raced as 2- and/or 3-year-old	562	-
Remained in flat race training as a 4-year-old	189	34
Retired to stud	149	27
Went abroad	92	16
Moved to National Hunt training	34	6
Dead	22	4
Untraceable	76	14

In a study of 916 two-year-olds in Queensland, More (1999) reported that 29% of those that ran won at least one race, equating closely with the figure of 28% in the present study. The mean number of starts for 2-year-olds that ran in 2001 (3.24) also corresponds well with the 3.1 starts reported by Jeffcott *et al.* (1982). However, the 2-year-olds in Queensland described by More (1999) had a mean of 4.2 starts. Bourke (1995) reported a predominance of males over females as race participants at age 2 years in Victoria, although no difference in gender in 2-year-old runners was found in the present study.

Jeffcott *et al*. (1982) grouped their 3- to 6-year-old horses together, but the percentages of older horses in training that won (30%) or were placed (48%) were identical for 1980 and 2001. Notwithstanding this, horses that raced at age 3 years in Queensland in 1997 made an average of 7.7 starts and had a 54% chance of winning a race if they ran (More 1999), appreciably more than the 40% chance for runners in Britain or Ireland in 2001.

Financial returns

Financial returns in the flat-racing industry in Britain and Ireland, based upon the arbitrary figure of £10,000 *per annum* to train a horse, showed that only 5% of the 2-year-olds and 17% of 3-year-olds were able to recoup the basic cost of training fees from prize money. More (1999) reported that 13% of the 1567 two-year-olds surveyed in Queensland earned their training costs in prize money. Similarly, only 39% of the Queensland 2-year-olds earned no money, compared to 64% of their UK counterparts. Clearly, based on these figures the pleasure of owning and training a racehorse in Britain and Ireland is not a pastime for the financially faint-hearted!

Age and parity

Several studies have reported the deleterious effects of increasing age and parity in Thoroughbred mares on placental and fetal development (Bracher *et al.* 1996; Wilsher and Allen 2003) and on racecourse performance of the progeny (Finocchio 1986; Barron 1995). It was therefore surprising to find in the present study that maternal age and parity did not significantly affect the racing performance of the total of 431 horses that were in training at ages 2 and 3 years. However, whereas previous studies compared the racing performance of several offspring produced by individual mares, the present survey could consider only a single offspring per dam. Therefore, the inherent biological variation in broodmare quality within the cohort is likely to have been responsible for the present negative correlations.

Veterinary problems

'Sore shins' was the most common problem encountered by 2-year-olds in training, with 29% afflicted. This was also rated the most frequently occurring problem in Australian 2-year-olds, where 60% of Sydney trainers recorded lost work days as a result of the condition (Bailey *et al.* 1997). Similarly, from their survey of Thoroughbred racehorse trainers and veterinary surgeons in Victoria, Buckingham and Jeffcott (1990) estimated the frequency of 'sore shins' in 2-year-olds to be as high as 80%. Dyson (1987) suggested that the higher incidence and severity in Australia, America and other countries related to horses training predominantly on oval-shaped dirt tracks rather than straight grass gallops as in Britain. The incidence of 'sore shins' in 3-year-old horses in the present survey reduced to <50% of the level recorded for the 2-year olds. Nunamaker *et al.* (1990) noted that, with increasing maturity, the third metacarpal bone of the horse changes in shape so as to lower the compressive strain at high-speed exercise. Since different training strategies appear to result in variations in the incidence of 'sore shins' (Jeffcott *et al.* 1982; Boston and Numamaker 2000; Verheyen *et al.* 2005), there is clearly a case for innovative changes to be made to the training programmes of 2-year-old horses.

Gender

Gender appeared to exert a profound influence on the frequency of some musculoskeletal problems, especially in 3-year-olds. Overall, colts and geldings were more injury-prone than fillies as 3-year-olds, especially in such areas as 'sore shins', fractures, joint inflammation and tendon strains. In a Japanese survey of Thoroughbred racehorses, Kasashima *et al.* (2004) noted that entire males were at greater risk of developing tendonitis and suspensory ligament desmitis than geldings or fillies. The question therefore arises as to whether circulating hormone levels may play a role in musculoskeletal problems. Hormones have been suggested as being involved in the big difference in the incidence of 'tying-up' between fillies and colts (MacLeay *et al.* 1999a; McGowan *et al.* 2002) and, although it is widely held that attacks of rhabdomyolysis occur more frequently in oestrous fillies, neither of 2 studies which examined that question specifically could provide a definitive answer (Frauenfelder *et al.* 1986; M. Serrantoni and P. Harris, unpublished data). Cyclicity in fillies may also be worthy of further examination as a potential risk factor for locomotor injuries, particularly stress fractures. Hypothalmic dysfunction associated with strenuous exercise has been reported in female human athletes, and may result in disturbances of GnRH pulsatility, disruption of menstrual cyclicity, hypo-oestrogenism and reduced bone density (Warren and Perlroth 2001).

Genomics

The genetic constitution of an individual clearly plays an important role in its predisposition to illness and injury. For example, MacLeay *et al*. (1999b) proposed that 'tying-up' may be inherited as an autosomal dominant trait with variable expression. The results of the present survey also suggested a genetic factor in association with laryngeal hemiplegia ('roaring'), since 5 of the 6 two-year-olds affected had been sired by the same stallion.

Undoubtedly, 'lack of ability' and 'too slow', which one trainer eloquently described as "the worst problem of all", also have a large genetic component. However, the nomination fee of a filly's sire appears to be a major factor in the decision to breed from her, regardless of her own racing performance. Although understandable from the point of view of the disappointed owner trying to recoup wasted expenditure, careful selection of broodmares on the basis of racecourse ability and soundness, rather than just pedigree, would undoubtedly produce progeny more likely to survive the rigours of training. However, Rossdale (1972) highlighted the relatively poor breeding performance of the winners of the Epsom Oaks when they retired to stud, illustrating that racing ability may not go hand-in-hand with fertility.

In the two decades that have elapsed between this present study and that of Jeffcott *et al.* (1982), the levels of wastage within British flat-racing, in terms of the proportions of horses in training that fail to reach the racecourse, win a race, or win any prize money at all, have remained virtually unaltered. Similarly, the incidence of specific veterinary problems has also remained unchanged. Clearly, if the racing industry wishes to reduce these high wastage rates, innovative changes will be needed in the selection of stallions and mares for breeding and in the rearing and training of their offspring.

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Manufacturers' addresses

[1]Microsoft Corporation, Microsoft UK, Reading, Berkshire, UK.
[2]Sigma-stat, SPSS Science Software UK Ltd, Egbaston, Birmingham, UK.

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