

SUBSCRIPT

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

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Further information:

Internet WWW

From inside BT:

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

From outside BT:

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

Adline (01473) 644474

Disabled diving event

Mick Morley

I am pleased and proud to report that our club is now recognised as the centre of expertise in the county for organising scuba events for the disabled.

We have been asked whether we could help with an Eastern Region Sports for the Disabled event on Saturday 20th June. It is being held at the sports centre at Bury St Edmunds and the pool has been booked from 12:00 to 1:30pm for scuba try-dives.

The event is being jointly organised by Suffolk Health, Social Services, Sports Development Council

and the Rethink Disability Trust. It is being heavily sponsored by BT and all transport (31p/mile) and out-of-pocket expenses will be covered. Students will be transported in from all parts of the region to take part and members of the national paraplegic Olympic team will be present.

I have stated that it will be necessary for all taking part in a try-dive to be passed in advance as medically fit for the event and that BSAC guidelines concerning illnesses such as epilepsy will also apply.

It would be great if we could field about 6 sets of kit plus at least 6 instructors and 9 -12 assistant instructors.

**** Are YOU interested in helping with this event? Please let me know as soon as you can and put the date in your diary *****

Branch Diving Program 1998

Pete Young (Diving Officer)

As you can see (next page - Ed), I want to have something ready to happen on all the weekends when the tides are good, even though I expect we will lose a few days to the weather.

There are lots of sessions earmarked for NII and Sport Diver training. These have been timetabled to give the Instructors something to aim for, to try and make the Sport Diver training more of a club activity.

If you have plans for any of the weekends that have been assigned, please contact the designated marshalls who will be only too pleased to make use of your ideas and time. Likewise, if you want to assist with instructing, marshalling, leading dives or helping in any way please contact the nominated marshall as soon as you can make a commitment.

Both boats will be used on the Weybourne weekends: the big boat will be used offshore to dive on slack

tides, at other times it will be available to ferry people to the Rosalie.

? means that I need a volunteer to organise some diving on a particular weekend. If I don't get volunteers, someone will be assigned!

April			
18/19	Dive Leader Training	Gildenburgh	?????????
May			
2/3/4	Novice II/Sport Diver Training	Gildenburgh	John Cook
9/10	Novice II / Sport Diver Training	Gildenburgh	Daren Wood
16/17	Practical Rescue Management	Alton Water	Dave Lock
23/24/25	Novice II/ Sport Diver	Gildenburgh	Pete Young
30/31	Local diving, all grades	Felixstowe	Raj Mistry
June			
6/7	Local diving	Felixstowe	Simon Keating
20/21	Local diving, Sport Diver	Southwold	Pete Young
July			
4/5	Local diving, Novice/SD (Buzo)	Weybourne	Raj Mistry
	Local diving, SD (Starfish) (to include The Umpire)	Weybourne	Pete Young
18/19	Local Diving	Norfolk	Daren Wood
25/26	Diving/training ?	Inland site	John Cook
August			
1/2	Local Diving, Novice/SD (Buzo)	Weybourne	John Cook
	Local diving, SD (Starfish)	Weybourne	?????????
15/16	Local diving	Norfolk	Dave Lock
29/30/31	Local diving	Norfolk	?????????
September			

Nothing planned with branch boats. Raj Mistry is planning a trip to the Farnes. Please contact Raj for further details. There will be opportunities for some more Dive Leader training, and this could also be fitted in on the NIL/SD weekends or at other times, instructors willing.

Editor's bit

Phil Sheppard



The main UK diving season is almost upon us and BTRSAC is well prepared with a comprehensive dive programme in hand and a big push on training to get people through their qualifications before the BSAC training changes.

As always the information you need is in Subscript! Have a glance at the photo gallery to see if you're there and for light relief take a peek at John's technical article (part 2 of 3)!

Training Corner - Preparations for the new BSAC diver qualifications

John Cook



I have been a bit remiss in keeping Subscript posted with 'training corners' over the past few issues but for this issue there really is a need to get some information over that can not wait any longer.

