

# SUBSCRIPT

The newsletter of the BT Research Sub-Aqua Club, **February 1998**

and one was last seen heading in the direction of the showers.



**Figure 1** Clownfish will actively defend their anemone, trying to chase away other creatures that could harm it... this includes divers.

Either they are a large bunch of delinquent youths "hanging out" or they are a large bunch of even more delinquent diver's off on holiday, swapping dreary Ipswich for the sun-drenched, crystal clear Red Sea. If you went for the first option, you're reading the wrong newsletter.



**Figure 2** The Red Sea has the largest number, and greatest variety, of upside-down jellyfish with crunchy bits of the world.

The start of the holiday was at a ridiculous hour in the morning, 4.30am. Knowing I couldn't trust myself to get up promptly even with my alarm, I went for the student's option and stayed up until it was time to set off for site. I turned up at around 4am and by the time 4.30 had arrived, so had everyone else bar Mick Morley. Now, this might not seem strange, but for the fact that Mick had been adamant that we would be

## IN THIS ISSUE

- **Red Sea Special!**
- Chairman's Corner (new Chairman)
- Totally immersed at the PRM (Practical Rescue Management course inside story)
- GMDSS - what is it?
- Diving holidays - watch out for diving opportunities
- NEW technical serial for nitrox techies
- Eastern Region SDCs
- Christmas Meal Awards
- Diary dates - lots of them
- ...and more

### Further information:

#### Internet WWW

From inside BT:

<http://webserver.bt-sys.bt.co.uk/httpd/docs/BTRSAC/>

From outside BT:

<http://www.geocities.com/Colosseum/2473/>

Adline (01473) 644474

## Red Sea at Night, Diver's Delight.

*(being a concise and possibly even accurate recount of doings in Naama Bay, Egypt)*

Words by Michael Worsley

Photos by John and Frances Cook

Twas a dark and cold night in late November. A crowd of rather furtive people are gathered in a car park. Some are cheerful, others sleepy, most are cold

leaving promptly at 4.30, leaving behind anyone who hadn't turned up... it was tempting, but given that the coach hadn't turned up either, it would have been a bit difficult to leave him behind, particularly as he had the tickets.



**Figure 3 Butterflyfish and angelfish abound. Here's an Emperor Angelfish, looking truly regal.**

We were staying in the Sanafir Hotel in Naama Bay, near Sharm El Sheikh. This is towards the southern tip of the Sinai peninsular, on the east coast. Several members of the club had stayed there before, and the Sanafir had undergone some renovations since, including new rooms and a swimming pool.



**Figure 4 One of the most spectacular corals, the fan coral faces the prevailing current so its polyps can have a snack.**

Naama Bay is heavily into diving, and the shooting in Luxor the week before hadn't badly shaken its trade: there had been a few cancellations, including all the Swiss who were planning on going (ah well, no particular loss then!)



**Figure 5 Remember: if you put your hand in a hole, and you don't get it back, that's a moray!**

The first night there, we split up into two groups to eat.... and ended up in the same place anyway...

Afterwards, we headed back to the hotel, and discovered that the quiet, tranquil hotel had been transformed into a blaze of music by a saxophonist and a singer. They were loud. They went on until late. They played the same songs in the same order nearly every night that we were there. Other than that, they weren't too bad.



**Figure 6 George is a huge Napoleon Wrasse who used to live around Shark and Yolanda Reefs in Ras Mohammed. This is not George. George, according to Steve, was a lot bigger. This Napoleon followed us throughout the dive.**

Morning came, and with it we all trooped down to the Red Sea College, the group that we would be diving with for the week. We collected crates to stow our gear in on the boat, picked up lead and trooped in to an introductory talk about the Red Sea and the plans for the week. The RSC has a series of dive boats. There being a rather large number of us (19 including 3 non-divers) we had a boat to ourselves. Thankfully, our boat wasn't the "Nancy Queen" but "Aisha." With us for the week as our dive guides would be Steve (a South African who had been with RSC for some years) and Yves, a French man who had been there for 6 weeks.



**Figure 7 Scientists with nothing better to do calculated that parrotfish excrete around about half a ton of sand per year, and are responsible for 90% of the coral sand beaches.**

Each and every dive we did was prefaced by an excellent dive briefing, normally from Steve, detailing what the terrain is like, what kind of fish we could expect to see, what the current is likely to be doing and so on, as you would hope and expect. Also included

was the most comprehensive set of dive signals I've come across, mainly for naming the fish around us (if you want to see some, catch us in the pub). The best performance of the signals was, however, given by Yves, when he ran through the entire set in under half a minute....



