

Nylon Highway Issue #50



... especially for the Vertical Caver

Nylon Highway

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The *Nylon Highway* is published by the Vertical Section of the National Speleological Society on a regular basis pending sufficient material. Material is posted on the Vertical Section's web site soon after being received by the Editor. A volume of all material is printed and distributed to those not having access to the electronic version on an annual basis.

It is the intent of this publication to provide a vehicle for papers on vertical work. All submitted articles containing unsafe practices will be returned to the author. Opinions expressed herein are credited to the author and do not necessarily agree with those of the Editor, the Vertical Section, its members or its Executive Committee. The reader should understand that some material presented in the *Nylon Highway* may be of an experimental nature and is presented herein for peer review. The reader should exercise good judgment and use common sense when attempting new vertical techniques or using new equipment.

WARNING: The reader must acknowledge that caving, climbing, mountaineering, rappelling, rescue work and other rope activities expressed in the *Nylon Highway* are inherently dangerous activities and serious injury or death could result from use and/or misuse of techniques and equipment described in this publication.

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In short, if you'd like to submit something for possible publication, send it to the Editor. Otherwise, send it to the Secretary/Treasurer.

See our web page at: <http://www.caves.org/section/vertical>

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A Degrading Life

Care and maintenance of your metallic equipment

By the British Mountaineering Council

Life moves fast these days. With the increasing popularity of climbing, manufacturers are taking every advantage of the latest advances in materials and technology to make exciting new gear available each year. But one thing never changes, climbing has been and always will be a risk sport, and all the latest equipment in the world will only increase the margin of safety at which you operate.

Risk can never be eliminated, so it's absolutely vital to understand the limitations of equipment, and recognize the situations that may cause it to become damaged or even fail.

But how do you know if a certain piece of equipment is damaged? Should you throw a rope away after washing it in detergent? What's a stress fracture? Just one of the important subjects is degradation of metallic equipment, so read on if even if you only own a single carabiner.

Equipment degradation

Every time you use your gear it is under attack from a variety of sources - UV light, dirt, dust, water, salt - really, the surprise is not that climbing gear sometimes fails, but that it doesn't more often! Here are some of the more common forms of metallic degradation that occur, and some of the ways in which you can combat them:

Fatigue

Whilst the maximum failure load is a concept central to all engineering applications and their designs, another aspect of equal concern is fatigue. Fatigue is well recognized by professional engineers in nearly all materials, but especially in metallic alloys since it affects the life span of a product.

If a load is applied that is lower than the stipulated failure load of a particular piece of equipment, but is done so repeatedly, then the piece may eventually fail. This process is known as fatigue failure. Each load application is known as a cycle, and the less the load, the more cycles are required to cause a failure (if the load is small enough then a failure will never happen) However in reality for climbing equipment, the load level over a sequence of cycles is not constant, and a sudden big load equaling the failure load will cause the piece to fail.

The importance of fatigue effects implies the need to keep the amount of load to a reasonable level- well below the failure load- and to avoid sudden large loads, thus prolonging the fatigue life of the item. The design of a piece of equipment should take fatigue into account in the following way:

"The usual loads expected should be such that many thousands of cycles are required before fatigue failure, and this should be beyond the expected usable lifetime of the product".

However, if through exceptionally heavy or abnormal use too many cycles have been accumulated and failure is near, then cracks in the highest stressed areas will be forming and growing. Hence, a close examination with a magnifying glass on well-used equipment will be very worthwhile. In climbing terms, this means that reasonable use should attempt to avoid any chance of fatigue failure by limiting the number and/or severity of the load cycles. Examples of use that go against this are excessive torque, or repeated hitting on rocks. Both scenarios will shorten the useful life of the equipment involved.

