

Issue 1 2011

For Eventers &
Show Jumpers

Talking Performance



From the editor...

Welcome to our first issue of 'Talking Performance' - the newsletter dedicated to providing practical reviews on aspects of training, common problems and nutrition for eventers, show jumpers and upper level equine athletes. We plan to publish 'Talking Performance' at 4 monthly intervals and focus on issues of interest to trainers and competitors.

In this inaugural issue, we provide Part 1 of a series of reviews on training methods to achieve optimum fitness of horses competing at all levels of these horse sports.

We include a brief on energy production and metabolism related to the speed of exercise and how to best condition these pathways.

In common with all our 7 other editions of 'Talking Horses' newsletters, we include a number of practical handy hints on a wide range of medical and health care problems. As an example, in this issue we give a guideline on the correct way to bandage the lower limbs prior to training and competition.

We hope that you enjoy reading 'Talking Performance' Issue #1.

All the best,

Dr John Kohnke BVSc, RDA

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'Talking Performance' will be available only by email. From time to time, hard copies will be available at seminars and events at the Kohnke's Own trade stand.

To ensure that you receive your copy as soon as each issue is published, please email **Gary at newsletters@kohnkesown.com** to register your name, post code and email details. Gary uses your post code to check email receipts as each issue is sent out in post code batches. You will not receive any promotional material from Kohnke's Own, nor will your email details be passed to other persons. For those of you already receiving other editions of 'Talking Horses', we ask you to subscribe separately to each edition you would like, as we do not wish to overload your inbox with each of the 7 other newsletters published at regular intervals. However, you may subscribe to receive them all if you have a range of equine interests.

Ones which may be of particular interest include...

Talking Horses Equestrian - published every 6-8 weeks - general horse health and care.
Taking Racing - published every 8 weeks - training and common problems of race horses.
Talking Dressage - published every 6 months - dressage training and health care.
Talking Breeding - published every 3 months - mares, foals and growing horses.
Other newsletters include Talking Endurance, Talking Ponies, Talking Minis and Talking Donkeys

In this issue...

- * Training and Fitness Part 1 – conditioning a base for fitness
- * Energy and Metabolic pathways - a basic understanding
- * How to Bandage the Limbs

Plus handy hints and lots more!

Handy Hint 1

Cooling out After Exercise

After exercise, when the flow of cool air over the body is reduced as a horse walks and stands to rest, 60% of the heat trapped in the working muscles is transferred quickly by the blood to a 'heat sink' within the large volume of the hind gut which stores up to 60 litres of water trapped in the fermenting fibre mass. This helps to prevent the 'hot' muscles, which have an after exercise peak at 41-42°C, retaining the heat for extended periods which would damage the muscle fibres. It takes up to 4-6 hours to offload the retained heat by sweating, radiation and 'blowing' heat off from the highly vascular lung airsac surface during the cool-out period. To remove this retained heat more efficiently, hose the horse's body with cold water, (or after competition or rest periods during competition, sponge the body down with iced water), specifically directing the cold water to under the belly area, between the hind limbs and over the flank area for 30-60 seconds to remove heat from the hind gut 'heat sink'. If the horse is 'puffing' or 'blowing', scrape off the warmed-up water from the coat and then walk the horse for 60-90 seconds to redistribute the heat and allow convection to evaporate water from the coat as the horse 'steams off'. Do not allow a horse under warm conditions to 'drip dry' as heat removal will be less efficient - always scrape the warm water out of the coat over the rump, topline and sides to allow the horse to 'steam off' and evaporate heat as it dries more efficiently with less water in its coat. If the weather is hot or humid, repeat the hosing (or strapping down with iced water) under the belly to remove more heat. If heat from exercise is not removed quickly and efficiently, the heart rate will remain elevated and heart rate recovery will be delayed until the body core temperature falls below 39.5°C.