**Figure 8 This is a scorpionfish. Highly camouflaged, and also highly poisonous. Not to be sat on.**

I know this has often been said, and by now sounds trite, but no matter how often you hear people talking about the wonderful visibility in places like the Red Sea, nothing quite prepares you for the incredible sight the first time you jump in and peer around from the surface. It was wonderful. Looking straight down 15m to the sand with outcroppings of coral and seeing fish is something that takes away your breath and holds it for ransom.



**Figure 9 When ya gotta go, ya gotta go. Frances is pictured here, sitting amongst some of the cargo of the Yolanda: toilets.**

## Editor's bit

*Phil Sheppard*



Another bumper issue - thanks everybody for your continued efforts in producing quality articles for our club's newsletter. I won't write anything more because there is so much else for you to read and look at (what do you think of the pictures? - good or what?!) - enjoy.

## Chairman's corner

*Dave Lock*



Hi everyone,

Firstly I would like to thank the retiring committee members for their many hours of hard work during the last 3 years. Until you have contributed to the club in this manner it is difficult to know just how much work goes into running the club. To the members who didn't retire and to the newcomers the work will not slow down but may increase as we have to review the main areas of the club during the next year! These activities have been split into 4 areas, headed by the people shown below:

- |                 |                       |
|-----------------|-----------------------|
| Training        | - John Cook           |
| Diving          | - Pete Young          |
| Social          | - Dave Garrett        |
| Club procedures | - Jonathan Legh-Smith |

These are by no means the only contributors and they will need advice from all quarters. If you have any suggestions please contact the relevant person. If you don't give an input and then complain later please don't expect anyone to take you seriously.

Secondly I would like to thank all those involved in making me an Honorary Life Member of BTRSAC. This is a high award and it's the first time I've been lost for words, when it was announced at the recent Annual Dinner. I shall continue to support the club in any way that I'm asked to contribute. Certainly my

impetus has been to encourage all to learn more about this incredibly diverse sport. Everyone has responded and we now have the most experienced divers and instructors in any club in the area. However I would ask you not to relax and to strive to improve one thing on every dive you attend. I've recently been trying to better my briefings and de-briefings so expect more chatter from me, during forthcoming dives.

I'm quite busy in the region and will be teaching on most of the Skill Development Courses organised by Ali White. I also teach and examine on the Instructor Training Scheme and would encourage all Sports Divers to attend an Instructor Training Course. This course is probably the best you will ever do and teaches you how to instruct diving in the pool and the classroom. Even if you don't want to be an instructor your technique, confidence and competence will increase. Jerry Hazzard (BSAC Director of Coaching) has also asked me to produce some technical papers for distribution to BSAC instructors. The first of these is on the Global Maritime Distress and Safety Scheme (GMDSS), reproduced later in this newsletter. I occasionally put in some hours for BT as well so that I can earn some money to go diving.

Finally I would like to wish you all a happy new year and safe diving in 1998. Let's all work together to make the club the best in the region.

## **Totally immersed at the PRM...**

*Tracey Skirrow*

Paul Skirrow, Roy Lobbett and myself went on the Practical Rescue Management course that took place in May. This course aims to give you the confidence and knowledge to manage an entire incident rather than being a detailed look at specific rescue techniques. There is also a lot of emphasis on good planning and preparation so that you won't ever need to use the knowledge you gained on the course. This course works well as a whole day event, as you spend all day thinking about the subject without any distractions.

The morning was spent role-playing various scenarios, looking at oxygen equipment, practising EAR (Expired Air Resuscitation) and rope throwing. Throwing ropes is much more difficult than it looks. I almost lassoed a car as well as several other course members! We practised throwing coiled ropes as well as trying to throw using a rope bag.

After a short break for lunch we moved on to Alton Water for the practical sessions, where we were shown many ways to carry casualties out of the water, how to disentangle yourself from a panicking casualty. We also had the opportunity to try parbuckling, which is a way of retrieving a casualty from the water, when the person needs to be lifted up onto a boat or a jetty. Roy very kindly offered his body to another lady and myself so we could practise on him, but we rejected him in favour of the heavy-weight instructor from Colchester (sorry Roy!).