Wear

Wear is a phenomenon that occurs when metallic surfaces are rubbed by other surfaces under pressure, and local shear stresses arise. Because of these, particles on the surface are eroded, and the physical volume of material locally decreases. The higher the contact pressure and the softer the material, the greater the rate of wear will be. Sharp surface features (like edges and corners) will also erode quicker than smoother parts, because the stresses in those features are higher under a rubbing force. For climbing equipment, any contacting surfaces are liable to wear since most alloys in common use are relatively soft. The most usual high-pressure situation encountered in practice is that of ropes passing through carabiners, rappelling and belay devices etc. Grooves can appear in these items of metallic equipment, and since a noticeable groove represents a new surface geometry with some material removed, the performance of these items will alter over time. This has the further implication that the failure load and other design parameters of the item are changed, and a safe course of action is to retire the piece of equipment once such a groove has become noticeable.

Stress degradation

Any piece of equipment that operates under applied loads becomes subject to the effects of the stresses that result from those loads. Thus, any structure or component used in an engineering application becomes stressed during the normal course of their intended operation, and metallic climbing equipment is no exception to this.

For instance, when a climber falls, the rope takes the climbers weight along with the harness, carabiners, slings and protection placed - all become stressed to a degree. The manufacturers design their equipment to withstand these stresses, but in conjunction with wear & tear and time, continued stressing sometimes leads to a failure.

Cracking

The presence of cracks in any structure that is designed to carry load is potentially dangerous, but obviously so where metallic climbing equipment is involved. Cracks can arise for several reasons:

During manufacture or heat-treatment of the equipment, commonly during welding processes - these are invariably detected at an early stage, or not critical to the intended performance of the equipment.

During a sudden overload when the failure load is exceeded and the item breaks - this is effectively the sudden initiation and catastrophic growth of a crack through the weakest part of the equipment.

Due to corrosion - see previous section.

By fatigue - as previously explained. Such a crack starts at a microscopically small size, growing as the fatigue life progresses until it is big enough to be noticed by the naked eye. In climbing equipment, this usually means that the fatigue life is nearly at an end, and that a failure is imminent.

This is the reason for recommending regular inspections of equipment both with the naked eye and with a magnifying glass, and when such a crack is detected to retire the item immediately. Continued use of a cracked item will almost certainly lead rapidly to sudden failure - a very dangerous situation.

Another relevant consideration when considering cracks is the influence of temperature. If the temperature is low enough, the brittleness of a material can increase significantly and any small cracks are liable to sudden and catastrophic breaking, like shattering glass. At higher temperatures, materials exhibit a more ductile characteristic making sudden cracking much less likely. For the alloys used in climbing equipment, the transition temperature between this brittle and ductile behavior occurs somewhere in the range -58°F (-50°C) to 122°F (+50°C).

The important factor for climbing equipment is that at cold extremes, it is more liable to brittle fracture, and prolonged use in these conditions increases the likelihood of this occurring (e.g. during an expedition). Although a lot of care is taken to consider this during design and material choice, it is prudent to check regularly for cracks in equipment that is used at cold temperatures for extended periods of time.

Further information is available from www.thebmc.co.uk

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ANCHOR WARNING

Danger from Anchors at Floor Level

National Caving Association, UK
Council of Northern Caving Clubs Technical Group (C.N.C.C.)

(Ed. Note: although this is written for the British caving group, all vertical cavers should heed the warning, when maneuvering at an anchor.)

After a thorough investigation, the C.N.C.C. Technical Group is issuing the following warning. It concerns the use of the following permanent anchors:

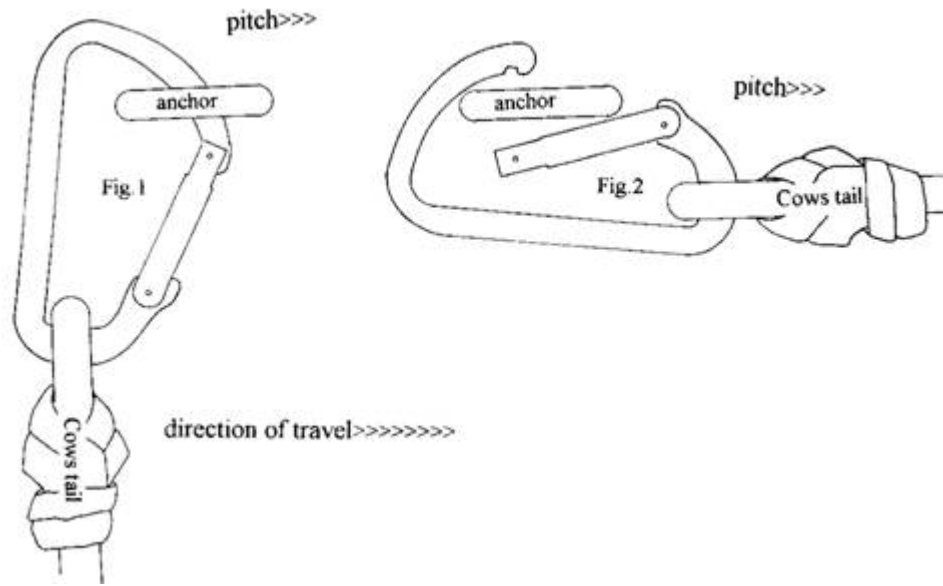
- Eco anchors
- Petzl safety bolt
- Fixe glue-in
- Collinox
- Batiinox