BSAC have been in the process of carrying out a review of the Novice and Sports Diver training programmes for the past six months. This has been done with the consultation of the branches and the regional organisations and in response to pressure from members and changes in the way people dive.

A hint at what was to come was contained in the information about the new BSAC resort/school qualification of "Ocean Diver" which was launched a few months ago. This qualification had been designed to get people into open water a bit earlier, and build them to a point where they could enjoy diving safely in a shorter period.

The revision of Novice and Sports Diver was launched at the London International Dive Show in Olympia on the 29th of March. It is to be described in the next issue of Diver, although at the time of writing this I don't have my copy yet, I'm sure you will have by the time you're reading this. I don't want to give too much detail here as it would be a duplication of effort, but enough is required to make this article at least make sense on its own.

The most obvious change is in the name; the replacement for the detestable "Novice" is to be "Club Diver". Some longer-standing members of the club will find this rather ironic, as this is the same name that many had under the SAA for their equivalent of the BSAC's Sports Diver.

The Club Diver programme includes 8 theory lessons (cf Novice 5), 6 pool lessons (cf Novice 9), a theory exam and 6 open water dives (cf 2 for Novice II). The new Sports Diver programme has 3 theory lessons (cf 9), 2 pool lessons (cf 0), a theory exam and 4 open water dives (cf 9).

Even from these brief statistics it is immediately apparent that there is much more in Club Diver than there was in Novice and rather less in the new Sports Diver than there was in the old.

These statistics simplify the picture though, as there are many other changes to the details. For example Club Diver contains no AV tuition whereas Novice did; Club Divers are permitted (at the discretion of the DO or his deputy) to dive together as buddy pairs where Novices are not; new Sports Diver training includes some basic experience of decompression stop diving where the old did not.

A very important difference for club training is that BSAC now insists that the new courses can only be taught by members with a minimum instructor qualification of Assistant Club Instructor.

Some BSAC Branches will find the new courses very difficult to teach for a variety of reasons; lack of instructors; number of dives required; costs; long traditions of instruction being done by non-instructors. Fortunately for the BTRSAC none of these basic problems is going to be disastrous, thanks to the excellent work done in the past to raise standards and increase instructor numbers. This still leaves us with a lot of work to do though.

It will be clear that the new courses don't map onto the old particularly well at the Novice level. Existing Novice I and Novice II divers cannot simply be signed over as Club Divers without extra training. Nor can they use the new Sports Diver course instead of the old. In addition the BSAC will be discontinuing the training materials for the old courses in April 1999. These facts mean that it will be much simpler if existing Novice members of the BTRSAC can complete the existing Sports Diver course this year. We will be running the Sports Diver lectures on Monday nights starting on April 20th according to the timetable below:

Date	Time	Lecture	Lecture
20 April	19:15	ST1	Sports Diving
20 April	20:30	ST2	Diver Self Help
27 April	19:15	ST3	Diver Rescue II
27 April	20:30	ST4	Navigation & SMB
11 May	19:15	ST5	Life and Gases
11 May	20:30	ST6	Deco Tables II
18 May	19:15	ST7	Dive Computers
18 May	20:30	ST8	Adventurous Diving
1 June	19:15	ST9	Theory Exam

Daren Wood is acting as my deputy to organise the rest of Sports Diver open water diving training this year. There's a great deal to do as we have about 24 Novices in the club at the moment. This is going to put a great deal of strain on the Club's instructors, even though we have 11 of them. Everyone can do his or her part to help:

- Novices: please be as flexible and enthusiastic as possible to get your training done this year.
- Sports Divers: consider finishing off that Dive Leader training and/or doing an Instructor Training Course (ITC) to become an Assistant Club Instructor (ACI). This is all that's required to become an ACI. It's not examined and you can't fail. At 65 pounds it may seem a little pricey, but for a whole weekend's training of the very highest standard it really is excellent value for money. In fact it's heavily subsidised by BSAC to encourage members to get this most valuable qualification.
- Dive Leaders: please help by attending Novice diving training events to assist the instructors (if you're not an instructor already, if not see above!). At this level you also have the opportunity to go on from your ACI to become a full Club Instructor by taking the Club Instructor Exam. This will require a lot of preparation but with 11 people in the club who've been through it before you'll have a lot of support and advice.
- CIs: your patience and dedication please: it's going to be a busy summer!