We had a demonstration of a well-handled rescue from one of the instructors, and then it was our turn to put together all the things we'd learn during the day. Everyone got a chance to manage a different situation, some of which were quite imaginative to say the least (I won't spoil the surprises for anyone who hasn't done the course yet!).

The cost of the course was 35 pounds, which included course notes, a groovy cloth badge, and entry to Alton Water as well as tea and biccies. While some people might feel that this is a lot of money to pay for a course, it does mean that BSAC can afford to pay for the expenses of three instructors, so you got plenty of attention.

All the participants of the course had great fun, although it is a serious subject there were many light-hearted moments to ease the tension and I felt that it was a day well spent. I know that if I'm ever in a situation where I have to take charge I could do it.

## **Global Maritime Distress and Safety System (GMDSS)**

*Dave Lock*

This is a new system to be introduced globally during 1999, the U.K. Coastguard agency is upgrading its equipment to comply with this international standard.

GMDSS is a series of sub-systems that together allow mariners to communicate with each other and the emergency services. These sub-systems cover short range VHF, medium range MF, long range HF and satellite radio sets. Other areas addressed are EPIRBS plus NAVTEX receivers which obtain text weather forecasts and navigational warnings which are broadcast twice daily.

As most dive boats are only equipped with marine VHF radios, this will be the only option covered in this article. A GMDSS VHF radio has a unique nine digit number supplied by Wray Castle, who also issue ships radio licences in the U.K.. This number or Maritime Mobile Service Identity (MMSI) is programmed into the VHF radio. The calling channel will be changed from channel 16 to channel 70. This channel uses Digital Selective Calling (DSC), where other stations can be called using their MMSI, the equipment automatically switches both stations to a designated working channel. Of course you will have to know the MMSI of the other station, the MMSI of Coast stations will be well publicised. If you don't know the MMSI of another vessel, it is possible to put out an "all ships" call on channel 70. Ships in radio range will change to the channel you have identified and listen for your voice message.

In the event of a distress call a dedicated button is pressed which transmits your MMSI on channel 70. If your GPS receiver is connected to the VHF your position is also transmitted with regular updates. Distress calls are heard by all ships and coast stations within radio range. As this is digital technology the radio range is approximately doubled and the message is transmitted more quickly than with voice calling. After making the initial DSC distress call the Mayday procedures are the same as they are at the moment using channel 16, but without the initial distress message. Once you switch to channel 16 the range of the transmitter is restricted by the old analogue technology.

GMDSS will not be compulsory for small craft, but this depends on the goodwill of the Coastguard agency. From 1/2/1999 it will mandatory for all craft over 300 tons to be equipped with GMDSS technology. However after this date it is not necessary for H.M. Coastguard to keep a listening watch on VHF channel 16. In the U.K. the Coastguard has agreed to maintain a watch on channel 16 for the foreseeable future. Some other European countries have said they will not maintain a listening watch on channel 16. So if you want to contact the Coastguard in these countries you will have to use a GMDSS VHF radio, you will also need GMDSS equipment to call ships.

U.K. based dive boats will still be able to communicate with the Coastguard and other dive boats without too many problems but the operational procedures may change. During the GMDSS Conference held in Plymouth in 1997 several recommendations were made:

- Small vessels should keep channel 16 for distress and monitoring.

- Small vessels to use channel 16 for distress purposes only.
- Channel 13 should be the calling channel, once contact is made immediately switch to a working channel.
- Coast stations to continue to monitor channel 16 for distress only, to be continued until 2001 with the option to extend this to 2005.

As divers we need to know that there is a change in procedures coming in 1999. The recommendations above have not been adopted yet so please do not start using channel 13 as the calling channel. If the recommendations are adopted an update will be published in this bulletin.

## Red Sea 97 Briefing

Mick Morley

*This is an edited version of a briefing Mick wrote for the November '97 trip that he organised to the Red Sea. I think it will be a useful guide to anybody going on future trips to the Red Sea and Sharm El Sheikh in particular. Some of the details such as weight allowances and prices may be different for your particular trip so just use this as a rough guide - Ed.*