In certain locations it has been necessary to locate the anchor placement at ground level. After an intense investigation the following points have arisen.

When an anchor is clipped into at ground level and progression to the entrance drop is made by keeping low, it is possible for the attachment carabiner to become detached from the anchor. Also, anchors that have been placed below waist height on traverses and not correctly aligned with the direction of loading, may produce a similar result. See figs. 1 & 2.

When using anchors placed in rock at ground level or anchors that have not been placed correctly on traverses (e.g. too low and the wrong alignment), certain extra precautions need to be observed:

1. While maneuvering, watch the attachment carabiner.
2. Always ensure that you have two safety devices connected.
3. You may want to consider using screwgate or twist gate carabiners on safety loops/Cows tails.
4. When belaying/top roping etc., where there is a necessity to move around, it may be desirable to tie into the anchor.



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Harness Induced Pathology

by the National Outdoor Leadership School
Original video produced by: Federation Francaise de Speleologie.
This translation by Christian Bisson
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In the past few years, a new type of accident has appeared in the caving world: Death due to exhaustion by hypothermia. Such cases have also occurred on-rope when the "frog" method of rope ascent was used. 15 cases have been noted and each time the reason for death was attributed to the same phenomenon of exhaustion. A 1983 study of these deaths has led France's medical commission to consider the possibility of an additional factor potentially responsible for the cause of death: suspension in a sit-harness.

In 1984, the first indoor experiments took place. The first two volunteers fainted and experienced serious difficulties, one after only 6 minutes of hanging. These tests, thought to be too dangerous in this experimental context, were stopped immediately. However, the hypothesis is well confirmed. In a particular context surrounding total inertia, which means without any voluntary muscular action for adaptation, a healthy caver could die very quickly due to his/her suspension.

This particularity of total inertia is evidently found in situations involving an unconscious victim such as after a cranial trauma.

This phenomenon is highly suspected in cases of death without understandable causes, which have previously said to be due to exhaustion. In all other cases of rope ascension, the problem could never be explained.

The seriousness of this phenomenon and the hope to find an efficient solution led us to organize new experiments in a hospital setting.

Organized in the physiology labs of Besanon Hospital, the new set of experiments allowed us to set up new parameters. The main controlled parameters were:

- Pulse
- Blood pressure
- Electrocardiogram
- Electroencephalogram
- Diverse blood controls

Despite the availability of resuscitation equipment, the safety of each subject was assured by the use of a quick-release (5 seconds) which would be used before any serious difficulties developed.

In the hope to find a preventive solution, 3 different experiments were attempted:

- The first subject was in a real situation, with his head in hyperextension and his legs dangling below heart level.
- The second subject wore a brace in order to eliminate the hyperextension of the head, his legs still dangling.
- Finally, the third subject had his head in hyperextension but with his feet in foot-loops, keeping his legs in a horizontal position.

In all 3 cases, the subjects experienced considerable difficulties after 12 to 30 minutes of hanging. One of them actually fainted in spite of the medical controls and monitoring.

The observed phenomena are similar to the 1984 conclusions when both volunteers had experienced serious difficulties to the point of fainting due to the lack of experience of the research team.