If all else fails and for whatever reason you find yourself in April 1999 and still with only a Novice qualification don't despair! If there's not much to finish off for Sports Diver we will still be able to complete the necessary skill sessions. If you've been unable to get started, perhaps due to work or family commitments, there is still a way out. We certainly won't be running the old Sports Diver course again from scratch but what is possible is that you can be issued with a new-style log-book and the club DO has the discretion to sign over skills and theory already learnt as a Novice against the relevant parts of Club Diver. You will then be able to continue with the rest of the Club Diver training, effectively crossing over to the new scheme. Of course this won't be 100% efficient, so it will be much better to complete your Sports Diver training this year if you can.

To help the club through this difficult transition it seems to make sense to avoid taking on another Novice intake this summer. So the next intake for the club will probably be in September 1998 and it will be for the beginning of a new Club Diver course.

The club has already obtained copies of the training material for the new courses from the LIDS show in March. As well as training as many Novices as possible to Sports Diver this summer the Club's instructors will have the task of becoming familiar with the new training material in time to teach the new courses in September. It will be my job as Training Officer to help them in this and, with their help and consultation, decide exactly how the club will go about running the new courses.

In summary then the BSAC has made considerable changes to the Novice and Sports Diver training. This has been done because of a perceived need for change and in consultation with the membership. It will result in a lot of work this summer for many of our club members. All of our members can help in carrying out these changes. I have absolutely no doubt we will succeed, after all we have only recently come through a huge change of philosophy when we joined BSAC just 3 years ago and this is a much smaller upheaval by comparison.

Chairman's corner

Dave Lock



Hi all,

The club is beginning to go through a period of change – for the better I hope! The diving and training activities have undergone reviews although both these areas have to be re-visited with the introduction of Club Diver into the branch training scheme. We will also have to train our current Sports Divers to be able to conduct decompression diving as part of the new training route. Also only Assistant Club Instructors or above will be able to teach the scheme, we have quite a few of these but many of these are involved heavily in the branch training. I would hope that some of you who are already Sports Diver will consider going on a Instructor Training Course and gaining this award.

From the Diving Review we now have a basic schedule of dives to be organised during 1998. Pete is still looking for organisers for some of these dives and I would like these events to be well supported. You

don't have to be an Advanced Diver to help organise a dive so please contribute and offer to help on at least 1 dive during 1998.

The Training Review concluded that we are broadly conducting pool training in a good manner. Where we have to improve is the transition from pool to open water as this is the time where we lose people's interest. The introduction of Club Diver should improve this but we must manage this step within the branch. Daren Wood has offered to help John with this but as Branch Treasurer he already is quite busy so he will need assistance. I will be asking to meet the trainees at the end of pool training for a feedback meeting, I will be able to look at their expectations and suggesting how they can progress easily into open water and on to Sport Diver.

Paul Brannan wants to retire from updating the Adline after several years running it. This is the prime method of updating Club members so we need someone to fill this gap. With the demise of the 'phone tree there have been problems in rolling out the Farnes trip and I believe a couple of people have missed the chance of booking due to distribution by E-mail. Paul has been very conscientious in updating the Adline so I would encourage all to use it regularly. If anyone has any suggestions of improving communications could they please let me know.

There will be an Eastern Region meeting on 24th March and I will endeavour to attend. This will be a chance to talk to National Council members about the new training scheme and the proposed changes to the BSAC Constitution. The BSAC AGM will discuss and vote on the Constitution changes on 30th May. However you can influence the proceedings by using your postal vote and I would encourage you all to take part. I will organise a meeting in early May to inform you of the reasoning for the changes and to answer questions on the candidates standing for BSAC Council.