1. The nominal weight allowance is 20 kilograms but an additional 10 kilograms is allowed if transporting diving equipment. We are advised to carry any emergency cylinders in hand baggage so are that we can demonstrate that they are completely de pressurised prior to flight. Dive knives must be placed in hold baggage and not carried in hand luggage.
2. The visas for entry into Egypt will be purchased on arrival. Twelve pounds sterling is needed for this in the form of a ten pound note plus 2 pound coins. Any camcorders must be registered on arrival and checked out of the country on departure. This is clearly explained on arrival.
3. We will be diving with the Red Sea College Dive centre. They supply weight belts and cylinders and can also supply Nitrox instead of air at an additional cost of \$8 per fill. For those not owning or taking their own equipment, this can be hired from the dive centre at a cost of £8- 10 per day.
4. The boats are usually well equipped for day tripping with one or two toilets on board and a galley for the crew to prepare a light lunch for anyone wishing to purchase this. The cost is generally around £3 today. When on board the boat we must obey the orders of the skipper at all times which are usually relayed via the dive guide. For those not used to life on board a boat, one of the rules is that you remove your shoes when boarding

- the boat and go barefoot or have Special Boat shoes.
5. We usually begin diving at a site close to Sharm called Near Garden. This is a very pleasant spot with a flat bottom at about 15 to 20 metres and is an opportunity for the Guide to check the general standards of diving of the party. Other reefs around Sharm and up to the Straits of Tiran are superb, ranging from flat sandy bottoms with scattered Coral ergs to large drop-offs with caves and other places to explore. A Mecca of diving is Ras Mohammed which is run as a nature reserve in Egypt. Entry is strictly controlled by licensing the boats and there is an additional charge of \$5 per diver for entry. This is thoroughly recommend as Sites such as shark Reef will live for ever in your memory.
  6. Diving in clear blue warm water is very different from diving in the North Sea. The visibility is typically 25 to 30 metres and there is near perfect light, even at greater than 30 metres depth. The combination of these characteristics tend to hide the inherent dangers of diving in deep water. It takes just as long to get to the surface 30 metres away when in warm clear water as it does in the cold sediment-laden North Sea. It is also easy to lose track of time in such a benign environment. Therefore, the constant checking of depth, time and the position of your buddy is critical, particularly in the early dives.
  7. The only other significant dangers concern bites or stings from the normal inhabitants of the depths. This is only a risk if a diver is careless or goes looking for trouble. Sharks are seldom a problem in Sharm El Sheikh, in fact we will be very fortunate if we see sharks at all. Bites from such creatures as Moray Eels are only likely to happen if fingers are poked down into the holes in rocks and reefs where an unsuspecting Moray is hiding.
  8. Stings can be suffered from fish like the beautiful Lion fish but they go to considerable trouble to demonstrate their presence and the inadvisability of touching their spines through the beautiful feather light shapes and colours of their fins and bodies. Fish such as the scorpion fish and stone fish are more of a problem however as they are very effective at camouflaging themselves against the surface on which they are lying.
  9. **THE DIVER WHO STAYS CLEAR OF THE BOTTOM AND THE CORAL HAS LITTLE TO WORRY ABOUT.**
  10. Sharm El Sheikh is little more than a number of hotels and shops grouped around Naama Bay. The number of activities open to the non - diving visitor is limited but snorkeling in shallow water near the edges of the bay should offer some very enjoyable underwater sights. You can also take a four wheel drive out into the desert if you feel sufficiently ambitious or even a camel, which we could all consider doing on the last day of the holiday.
  11. Restaurants in Sharm are very good in my experience and offer a wide range of cuisine from many different countries at quite modest cost. We are advised to wear long sleeved shirts or jumpers plus trousers or leggings in the evenings to minimise the risk of being bitten by mosquitoes.
  12. We are advised to take an amount of Egyptian currency (eg 50 pounds sterling equivalent) plus small denomination sterling travellers cheques. Credit cards are widely accepted and offer an excellent way of paying for gifts and food in the restaurants, hotels, etc.
  13. **OTHER THINGS THAT YOU MUST BRING ARE A VALID MEDICAL CERTIFICATE, YOUR DIVE QUALIFICATION LOG, AND DIVE LOG BOOK DESCRIBING YOUR MOST RECENT DIVES.**
  14. Decongestant tablets and sea sick pills may be advisable in case mild conditions can safely be held at bay. Other medication to treat an upset tummy could be useful although Sharm is not as prone to this problem as some other areas around the Red Sea. You are strongly advised to only drink and brush your teeth with bottled water, not have ice in drinks and to peel all fruit before eating.
  15. Basic spares such fin straps and masks straps will be carried by the more experienced divers but it is advisable to ensure that your particular equipment can be adequately repaired to prevent a whole day or even more being lost due to the failure of a small piece of equipment.
  16. Sun block and high factor screens are essential as the sun can be much hotter than it feels due to sea breezes. Also, covering equipment with a towel can prevent it getting unnecessarily hot when laying in open sun.
- ABOVE ALL, BE PREPARED TO HAVE A REALLY SUPER TIME AND A BRILLIANT HOLIDAY.**