Pulse control excludes the phenomenon of blood garrot. Abnormal feelings described by the volunteers clearly reveal a nervous compression, but this is not significant.

Discomfort due to blood return after garrot, quite low in the feet, is higher in the hands and neck, where venous dilatation is obvious. The physical mechanism of faintness is complex but can be described as follows: perturbation of the cardiovascular system balance, leading to a failure of the blood circulation with cerebral ischemia quickly followed by death.

For all 3 experiments, similar changes took place concerning heart rate and blood pressure. These changes illustrate well the efforts of the blood system to adapt itself to a stress situation.

With all data in a diagram, we can better understand the process. In the first case, the subject feels faint after 10 minutes. At the beginning, the pulse is normal at 80. Progressively, it will increase until faintness. Concurrently, the blood pressure normal at first with 12/8, will increase abnormally to reach 18/12.

Faintness with hot flushes, paleness, abundant sweat and breathlessness take place during a more intense pulse and blood pressure acceleration. Without a quick unhooking, faintness can be very serious. Unhooking before faintness provokes a brutal return to the heart of blood which was in the legs. The signs of faintness persist for a few minutes. The hyperextension of the head is very painful and leads to a quicker faintness. A manual correction of head hyperextension lessens the troubles, but pulse and blood pressure accelerate again within 5 minutes. In order to avoid a serious second faintness, the subject is unhooked.

In the second case, thanks to the brace, we can say with certainty that the origin of the faintness is not entirely cervical. In that case the unhooking took place after 20 minutes.

In the third case, unfortunately, we could not avoid faintness, although the legs were in a

high position. We point out that active leg movements are a good thing, but only for a short time, after which difficulties worsen rapidly. It is almost certain that this is what had happened in all death cases due to exhaustion.

Faintness is a complex medical matter, but we can come to the following conclusions: Whatever the type of harness, motionless suspension is not physiologically safe and will eventually lead to very serious blood circulation problems. It seems useless to try to invent a preventative harness.

The experiments led to the following advice:

1. A caver in difficulty on a rope, due to exhaustion or to technical problems, must be helped very quickly.
2. A caver hanging completely inert must be unhooked with all speed by other team members.
3. A team shall never let one of its members begin a rope ascent alone, even if he is in very good shape.
4. A tired caver should refuse to begin a long and difficult rope ascent, especially in a wet pit, without recovering first. He/She must carry and use properly his/her survival food and emergency shelter.

By following these recommendations, one should be able to avoid all danger due to motionless suspension. Today, this is the cause of many deaths, but should not occur in the future.

Knot Break Strength vs Rope Break Strength

This article has been removed pending further review by the Vertical Section Board.

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Minutes of the 2005 NSS Vertical Section Meeting July 6, 2005

The 2005 NSS Vertical Section meeting was held Wednesday, July 6, 2005 at the Grissom High School in Huntsville, Alabama. Executive Board members present were Chair Miriam Cuddington, Secretary-Treasurer Bill Boehle, At-Large members Bart Rowlett, Ed Sira, and Ed Kehs, Jr., Vertical Techniques Workshop Coordinator Terry Clark, Training/Education Coordinator Bruce Smith, and Contest Coordinator Bill Cuddington. Approximately 45 Vertical Section members were in attendance.