The committee is trying to provide a better service to members and hence offer better value for money but it cannot work in isolation so please contribute in any way you can. So again I ask all to contribute to the ongoing review of club activities, either speak to the person leading the relevant section or to me.

Dave 01473 605622 (Work) 01394 279140 (Home)

Photo Gallery

Photos courtesy of John & Frances Cook

Christmas Meal awards

5th December 1997



**BSAC First Class Diver No. 738
(Dave Lock)**



**Jim & Cindy Tatham remembering
their heads**

Dance with “Words and music by Lennon and Macartney”

23rd January 1998



Part 2 of a 3 part technical serial from John Cook for all you techies out there. As stated in the last issue the first part was a gentle introduction - Part 2 in the current issue contains the promised equation! The challenge to find an error in the maths is still on. Ed.

The finite compressibility of gasses and its impact on the mixing of Nitrox - part 2

John Cook

3. Ideal gas laws

3.1 Derivation of the combined gas law

The ideal gas laws were developed piece meal during the 17th and 18th centuries. By carrying out experiments on air trapped over a bath of Mercury Robert Boyle asserted in 1662 that the product of volume (V) and pressure (P) was a constant:

$$\text{Boyle's eq} = PV = \text{constant}_1;$$

A century on, in 1787, Jacques Charles, using similar apparatus, was able to assert that the volume of a quantity of trapped gas was linearly dependent on temperature, T: (although it is now thought that John Dalton had already reached the same conclusion much earlier and the discovery is mis-credited)

$$\text{Charles' eq} = V = T \text{constant}_2 + \text{constant}_3;$$

It was not until much later in 1848 that Charles' work caused William Thompson to propose a temperature scale such that constant_3 became zero. On this temperature scale Charles' Law took a simpler form with volume directly proportional to temperature:

$$\text{Charles' eq} = V = T \text{constant}_4;$$

William Thompson was eventually raised to the peerage as Lord Kelvin, and this temperature scale bears his name today.

John Dalton proposed at around 1800 that the total pressure of a mixture of gases is equal to the sum of the partial pressures of each of the component gases which make it up, where the partial pressures are those pressures which the component gases would cause if they alone were present in the same space.

This idea can be seen to be closely linked to another one proposed much later, around 1850, by Amedeo Avagadro. He proposed that a given volume of any gas at the same temperature and pressure contained the same number of molecules of the gas (n), although this idea wasn't fully accepted by the scientific community until about 1860. This idea can be expressed as:

$$\text{Avagadro's eq} = V = n \text{constant}_5;$$

Boyle's, Charles' and Avagadro's ideas can be worked into a single combined gas law as:

$$PV = nRT;$$

In this equation P is pressure, v volume, n the "amount of substance", T is temperature and R a single unified constant which has become known as the molar gas constant. It is convenient to express R in our chosen unit system as:

$$R_{\text{rule}} = R \rightarrow 0.08314510 \frac{\text{Bar Liter}}{\text{Mole Kelvin}};$$

Although it should be noted that 1 "Bar Liter" can be reduced to 100 Joule, which would return R to its more commonly quoted units of Joule/(Mole Kelvin).

The contribution of Dalton to the combined gas law has to be that the "n" can be the sum of the numbers of molecules due to a mixture of gases, and the gases therefore don't have to be pure. This is of course very useful when the concern is the planning of gas mixing.

3.2 Mixing using the combined gas law

The combined gas law is easily rearranged to give an estimate of molar density, n/V or npV :

$$npV_{cgl} = \frac{P}{RT};$$

This implies that with the rather large proviso that temperature is kept constant then the molar density can be quickly estimated from the pressure of the cylinder. Values of in_{pV} can be estimated from the measured pressure of the contents and fn_{pV} can be estimated from the cylinder working pressure. Similarly if_{O2} can be measured with a gas analyser, so with a knowledge of the desired ff_{O2} all the information is available to carry out the mixing operation.