Handy Hint 2

Provide Hydration Fluid after Training/Travelling

Studies have shown that horses prefer to drink cool (not cold) water from the 'hose end' or preferably luke-warm water after exercise. Many trainers condition horses to drink molasses water or weak rehydration fluids after exercise each day. One cheap and highly effective way of rehydrating a horse after daily exercise, travelling or after a competition, is to provide 5 litres of luke-warm water (eg add hot water from a thermos to cold water) containing 50 g (2 ½ tablespoonsful) of plain, fine table salt (it dissolves quickly) and 50 g glucose or dextrose (glucose assists sodium uptake from the small intestine) to ensure its palatability. Horses can be conditioned to drink the warm, salty water after each training session by offering it in the wash bay in a small tub or bowl/dish – after a couple of days they will begin to drink the fluid and once 'hooked', it is an easy, effective way of rehydrating a horse within 5-10 minutes after training, or following a competition before the return trip to home stables.

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TRAINING AND FITNESS *Part 1 - conditioning a base for fitness*

A horse's body undergoes a number of physical and metabolic changes in response to training. The musculoskeletal, cardiovascular and respiratory systems make significant adaptations during training to improve **strength** (power), **stamina** (endurance and staying ability) and **speed** as a horse gains fitness. Eventers require all three adaptations to prepare them for competition, whilst jumpers must develop stamina and strength, but still condition for speed to a lesser extent for competition. The thermoregulation system also improves its cooling efficiency to adapt to increased heat production and the need to dissipate large amounts of heat produced by aerobic metabolism during exercise. It also needs to adapt to changing climatic conditions during a long-term training preparation. A significant improvement in energy production efficiency occurs as a horse adapts to an increasing reliance on aerobic metabolism at higher speeds as oxygen uptake (VO₂max) is optimised to conserve muscle energy and sustain exercise intensity at higher speeds.

STRENGTH, STAMINA AND SPEED

Strength and stamina (endurance) are interrelated. They are established and conditioned in early training by **long, slow distance (LSD) or aerobic exercise** to provide the full range of body adaptations to enable it to handle metabolic and physical stress, as well as the high loading forces of longer distance fast (speed) exercise as the training preparation progresses. **Training to maximise speed and anaerobic capacity by all-out fast workouts** tops off the training preparation to prepare the horse for competition. Slow, mainly aerobic exercise can help to enhance strength and stamina during the first 6-8 weeks of a training preparation. A study by Professor Reuben Rose and co-workers at Sydney University in the mid 1990s using controlled treadmill exercise concluded that trotting exercise for 1500 metres daily for the first 2 weeks of training provided controlled loading exercise to enable musculoskeletal conditioning and improved oxygen uptake from 30% in the unfit horses to 50% VO₂max in this initial 2 week period. (See diagram on page 3)

The introduction of controlled, short speed workouts over 200-400 metres, initially at the free canter and then at a medium gallop, from the third week of training is helpful to stimulate and adapt the load bearing capacity of the bones, tendons and joints early in training. This will help to minimise the risk of overload injury when fast and sustained exercise under saddle over longer distances is introduced after 2-3 months into a full preparation.

Handy Hint 3

Feed Fats from the Start of Training

Fats (or long chain saturated and polyunsaturated lipids in vegetable oils) can provide a valuable source of aerobic energy in the early stage of training as the aerobic limit is extended to higher training speeds. They help to spare muscle glycogen (muscle 'carbo' stores) for faster speeds once fast work is commenced. However, whilst horses can efficiently digest fat in the small intestine to provide fatty acids in the blood and muscle cell stores for aerobic energy use, it takes time for the digestive enzymes (called lipases) to increase their rate of secretion in response to additional fat added to the diet. Common cereal grains provided as a starch energy source, contain between 3-5% crude fat. However, the sudden introduction of high fat (10-11% crude fat) commercial feeds as the major energy base in early training, or adding Omega oil supplements above 100mL daily virtually overnight, can result in poor utilisation of this useful energy source. Studies have shown that it can take up to 6 weeks, or as long as 3 months, to adapt fat digestive processes and muscle cell metabolic pathways to efficiently use higher levels of fat. It is a good idea to introduce blended Omega-3/Omega-6 oils, such as **Kohnke's Own Energy Gold** (it also contains 3000IU of Vitamin E per litre to help protect fats against damaging oxidation in muscle cells), in a step-wise manner over a 3-4 week period. This can be achieved by commencing on 50mL per day and increasing the fat supplement by 50mL every 10-14 days until 150-200mL per day is reached as an energy source. To provide adequate Omega-3/Omega-6 balance, 60-80mL daily of an oil supplement, such as Energy-Gold, is usually adequate.