- I. **Meeting opened at 1:06 PM by Chair Miriam Cuddington**
Announcements - Thank you to all who helped at the climbing contest on Monday and Tuesday. Recognition of pioneer vertical cavers present at the meeting: John Cole and Dick Mitchell.
- II. **Minutes of the Last Meeting** - were published on the website. Minutes were accepted as published.
- III. **Officer Reports:**
 - o **Secretary/Treasurer:** Bill Boehle -
Secretary's Report - See attached.
Treasurer's Report - See attached.
 - o **Editor:** -
Information from Tim White (not present) relayed. Working on next volume. More articles are always appreciated. Bill Boehle also reported on the status of the Nylon Highway back issues. About half are out of print and no longer available. Bill is working on a project to scan these issues and make them available on the website. To date, five issues have been converted to PDF files (#1, 2, 3, 5, and 7) and posted on the website by Gary Bush. All issues will ultimately be scanned and posted. Issues will not be posted until all the existing stock of a particular issue is sold out. The scanned issues will be available to anyone visiting the website. Only the current issues will be located behind the passcoded portion of the website. The rest will be a reference resource to all interested parties.
 - o **VS Symbolic Items** - Bill Boehle. See Treasurer's Report. Commercial message: Plan ahead buy your sweatshirts at convention and save the postage.
- IV. **Committee Reports:**
 - o **Contest:** Bill Cuddington -
Thanks to all who help during the vertical contest. Whether you can only spend a little time or a lot, it all adds up. Without help it would be impossible to run the contest. Awards will be given out on Friday at 1:00 PM. Miriam added her thanks to all who volunteer their time to help at the contest. We appreciate any help from section members and others with timing, pulling rope, running the rack, etc.
 - o **Vertical Workshop:** Terry Clark -
Terry recounted that in recent years there has been some problems getting the money from the Vertical Workshop registrations collected by the conventions to the Vertical Section accounts. Lists of participants were compiled by Terry and Lynn Fielding. Lynn

then followed up with the past conventions and within three months all overdue monies were received by Treasurer Bill Boehle. Lynn is Terry's assistant with the workshop and handles all the paperwork for Terry. Terry thanked Lynn for all her hard work. Terry also informed the members that there are now some pictures from the vertical workshops posted on the website. These pictures were taken by Barb Ritts at the workshop held at the California convention. The workshop is held on Thursdays at convention and teaches various techniques at 8 stations. Qualified vertical cavers are always needed to help out with the workshop. Even if you are not vertically competent, there are plenty of jobs to do to assist with the workshop. There were about 36 students last year. There are 35 students registered for this year and about 5 more are expected. Miriam pointed out that there was a lot of vertical history represented in the room: John Cole, Dick Mitchell, Kirk MacGregor, Bruce Smith, and Bill Cuddington. Some reminiscing occurred. She thanked them for their contributions to vertical caving.

- **Education:** Bruce Smith -

The Basic Training Course manuals are available either from Tim White or Bruce. Last month Bruce was approached by John Hickman (Nashville) to give the Intermediate Training course another try. This has been a very difficult class to teach due to its complexity. You can't become proficient in some things in a short training class that are better learned through experience. We have to learn how to do this better. Bruce stated that he was humbled by some of the experience present in the room. He acknowledged the presence of Dick Mitchell and pointed out that there was a recent article in top sailing magazine that reviewed the Mitchell climbing system for use in mast climbing. The system is catching on and is expected more and more to replace the use of the traditional bosun's chair for this task. Bruce will try to get a link to the article if it is available online. Also received very well was the video prepared by Dave Socky. Bruce has had much positive feedback on it and it is being used strongly as a teaching aid. A issue was raised about the desire by some to add rescue related techniques to the Intermediate Training course. There was some discussion that this would be a mistake since the purpose of the training course series was to sequentially teach vertical techniques to regular students. Vertical techniques as it relates to cave rescue is very specialized and could be handled by NCRC as a separate course to add to its many other courses. Bruce agreed that this type of training might not be most appropriate under the Intermediate Training course. Regular students might not be capable at this point of their learning or even interested in the specialized aspects of the training that might be applicable to vertical caving in a rescue situation. Other forums for this training would most likely be more appropriate.

- **Web Page:** Gary Bush, webmaster -

The Nylon Highway issue for 2005 has not been started yet. Look for it shortly. Workshop pictures from Barb Ritts were relocated and are now posted. Everything else is up to date and more back issues of the Nylon Highway will be posted as they are scanned and converted to PDF files. At what point the newer issues will be taken out from behind the passcode will be up to the Executive Board. Suggestions for improvements are welcome and should be directed to Gary. Membership status information is now available on the website and is updated periodically. There was some discussion of why membership numbers had fallen off. It was generally agreed that past problems with getting our publication out were a major contributing factor. Since we have gone electronic our membership numbers have improved, with many old members returning. Hopefully this trend will continue. Greater membership fosters a more widespread exchange of ideas related to vertical caving. Kirk MacGregor raised the issue of sending out email renewal notices. This might help remind people to renew their membership. Larry Southam also suggested that an email notice should go out

when new articles are published in the Nylon Highway. The problems and practicalities of these suggestions will have to be looked at. Perhaps more reminders will inspire more articles to be submitted?