The vn_{pV} mixing result can be quickly converted back to a pressure using the inverse relation:

$$P_{cgl} = npVRT;$$

In this simple case, because of the direct proportionality, the whole concept of molar densities can be "cancelled out" from the calculations and all that is necessary is to work the mixing equation in terms of pressure directly.

4. Van der Waals equation

Although the combined gas law is very useful it does break down when pressures are extreme (as well as under other conditions not of any great interest to divers).

Better accuracy can be obtained under these more extreme conditions by using an empirical modification developed by Johannes van der Waals in 1873 from laboratory observations of pure gases. This is known as Van der Waals equation which is given by:

$$vdweq = \left(P + \frac{an^2}{V^2} \right) (V - bn) = nRT;$$

In this equation, as before, P is pressure, V is volume, T is absolute temperature, n is the "amount of substance", R is the universal gas constant as before, a is a constant which allows for small inter-molecular forces in the gas and b is a constant which allows for the finite size of the gas molecules.

4.1 Solutions to van der Waals equation

By dividing through by V this equation is easily re-expressed in terms of the reference variable, molar density n/V or npV .

$$vdweq = (P + a npV^2) (1 - b npV) = npVRT;$$

Expanding this equation reveals it to be a cubic in npV :

$$vdweq = a b npV^3 - a npV^2 + npV (bP + RT) - P = 0;$$

Cubics can be solved generally however:

$$\text{npVvdw} = \text{npV} / . \text{Solve}[\text{vdweq}, \text{npV}] [[1, 1]]$$

$$\frac{1}{3b} - \frac{(2^{1/3} (-a^2 + 3ab(bP+RT)))}{\left(3ab \left(2a^3 + 18a^2b^2P - 9a^2bRT + \sqrt{4(-a^2 + 3ab(bP+RT))^3 + (2a^3 + 27a^2b^2P - 9a^2b(bP+RT))^2}\right)^{1/3} + \left(2a^3 + 18a^2b^2P - 9a^2bRT + \sqrt{4(-a^2 + 3ab(bP+RT))^3 + (2a^3 + 27a^2b^2P - 9a^2b(bP+RT))^2}\right)^{1/3}\right)}{3 \cdot 2^{1/3} ab}$$

This is a rather complex expression [thanks for letting us know John! - Ed], but its computation can be somewhat simplified by breaking it down into parts:

$$\text{npVvdw} = \frac{1}{3b} + \frac{\text{se1}}{3 \cdot 2^{1/3} ab} - \frac{2^{1/3} (-a^2 + 3ab\text{se2})}{3ab\text{se1}};$$

$$\text{se1} = \left(2a^3 + 18a^2b^2P - 9a^2bRT + \sqrt{4(-a^2 + 3ab\text{se2})^3 + (2a^3 + 27a^2b^2P - 9a^2b\text{se2})^2}\right)^{1/3};$$

$$\text{se2} = bP + RT;$$

It is comparatively easy to solve the equation for the pressure corresponding to a given npV:

$$\text{Pvdw} = \text{Apart}[P / . \text{Solve}[\text{vdweq}, P] [[1]]];$$

$$\text{Pvdw} = \frac{\text{npVRT}}{1 - b\text{npV}} - a\text{npV}^2;$$

4.2 van der Waals constants

To do anything useful with van der Waals equation values for the constants **a** and **b** are required. For Nitrogen these are:

$$\text{Nrules} = \{a \rightarrow \frac{1.4084175 \text{ Bar Liter}^2}{\text{Mole}^2}, b \rightarrow 0.0391 \text{ Liter / Mole}\};$$

For Oxygen:

$$\text{Orules} = \{a \rightarrow \frac{1.37802 \text{ Bar Liter}^2}{\text{Mole}^2}, b \rightarrow 0.0318 \text{ Liter / Mole}\};$$