## Weymouth diving

*Dave Lock*

I've sorted some dates for the Weymouth trip. This will run Monday 22nd June until Friday 26th. I would like to use club boats so spaces will be limited. The diving is varied from shallow inshore stuff to 40+ metres so it's open to all. I'm teaching on 20/21 and in Norfolk on 27/28 (got to get my monies worth out of that rebreather) but if someone wants to run a weekend they are welcome. It gets very busy at weekends though so the organisation needs to be slick. I will try and book places at the Bunkhouse when I have enough people. There will be a non-refundable deposit of 25 pounds. Could I have names first then I'll chase for money.

Dave's phone number (01473) 605622



## Eastbourne - Taurus diving

*Pete Young*

I have booked the following days on Taurus next year, out of Eastbourne, for BTRSAC. Cost will be 24 quid per day (240 spread among 10 divers), plus air / nitrox, etc.

Diving will be the normal kind of Eastbourne stuff, which means two wrecks, the first dive of the day may be in the 35-45m range so I have to restrict this to Dive Leaders or very experienced sport divers.

Dates are as follows:

Friday 19th June

Friday 17th July

Thursday 13th/Friday 14th August

The Thurs/Fri will require accommodation on Thurs and probably Weds night. Tides for the single Fridays will allow us to make it a one-day thing albeit with a reasonably late finish, so no overnight accommodation is required.

Please contact me ASAP with a deposit of 5 pounds per day to reserve your space. If I don't fill the places I'll open these up to the net in a month or so.

## Dive Programme 1998

*Editor*

Please note that Pete Young, our Diving Officer, is putting together a dive programme for 1998 and is aiming to have a diving event every weekend during the main diving season. To achieve this he needs qualified Dive Marshals to volunteer to lead a weekend or two. Volunteers from non-Dive Marshals who would like to increase their experience by assisting in organising an event are also sought. If you have a diving event you are planning that needs to use the club boats then please book early to avoid disappointment. Booking of the club boats, the RIB Starfish and the inflatable Buzo, should be made with our Boat Officer Barry Manning.

## Expeditions Officer - appeal for information

*Dave Lock*

I've been given another job by BTRSAC committee, that of Expeditions Officer. The job involves collecting and distributing information on Dive Sites, accommodation, air launching ramps, etc., etc. So I'm appealing for information from all sources, so if you have been diving at any site please pass information to me. We need to collate bad skippers/boats as well as good so keep that in mind. In return I will be able to supply details to anyone who fancies running a trip, this doesn't mean you get my wreck marks for Norfolk though!!

## Phone tree - to be ceased

*Editor*

Please note that the committee are proposing that the phone tree that was set up a couple of years ago to notify people not available on email of diving events at short notice be ceased. This is due to two main reasons - it was not being used and it is very difficult to maintain since "churn" of members means that membership of the phone tree becomes out of date quickly. Instead it is proposed that members who cannot be contacted via email ask a member who can be to pass on late-breaking diving information. With the diving programme being built early this year (see above and in the next issue of Subscript) the need for

the phone tree should be reduced. Any views on this please direct to any of the committee members.

## **Christmas Meal Awards**

*Frances Cook*

*[Note from Editor: The Christmas meal at the Marlborough Hotel was another excellent event organised by Frances - great food, good company and some fun and serious awards. Well done Frances and good luck to Dave Garrett who takes over your post as Social Secretary]*

Here are the awards given to BTRSAC members at the club Christmas meal in December. Prizes appropriate to the award were given!

### **Pony Express - to Mick Morley**

For breathing off a Pony Cylinder by mistake for 15 minutes at 36 metres.

### **Forget Your Head Next - to Jim and Cindy Tatham**

For discovering they had forgotten their dry suits after a very long drive from Grimsby to the Farnes.

### **The Cheats - to Raj Mistry, John Cook and Andy Saunders**

For passing the BSAC Diver Cox by an administrative error and officially getting away with it.