STAMINA

There are a number of muscular and metabolic adaptations which are conditioned during the initial 4-6 weeks of any early training program to improve stamina or endurance in eventers and jumpers.

1. Muscle Changes - The major muscle structural changes include an increase in the number of blood vessel capillaries which proliferate within the muscle bundles. These capillaries deliver increased amounts of blood and oxygen, as well as muscle energy (muscle glycogen and fats) and protein for muscle development as a horse progresses through early conditioning training. The density of branching capillaries infiltrating the working muscles also increases. This adaptation delivers more blood containing nutrients to build and strengthen the working muscles. It also acts to increase the efficiency and rate of removal of metabolic wastes from muscle contraction, such as lactic acid at higher speeds, as the anaerobic threshold is reached during the faster workouts of advanced training.

This process of vascular adaptation can start in young horses during paddock exercise and in the pre-training period before entering full time training. Any speed exercise at the canter or above stimulates this process to provide more oxygen and substrates to the rapidly contracting muscles to increase stamina and endurance capacity.

Early conditioning work-outs also stimulate the increase in the number of mitochondria, the 'power houses' within the muscle cells, to efficiently utilise oxygen and energy substrates to fuel muscle contraction. The combination of increased capillary density and the volume of mitochondria within the muscle cells improves the aerobic metabolic capacity and efficiency of oxygen utilisation. In an exercising horse, as compared to other sprint human and animal athletes, aerobic metabolism is the primary metabolic pathway which produces up to 80% of the contraction energy in rapidly contracting muscles, even at galloping speeds. These muscle changes also increase the ability of the muscles to utilise fat as an 'aerobic' energy source (fats can only be used aerobically to produce energy, containing 2¼ times more energy than carbohydrates or protein), predominately during slow and prolonged exercise to increase stamina and endurance. Once faster work commences, the efficient metabolism of fats at slower training speeds on slow work days ultimately spares muscle glycogen for faster anaerobic exercise. The 'aerobic' energy pathway adapts to increase endurance and stamina, as well as conditioning for speed as regular fast work is introduced. However, the full storage capacity of muscle glycogen, used in increasing proportions as the speed of exercise is increased, does not significantly change during the early conditioning period where fats can be used as an energy source.

2. Metabolic Efficiency - Significant increases in oxygen uptake occur early, with a 20% increase in VO₂max (See diagram on page 3) before an increase in muscle fibre size or the metabolic conversion of slow twitch to faster twitch highly aerobic fibres occurs within rapidly contracting muscles at galloping speeds. Limited increases in muscle glycogen storage occur during the first 10-14 days of commencing trotting and cantering exercise in the early foundation LSD exercise program. It can take a further 6-8 months to adapt muscle fibres and glycogen storage to the speed and intensity required in eventers competing in the cross country phase in elite competition.

STRENGTH

The major increase in strength, or peak force capacity or 'power' of muscle contraction results from an increase in muscle fibre size and overall mass of the hindquarter 'driving' and impulsion muscles, in particular, as a result of a step-wise increase in stamina and speed.

1. Skeletal Adaptations - Conditioning training at slower aerobic speeds below 8 metres per second, for the first month of a training program out of the paddock, improves both stamina and endurance capacity. This 'foundation' loading exercise progressively loads the bones, joints and tendons to enable them to adapt to higher loading forces at faster exercise speeds and weight loading during jumping. Occasional once weekly speed hit-outs over 200-300 metres on a flat working area helps to impose safe loading forces for skeletal

adaptation without risk of over loading the skeletal structure and causing strain or sprain injuries. This programmed increase in loading as step-wise increases in momentum (body weight and speed combined) occurs in early training and helps to strengthen lower limb bones, joints and tendons.

The bones adapt slowly over a 6-10 week period by increasing the density (calcium deposition) and thickness of the cortical bone shaft, such as the front cannon bones in particular, in response to increased load/weight bearing at speed. The tendons adapt slowly as well over 6-8 weeks during a progressive loading program to increase load bearing strength. The elasticity (tensile and stretch strength and rebound) is increased by deposition of increased matrix material within the tendon fibrils.