- **Rebelay Course:** Gary Bush -
It was busy this year. Thanks for the assistance of John Woods. This year 29 people signed up and 24 climbed the rope course. It was a long day, but it was well received by all who participated. As with any event of this nature, it would have gone more smoothly if more help were available. A lot of time is spent helping people who come in with problem with their rigs. Improper rigs make rebelay work more difficult. More help getting people setup properly would speed up the actual training on the rebelay course. Gary Storrick volunteered to help next year, but asked if he could be reminded a little before convention so that he could remember to bring certain gear with him. Training on tuning up your rig for better efficiency would be helpful for all climbers. Matching your gear to the task is very important (e.g., don't use a rack too big for a frog system if you are trying to do rebelays, etc.). Terry Clark suggested that perhaps we need a notice posted at the contest with a safety disclaimer concerning the various types and riggings of equipment used by the people competing.

V. **Old Business:**

- No old business from the floor

VI. **New Business:**

- Bill Cuddington raised the issue that he needs new record boards for the contest to cover all the Sit-Stand categories and the new 80-89 age group tier in the existing categories.
- Ed Kehs, Jr. Thanks to the Vertical Section from the JSS for the use of ropes and help with training the vertical cavers of tomorrow. Usually they spend time on one day with training in the gym followed by going to a cave or cliff the next day to practice what they learned. Ed pointed out that he could use more help from experienced climbers to make everything work more smoothly in the future. The kids need to be kept busy so they don't get bored. More adult help would speed up the process and keep everything moving safely. The kids are really interested in learning. The section acknowledged the good job that Ed is doing with the kids in the JSS. It was also raised that we need to ensure that there are better facilities at the convention for rappelling (both for adults and kids). 15 feet or so off the bleachers is not adequate to teach and practice rappelling.

VII. **Elections:**

- **Secretary/Treasurer** (1-year term) - Bill Boehle was nominated and re-elected by acclamation.
- **Editor** (1-year term) - Tim White was nominated and re-elected by acclamation
- **At-Large Board Members** (2-year term, 2 to be elected) - Miriam Cuddington, Brice Williams, Bart Rowlett, and Dan McConnell were nominated. A ballot of the section members present was taken and Miriam Cuddington and Brice Williams were elected. [Note: Current At-Large members Ed Sira and Ed Kehs, Jr. have 1 year remaining in their terms.]

VIII. **Motion to Adjourn:**

Motion to adjourn was made and carried. Time of adjournment was approximately 2:40 PM.

[Additional note: Subsequent to the Meeting, the new Board Members elected Miriam Cuddington as Chair. The three appointed members were re-appointed to serve for another year. They are:

- Contest Committee - Bill Cuddington
- Vertical Techniques Workshop Committee - Terry Clark
- Education Committee - Bruce Smith

The Executive Committee addressed one additional item. At the 2004 business meeting the following resolution was adopted: Resolved that the Executive Committee may determine a transportation reimbursement subsidy for Section material used at convention. To address this resolution, Ed Sira made a motion that was discussed and then amended (as proposed by Brice Williams) to set the subsidy at \$100 plus \$0.10 per mile. The committee passed this motion. Based upon this action, payment for the 2005 convention to Terry Clark in the amount of \$150 was approved (\$100 + 500 miles @ \$0.10).]

Respectfully Submitted,
Bill Boehle

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NSS VERTICAL SECTION
SECRETARY'S REPORT

JUNE, 2005

By Bill Boehle

Number Of Memberships	191
Number Of Members Paid Through 2005	123
Number Of Subscribers Paid Through 2005	12
Number of Annual Volumes Paid Through 2005	17
Number of Complementary Subscriptions	3

YEARS PAID:	MEMBER/SUBSCRIBER	ANNUAL VOLUME
2006	50	8
2007	14	2
2008	0	0
2009	1	0
2010	1	0
2011	0	0
2012	1	0

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