### **Chartwork and Navigation - to Paul and Tracey Skirrow and John and Frances Cook**

For driving from East Ipswich to Debenham the long way round - via Hadleigh.

### **Only 100 miles to go - to Howard Westlake**

For running out of fuel on the way back from the Farnes to Ipswich - diesels are very fuel efficient but Howard misjudged this one by 100 miles.

### **Honorary Membership of BTRSAC - to Dave Lock**

An exceedingly rare award. For services rendered to the club over several years.

### **First Class Diver - to Dave Lock**

For achieving the prestigious BSAC First Class Diver qualification. See previous Subscript for details.

### **The Golden Porthole - to Andy Saunders**

Awarded after ballot of club members - for great effort in organising events and the club diving kit during the year.

### **The Steve Jensen Trophy - to Mick Morley**

Awarded after ballot of club members - for organising the most enjoyable dive holiday during the year (actually two - Farnes and Red Sea).

There now follows Part 1 of a 3 part technical serial from John Cook for all you techies out there. The first part is a gentle introduction - just wait until you see the equation in Part 2! You are challenged to find an error in the maths. Ed.

## The finite compressibility of gasses and its impact on the mixing of Nitrox - part 1

John Cook

### 1. Units

In order to get calculations about gas mixing correct it is necessary to use compatible units for all the various quantities and constants involved. As a number of different units are used in various disciplines it is important to be able to convert between them correctly. Some of the Imperial and metric units involved can require quite elaborate conversions, so as a precursor to a discussion of the various relevant gas laws these conversions are stated here.

Throughout the rest of this document the following units will be used:

Pressure:	Bar
Volume:	Liter
Temperature:	Kelvin
Amount of substance:	Mole (Avagadro's number of molecules)
Mass:	Kilo Gram
Length:	Meter

I apologise for the American spellings; they derive from the software I used to help me prepare these notes. The Bar is a unit of pressure familiar to most divers in Europe. Contrary to popular belief though this unit is not just a pressure of about one atmosphere, but rather is a metric unit *derived* from SI base units. As such it converts to a round number of such units:

$$\text{Convert}[\text{Bar}, \text{Kilo Gram} / \text{Meter} / \text{Second}^2] \quad \frac{100000 \text{ Gram Kilo}}{\text{Meter Second}^2}$$

Many physics texts use the concept of the standard atmospheric pressure however. This is the mean sea level atmospheric pressure and doesn't convert so neatly:

$$\text{Convert}[\text{Atmosphere}, \text{Kilo Gram} / \text{Meter} / \text{Second}^2] \quad \frac{101325. \text{ Gram Kilo}}{\text{Meter Second}^2}$$

$$\text{Convert}[\text{Atmosphere}, \text{Bar}] \quad 1.01325 \text{ Bar}$$

Another popular unit of pressure is the PoundForce per square Inch (psi)

$$\text{Convert}[\text{Bar}, \text{PoundForce} / \text{Inch}^2] \quad \frac{14.5038 \text{ PoundForce}}{\text{Inch}^2}$$

$$\text{Convert}[\text{Atmosphere}, \text{PoundForce} / \text{Inch}^2] \quad \frac{14.696 \text{ PoundForce}}{\text{Inch}^2}$$

Of interest to divers:

$$\text{Convert}[232 \text{ Bar}, \text{PoundForce} / \text{Inch}^2] \quad \frac{3364.88 \text{ PoundForce}}{\text{Inch}^2}$$

Although this is commonly rounded up to 3400 psi. Also:

$$\text{Convert}[300 \text{ Bar}, \text{PoundForce} / \text{Inch}^2] \quad \frac{4351.13 \text{ PoundForce}}{\text{Inch}^2}$$

The Liter is of course another derived SI unit, in which system the proper unit for volume would be Meter<sup>3</sup>:

$$\text{Convert}[\text{Liter}, \text{Meter}^3] \quad \frac{\text{Meter}^3}{1000}$$

Other popular units for volume are the gallon and the cubic Foot:

$$\begin{aligned} \text{Convert}[\text{Gallon}, \text{Liter}] & \quad 3.78541 \text{ Liter} \\ \text{Convert}[\text{ImperialGallon}, \text{Liter}] & \quad 4.54609 \text{ Liter} \\ \text{Convert}[\text{Foot}^3, \text{Liter}] & \quad 28.3168 \text{ Liter} \end{aligned}$$

Notice there's more than one type of gallon!