Studies in Holland by Dr Peter van Weeren and colleagues during 2001 to 2003 found that tendon and joint structure is fully formed by 5-7 months of age in the young growing horse for its lifespan. Other research has shown that the cross-sectional area of the Superficial Digital Flexor Tendon (SDFT) (the outer tendon 'strap' down the rear of the lower limbs) increases as a young horse grows and adapts to carry more bodyweight and speed of movement up to 2 years of age. However, the thickness of the tendon 'strap' does not increase in response to training after this age. The tendon fibril number remains constant, but the loading capacity increases relative to the higher weight bearing and momentum imposed during the training program. These bone and tendon changes are more pronounced in the front limbs which bear up to 80% of the body weight and momentum loading during exercise under saddle.

Joint cartilage responds more quickly by increasing in thickness and 'shear' (tearing or distortion) strength to withstand the higher loading and compression forces as speed and momentum loading is progressively introduced in a well planned training program. These adaptations are needed to withstand the 'wear and tear' as the speed and loading forces are stepped-up in training. Studies have shown that the cartilage mass to withstand increased compression and shear actually decreases and it becomes more densely packed with matrix material. The cartilage also contains less water, which reduces the 'hydraulic' dampening properties within the cartilage structure. The sub-chondral bone (the bone cap layer under the joint cartilage of 'hinge' joints of the limbs) must also adapt to withstand more loading. However, there is evidence to suggest that providing excessive calcium may increase the density of the sub-chondral bone and may actually result in increased cartilage compressive 'squish' on loading and damage the load bearing cartilage layers sandwiched between the hardened end caps of the fetlock, elbow, shoulder and stifle joints.

2. Muscle strength - There are no other adaptations, other than an increase in muscle size to improve strength of the muscles. However, excessive muscle 'bulk' can be a disadvantage in relation to speed and stamina during sprint and longer distance competition. The extra

weight or 'ballast' of excessive muscle bulk increases energy use to gain momentum in eventing competition and lift-off in jump training. Once fast work and speed training commences, the emphasis is shifted to improving aerobic capacity in the muscles and delaying the onset of fatigue from extended anaerobic metabolism as oxygen debt begins at speeds above 14 metres per minute.

The strategy to increase both speed and stamina to maximise aerobic capacity over distance, will help reduce the rate of glycogen drain and lactic acid accumulation during the fast, intense phases of exercise.

The early conditioning program of any training plan is an essential foundation for immediate and long-term skeletal soundness in any horse. Once the musculoskeletal structures adapt, in most cases, they become permanent changes in structure and strength, which are carried on to future training preparations. However, failure of any of these structures can affect the long term soundness and suitability of a horse for high risk sports, such as eventing and jumping, as the horse is schooled in competition techniques, gains exercise ability and experience with age.

SPEED

Training to increase speed is the last major adaptation during a training program. However, a step-wise increase in the speed of exercise over short distances imposes additional loading forces on the limbs to stimulate muscle and skeletal strengthening to accommodate the higher loading once sprint exercise is included in the training program. Whilst stamina (endurance) and strength are largely dependent on aerobic capacity or oxygen uptake, speed conditioning is associated with increasing reliance on anaerobic metabolism. There are a number of changes which the muscles undergo to adapt to the stress and metabolic demands of fast exercise. These include a slight increase in muscle volume relative to the strength and genetic influences of muscle size in a particular horse or breed of horse. Major increases occur in the activity and efficiency of anaerobic muscle enzymes, high phosphate energy compounds within the muscle cells stimulated by short high intensity sprints and increased muscle lactic acid buffering capacity relative to the duration and speed of fast exercise. There is also a conversion of muscle fibre types to fast twitch anaerobic isoforms as the speed and duration of fast exercise is increased to gain and sustain optimum fitness for competition.

Handy Hint 4

It Takes Time to Adapt Skeletal Strength

The strengthening and structural changes to bones, tendons and joints is a slow process because of blood supply limitations and the need for structural cell proliferation in response to loading. Therefore the training program should be based on an LSD foundation over at least a 6-8 week period to ensure that these structures have time to adapt and are able to withstand the higher and repetitive loading and strain of fast exercise and concussive 'wear and tear' over an extended competitive season. The red blood cell count, oxygen carrying capacity, the lung capacity and heart muscle strength, blood pressure and heart output is able to respond more quickly to exercise. The VO2max response is even slower, taking up to 16 weeks or longer to reach near maximum uptake capacity and aerobic fitness. The musculoskeletal system must therefore have time to adapt in a step-wise loading program to avoid the risk of overloading and breakdown due to a 'too hard and too fast - get fit quick' type of training program.