For Helium:

$$\text{Herules} = \{a \rightarrow \frac{0.034551825 \text{ Bar Liter}^2}{\text{Mole}^2}, b \rightarrow 0.02370 \text{ Liter / Mole}\};$$

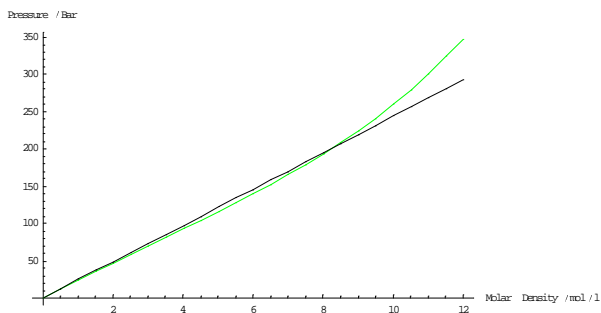
Its also necessary to make some assumption about the temperature of the gases involved. A good guess might be about 20 Celsius, ie:

$$\text{temprule} = T \rightarrow 293 \text{ Kelvin};$$

although the results are not overall terribly sensitive to this assumption, fortunately, provided it is held constant, which in practise means continually waiting for things to cool down or warm up.

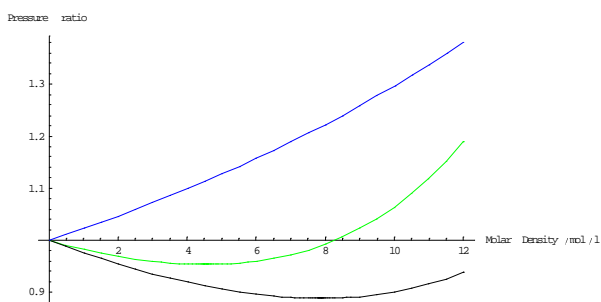
4.3 plots of solutions to van der Waals equation

It is interesting to plot van der Waals pressure solution out, say for Nitrogen, at the same time plotting the pressure expected from the ideal combined gas law under the same circumstances for comparison



This shows the way in which with increasing molar densities van der Waals equation first predicts a slightly lowered pressure due to the attractive forces constant, a , then an increased pressure rise due to the reduction in effective volume from the constant b . The divergence from ideal becomes quite significant by the time pressure reaches 300 bar (~10%).

This effect becomes more visible if the ratio between van der Waals pressure and ideal pressure is plotted. This has been done below for Nitrogen (green), for Oxygen (black), and Helium (blue). The plot shows that different gases exhibit different trends



<End of Part 2>

The remaining part of this technical serial will be included in the next issue 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>
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

12 June 1998.

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

IMPORTANT NOTE: For inland diving events see the Branch Diving Programme 1998 earlier in this issue.

Date	Events	Contact
April 16	Curry Night followed by drinks in Lord Nelson	Dave Garrett (if interested ring Dave on 01473 688095)
April 19	Colchester Pool	Daren Wood
May 30	AGM and Branch Officers Conference, location TBA	Dave Lock
May 30/31	Felixstowe diving, all grades	Raj Mistry
June 6/7	Felixstowe diving	Simon Keating
June 20	Eastern Region Sports for the Disabled try dive event	Mick Morley
June 20/21	Southwold diving, Sport Diver+	Pete Young
June 22-26	Weymouth diving	Dave Lock
July 4-5	Weybourne diving, all grades incl The Umpire (Sports Diver +)	Raj Mistry (Buzo) Pete Young (Starfish)
July 10-11 (probably)	Camping/caravan weekend tba	Dave Garrett
July 17	Eastbourne, Taurus diving	Pete Young
July 18-19	Norfolk diving	Daren Wood
August 1-2	Weybourne diving, all grades	John Cook (Buzo) ???? (Starfish)
August 13, 14	Eastbourne, Taurus diving	Pete Young
August 15-16	Norfolk diving	Dave Lock
August 29-31	Norfolk diving	???? (contact Pete Young if interested)
September ??	The Farnes	Raj Mistry
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