Then there's more familiar conversions too:

$$\begin{aligned} \text{Convert}[\text{Kilo Gram}, \text{Pound}] & \quad 2.20462 \text{ Pound} \\ \text{Convert}[\text{Meter}, \text{Foot}] & \quad 3.28084 \text{ Foot} \end{aligned}$$

## 2. Gas mixing in terms of molar densities

In order to be able to achieve a consistent approach to gas mixing using a variety of methods it is vital to consider first gas mixing in terms of the molar density ( $n/v$ ) of the gases involved where  $n$  is the number of Moles of gas contained in volume  $v$ . This is natural since it is this quantity for each of the mixed gases is actually implied by the percentage of each gas present. For ease of reference this quantity can be called  $npv$ . The contents of any cylinder can then be described in terms of the molar density of the gas components which make it up. For a two gas mix (such as Nitrox), the state of fill of a given cylinder can be described as a two-element vector (neglecting the small quantities of noble gases which may be present from any air used in the filling process):

$$\text{fillstate} = \{npvO_2, npvN_2\};$$

where  $npvO_2$  is the molar density of Oxygen and  $npvN_2$  is the molar density of Nitrogen. This can be factorised as:

$$\text{fillstate} = npv \{fO_2, 1 - fO_2\};$$

where  $npv$  is the total molar density of the mix and  $fO_2$  is the fraction of the molar density made up by Oxygen.

The process of adding a gas of fraction Oxygen  $fO_2$  to the cylinder will move the fill state in a direction given by:

$$\text{plusgas} = \{fO_2, 1 - fO_2\};$$

Adding air will therefore move the fill in the direction given by:

`plusair = plusgas / . fO2 -> 0.208`      `{0.208, 0.792}`

The process of adding Oxygen to the cylinder will move the fill state in a direction given by:

`plusO2 = plusgas / . fO2 -> 1.0`      `{1., 0.}`

If the initial contents of the cylinder can be given as:

`istate := inpV {ifO2, 1 - ifO2};`

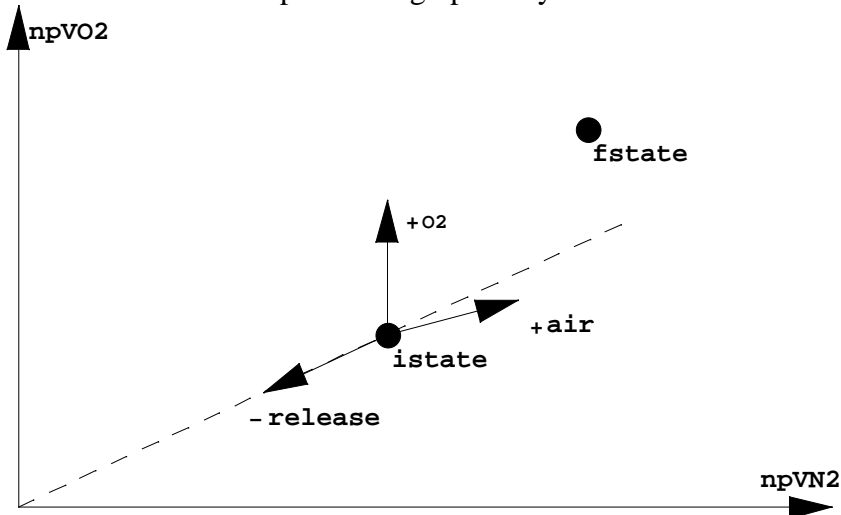
then the process of letting gas out of the cylinder moves the molar densities in a direction given by:

`release = -{ifO2, 1 - ifO2};`

In the same notation the final contents of the cylinder can be given as:

`fstate := fnpV {ffO2, 1 - ffO2};`

These ideas can be represented graphically as below.



From this diagram it can easily be seen that depending on the relationship between `istate` and `fstate` it will be possible to find a way to move the cylinder contents from one point to the other using at most two of the three available operations of letting content out, adding Oxygen or adding air.