Figure 1 - Fitness Related to Efficiency of Oxygen Uptake and Length of Time in Training

This diagram illustrates that a horse at the start of a training program reaches 50% of its fitness relative to oxygen uptake (VO2max) (Response Phase) after only 2 weeks of daily exercise at a trot over a distance of 1500 metres daily.

The next phase of establishing fitness (Establishment Phase) takes a further 8 weeks, irrespective of the speed of exercise to reach 70% of VO2max after 10 weeks in work. During the first 8-10 weeks, the bones, joints and tendons also need the time to adapt to the increased loading of fast work. If a horse is given lighter work or a forced rest for 2 weeks due to injury, it can lose 10% of its oxygen uptake per week.

Once regular fast work is commenced (Improvement Phase), the muscle oxygen uptake is improved slowly over a 6 month period. If a horse is rested for up to 3 months once VO2max is well established, then only a 20% reduction in oxygen uptake occurs during this period. This means that a horse can be turned out for a short rest and still retain significant muscle oxygen uptake ability. However, bones and tendons begin to lose their loading capacity after 4-6 weeks of rest and care must be taken to re-establish loading capacity by a progressive increase in fast work.



Energy and Metabolic Pathways

The exercising muscles have the ability to use high phosphate energy compounds during acceleration to gain speed, enabling aerobic pathways to kick in as the vascular system ramps up to deliver oxygen within the first 15 seconds of speed exercise. The aerobic pathways support endurance exercise to efficiently metabolise muscle glycogen and fat energy, with anaerobic metabolism acting as a speed booster at all out speed over a short distance. These are the basic sequences of the energy production pathways used by wild horses in their 'escape from predators' mode and it applies to exercise metabolics in horses in training and competing in horse sports.

- The high phosphate energy compound Adenosine Triphosphate (ATP) is the energy source primarily used to contract and relax muscle cells at both slow and fast speeds. ATP breaks down to ADP releasing phosphate and is regenerated to ATP in the liver and muscles during recovery.
- All speeds of exercise use ATP, but aerobic exercise at speeds between a walk to a medium gallop (11-12 metres per second) use muscle glycogen more efficiently to produce ATP. Horses use oxygen, even fully fit, to produce 80% of their energy needs during exercise. When galloping, the large muscle bulk metabolises muscle glycogen using up to 70 litres of oxygen per minute. The horse has the highest VO₂max of all athletes, with an oxygen uptake in a fit horse approaching 165ml/kg bodyweight of the horse per minute at the sustained gallop.
- ATP can be generated aerobically using oxygen, with each unit of glycogen (muscle energy store sugar) providing 36 ATP units for muscle contraction. Fats, when metabolised in muscle cells during exercise yield 2.25 times the energy produced by aerobic metabolism of muscle sugars and protein. ATP is also generated under conditions of low oxygen, or anaerobically, usually at the fast gallop or at the end of exhausting exercise, when oxygen debt develops in contracting muscles, producing only 3 units of ATP per unit of muscle energy. This form of energy production rapidly metabolises and depletes muscle glycogen stores and cannot be sustained for long. The anaerobic pathway also produces lactic acid as a by-product of anaerobic metabolism, which has an effect on suppressing further energy production and results in muscle fatigue and reduction of the speed of exercise.
- The conversion of lactic acid to lactate in the muscle cells and liver and its conversion back to pyruvate and eventually muscle glycogen, is used as the energy for muscle contraction during 'cool out' exercise and recovery when the muscles are fatigued. Slow speed 'cool out' exercise uses lactate as an energy substrate to assist recovery after exercise and this also helps to both conserve and restore muscle glycogen.
- Aerobic metabolism is used during all speeds of exercise, with fat being used at slow speeds to conserve muscle glycogen and glycogen being primarily used aerobically at medium trot to medium gallop. Show jumping, dressage and lower level eventing, primarily use aerobic energy from fats and glycogen. Fats are only metabolised aerobically.