To remain completely general allow the choice of these two operations to be undefined as `aoper` and `boper`:

Then the process of changing the cylinder contents from the initial state to the desired final state can be defined as finding positive `lnpV`, `mnpV` such that the following mixing equation is satisfied:

`blendeg = istate lnpVaoper + mnpVboper == fstate`

It is possible to make algebraic definitions for `aoper` and `boper`:

`aoper = {afO2, 1 - afO2};`

`boper = {bfO2, 1 - bfO2};`

Once this is done the mixing equation can be solved in the general case:

$$\text{blendsol} = \text{Solve}[\text{blendeq}, \{\text{lnpV}, \text{mnpV}\}][[1]]$$

$$= \left\{ \begin{array}{l} \text{lnpV} \rightarrow \frac{(\text{bfO2} - \text{ffO2}) \text{fnpV} + (-\text{bfO2} + \text{ifO2}) \text{inpV}}{\text{bfO2} - \text{afO2}}, \\ \text{mnpV} \rightarrow \frac{(\text{afO2} - \text{ffO2}) \text{fnpV} + (-\text{afO2} + \text{ifO2}) \text{inpV}}{\text{afO2} - \text{bfO2}} \end{array} \right\};$$

Values of  $\text{lnpV}$ ,  $\text{mnpV}$  can be calculated quickly for each pair of operators. A valid solution will have been found if both are positive (with the exception that  $\text{lnpV}$  must be negative if  $\text{aoper}$  is a **release**). The intermediate molar density after  $\text{aoper}$  is completed will be  $\text{vnpV}$  given by:

$$\text{vnpV} = \text{inpV} + \text{lnpV};$$

<End of Part 1>

*The remaining two parts of this technical serial will be included in the next two issues of Subscript. The complete document contents will be:*

#### *Part 1*

- 1. Units*
- 2. Gas mixing in terms of molar densities*

#### *Part 2*

- 3. Ideal gas laws*
- 4. Van der Waals equation*

#### *Part 3*

- 5. Interpolating van der Waals constants*
- 6. Mass estimates*
- 7. Further Study*

## Eastern Region Skill Development Courses (SDCs) 1998

*Dave Lock*

<i>Date</i>	<i>Subject</i>	<i>Venue</i>
February 8	Oxygen Administration	Havering
February 21	Equipment Care	Ipswich
February 22	Decompression Workshop	Ipswich
March 7	First Aid for Divers	Havering/St. Albans
March 8	Oxygen Administration	Havering
March 21/22	Advanced/Combined Nitrox	Ipswich
April 4/5	Search and Recovery	Ipswich
April 25/26	Boathandling + Diver/Cox'n	Felixstowe
May 16	Rescue First Aid	Ipswich
May 17	Practical Rescue Management	Ipswich
June 20/21	Dive Planning and Marshalling	Portland
Sept 12/13	Chartwork and Position Fixing	Ipswich
October 3/4	Boathandling + Diver/Cox'n	Felixstowe
October 24/25	Combined Nitrox	Ipswich
November 21	Oxygen Administration	Norwich
November 22	First Class Prep. (T)	To be announced

Please note these courses have to be booked via the Regional Coach at least a month before the event, I will have the necessary forms if you want them.

In addition I'm willing to run local SDCs but I need to know what you want. The only suggestion I've had so far is for Marine VHF Radio, so please tell me what is needed.

I also have the dates and venues of all the Instructor Training Courses, entry level is Sport Diver. This is probably the best course you will ever do and shows you how to teach students to Novice 1 level, contact me for details.

## DIARY DATES

Subscript article submission deadline

27 March 1998.

### Events, courses and holidays (just a few! - Ed)

Date	Events	Contact
February 25	Brewery Tour, Tolly Cobbold	Dave Garrett
March 12-19	Red Sea holiday	Dave Lock / Raj Mistry
March 26	Curry Night followed by drinks in Lord Nelson	Dave Garrett
March 28/29	London International Dive Show (LIDS), Olympia	
April 16	Curry Night followed by drinks in Lord Nelson	Dave Garrett
May 30	AGM and Branch Officers Conference, location TBA	Dave Lock
June 19	Eastbourne, Taurus diving	Pete Young
June 22-26	Weymouth diving	Dave Lock
July 17	Eastbourne, Taurus diving	Pete Young
July 10-11 (probably)	Camping/caravan weekend tba	Dave Garrett
July 4-5	Weybourne diving	Pete Young (DM to be found)
August 1-2	Weybourne diving	Pete Young (DM to be found)
August 13, 14	Eastbourne, Taurus diving	Pete Young
Sept. 14-19	National Free Try Dive Week	
October 3	60's dance, Trimley Social Club	Dave Garrett
October 17/18	Dive '98 Show, NEC	
November 21/22	Underwater World '98, Harrogate	
December	Christmas Party	Dave Garrett