How to Wrap a Working Bandage

It is important that bandages provide protection, but do not constrict the limb when the horse is exercising. Always ensure that the bandage is flat and free of ridges and folds by rolling it carefully into a roll before wrapping. You must always wrap the limb in a circle direction so as to pull the tendons to the inside, to help avoid abnormal alignment of the tendon as the limb bears weight when the horse is exercised. On the right (offside) limbs, the bandage should be wrapped in a clockwise circle (to the left) and on the left (near side) limbs, wrap in an anti-clockwise direction (to the right) to keep the tendon alignment on the inside of the limb. When wrapping, start on the lower part of the leg to be wrapped, wrapping the first layer around the limb firmly and folding a small part of the free end over the outside of the initial layer in order to lock the bandage onto the limb so that it is unable to loosen and twist, unravel, or distort the skin. Wrap the bandage firmly, but not too tight in layers around the limb, overlapping each layer by a third as it is wrapped. Finish at the top and secure by adhesive tape or bandage clips. Do not use safety pins or round cord to secure the wrap, as the thin edge may act as a ligature on the limb. Check the tension by pushing your index finger from the top down in the tendon groove - it must not feel constricted or excessively tight. Rewrap if necessary. Remove the wrap immediately after exercise to allow the limb to cool down, using cold water hosing or icing to cool the tendons. Tendons warm to 45°C during exercise due to the heat generated by their elasticity. Failure to remove a thick working bandage promptly after exercise, particularly prior to travelling can damage the tendons. Retention of heat each time after hard exercise may eventually denature the tendon matrix and core fibrils and weaken the tendon, leading to an increased risk of tendon breakdown.

Kohnke's Own[®] Product of the Month

The start of training for a young horse can be stressful with an increased risk of injury to the horse and rider due to inexperience, fear and insecurity until the horse learns to handle the training routine. Many owners supplement their young horses with a course of Mag-E, the innovative supplement containing organic magnesium, 2 forms of Vitamin E and mucilage compounds to correct low or inadequate levels the diet. It may assist in establishing proper nerve and muscle function during the first 4-6 weeks of training, or longer if necessary. Daily supplementation with Mag-E will help ensure that all horses, especially young horses, maintain an unfazed and co-operative, safe approach to training. Available pack sizes 1kg, 2.5kg.



Handy Hint 5

Training for Aerobic and Anaerobic Capacity

Horses training and competing in horse sports, such as eventing and jumping, utilise aerobic metabolism for stamina and the speed phases of competition. As a practical 'change point', aerobic capacity is conditioned at heart rates of between 150-160 beats per minute, or up to strong canter at 8-10 metres per second. However, to condition the utilisation of both aerobic and the switch to anaerobic pathways, a heart rate of up to 180-200 beats per minute in a fit horse is required to improve overall efficient energy and oxygen use. To condition anaerobic metabolism at speeds where oxygen debt occurs, a heart rate above 200 beats per minute, or a gallop at 13-14 metres per second is required to reach V₀₂max in advanced training. This is best achieved by incorporating short sprints over 300-400 metres after the first 6-8 weeks into a training program to help ensure optimum oxygen delivery is conditioned by increasing the red blood cell count and anaerobic muscle enzymes, as well as to facilitate efficient lactic acid removal and muscle buffering to delay the onset of fatigue. After warm up exercise, a sprint over 400 metres in a straight line, followed by 800 metres at the fast trot or free canter to allow re-oxygenation of the blood and muscles and dissipate heat and lactic acid. Then follow on from the trot/canter with a 300 metre straight line sprint (so as not to overload the bones, tendons and joints by cornering and to allow them to adapt to the extra loading at sprint speed). This is then followed on by cool down exercise over 1000 metres at the light trot and walk. This is a safe and effective way to introduce sprint conditioning and improve both aerobic and anaerobic pathways if the sprint-ups are repeated initially at weekly intervals. As the horse becomes more adapted to the sprint exercise, the sprint program can be repeated at 3-4 day intervals as part of routine training.

Disclaimer: The information and recommendations in this newsletter have been presented as a guideline based on the veterinary experience and knowledge of the author, Dr John Kohnke BVSc RDA. Whilst all care, diligence and years of practical experience have been combined to produce this information, the author/editor, Dr John Kohnke, accepts no responsibility or liability for unforeseen consequences resulting from the hints and advice given in this newsletter.

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