NEWSLETTER

RETIRED CHARTERED ENGINEERS ASSOCIATION
WORTHING

Hon. Secretary: S. Oliver Elphin, North Dive, Angmering, BN16 4JJ ☎ 01903 787116

FORTHCOMING EVENTS

30th April	Thursday	**Lunch** at the Charmandean Centre, Worthing see pages 3 & 13 for signing up
4th to 8th May		**Spring Break** to Yorkshire see page 2
12th May	Tuesday	**Outing** to Ordnance Survey, Southampton see pages 3 &13 for details and signing up
9th June	Tuesday	**Outing** to Magnox Nuclear Power Station, Dungeness see pages 3 &13 for details and signing up
14th July	Tuesday	**Outing** to Hampton Court Palace via boat from Richmond see pages 4 & 13 for details and signing up
11th August	Tuesday	**Outing** to Bluebell railway and Sheffield Park see page 4

Coffee Mornings

Laing's Arcade Cafe, Montague Street, Worthing.	Every Monday
Albion Inn, 110 Church Road, Hove.	First Wednesday of the month 1 Apr, 6 May, 3 Jun, 1 Jul, 5 Aug
The Spotted Cow, Angmering see page 2 for details	Third Thursday of the month 16 Apr, 21 May, 18 Jun, 16 Jul, 20 Aug
Beach Hotel, Worthing (with Ladies)	Last Thursday of the month 26 Mar, 30 Apr, 28 May, 25 Jun, 30 Jul, 27 Aug

Coffee mornings commence at 10.30 a.m., except at The Beach, which is from 10.45 a.m.

Copy date for next Newsletter 10 Aug

Errata

The address for new member **B.B. Bartlett** was given incorrectly in the December Newsletter; the correct details are repeated below.

Membership

We welcome the following new members:

To date we have 105 members.

Spring Break to Yorkshire Dales

The Spring Break is in danger of being cancelled due to lack of support. We need a further six couples to save the tour.

Please review your commitments and if possible sign up without delay. Your friends and relations will also be very welcome. We have until 24th March to save the tour and avoid disappointment to those who have already signed up. (Providing you pay your insurance, your deposit and payment for the tour will be refunded in full, should the tour be cancelled).

Coffee mornings at The Spotted Cow, Angmering

The Three Crowns at East Preston is being pulled down for housing. After investigation of other facilities in the area, it is proposed and supported by several of the attendees that we move to The Spotted Cow. The first coffee morning at the new venue will be that of 16th April.,1998. From the roundabout by the Roundstone PH on the A259, which is the next RB west of Angmering station RB, proceed north towards Angmering for 1km, take the first turning on the right signposted "no through road" and the Spotted Cow is 200m on the left. There is a large car park beside the PH.

Lunch at the Charmandean Centre, Thursday 30th April,1998 at 1230 for 1300 hr

The Charmandean Centre is situated on the south side of the main Upper Brighton Road Worthing, on the corner of Forest Road. Formerly it was known as the Drill Hall. There is a bar and lounge at the Centre for pre luncheon drinks.

The menu will be smoked haddock in a cream sauce followed by pork in a cream and wine sauce with a selection of vegetables and apple pie and ice cream for dessert; a glass of wine and coffee is included. There will be an alternative of fish for those who do not wish to have meat as the main course.

The cost per person will be £11. **Closing date for applications 2nd April,** 1998 - please return form on page 13.

Outing with Ladies to Ordnance Survey on Tuesday 12th May, 1995.

The O.S. is located N.E. of the city, a short drive from the M27 in Romsey Road, Maybush, Southampton. Tel 01703 792912. In view of the nature of this Organisation's activities, they have found that presentation of information is best done via an exhibition centre and, as a consequence, much of our time will be spent in this area. Subjects that will be covered are:- history, map markings, ground survey, aerial survey, digital mapping and its application, plus map printing.

Since our tour will start at 1330 hr, they would be happy to make their staff restaurant available to us at 1230 hr. It is appreciated that some members may not wish to take advantage of this offer; therefore it is essential that your preference is clearly indicated on the application form.

Numbers are limited to twenty, but you will only be contacted if your application is unsuccessful. **Closing date for applications 30th April,** 1998 - please return form on page 13

Outing with Ladies to the Dungeness Magnox Nuclear Power Station, on Tuesday 9th June, 1998

Visits to the Nuclear Power Station at Dungeness seem to be very popular and on the 9th of June three other parties also wish to visit the site. This means we have to arrive at a specific time which been given as 13.30 hrs.

The visit, which is scheduled to last for approximately 2 hours, will include a tour of the site, including the turbine hall, control room, and reactor hall, etc., and the visitors' centre. As with the visit to Hampton Court ,the outing will involve the hire of a coach.

Coach leaves West Parade*, Worthing 0830

Arrive Rye for Lunch stop	1100 approx
Depart Rye for Dungeness	1230
Visit Magnox station	1330
Depart after visit	1530 approx
Stop for refreshments	1700
Arrive back at Wesr Parade	1900 approx

*just to the east of Wallace Avenue, cars may be parked on the sea side of West Parade

The cost per person will be £10.00. **Closing date for applications 30th April, 1998** - please return form on page 13

Outing with Ladies to Hampton Court Palace and river trip, on Tuesday 14th July, 1998

The proposed Summer outing to Hampton Court Palace with a trip on the river will, to ease travel arrangements, potential parking difficulties and co-ordinate meeting times etc., involve the hire of a coach.

The price includes:- coach transport, a one way trip on the river between Richmond and Hampton Court and entrance to the Palace. There are a number of restaurants within easy walking distance of the Palace which provide reasonably priced lunches and there is an excellent self service restaurant within the Palace.

Coach leaves West Parade, Worthing	0800
Arrive Richmond	1030
Boat departs for Hampton Court	1100
Arrive Hampton Court	1200
Coach leaves Hampton Court	1700
Arrive back at West Parade	1900

The cost per person will be £20.00. **Closing date for applications 30th April,** 1998 - please return form on page 13

Outing to Bluebell Railway and Sheffield Park, on Tuesday 11th August 1998

Operations permitting, we will have a trip round the workshops, followed by a train trip

1030 Meet at Bluebell Station, Sheffield Park
1230 Retire to the nearby Public House for Lunch
1400 Visit Sheffield Park. NT members, don't forget your membership card!

Recent problems in water supply - Talk by A.C. Twort, member, at Durrington C.C on 10th December, 1998 at 2.30 p.m.

The second part of the talk, given by H. Speight, will appear in the next newsletter.

Leakage

The latest position of the total water supply in England and Wales for the period 1995 to 1996 is given in the table below:

	m^3/day	**m^3/day**	**%**

Metered to industry	3948		
Metered to households	436	4384	25.8
Unmetered to small shops etc	370		
Unmetered to households	8379		
Unmetered to builders, fire brigade etc	153		
Unmetered for flushing mains	56	8958	52.6
Total estimated supply		**13342**	**78.4**
Balance - assumed distribution mains leakage		3685	21.6

This shows that only 25% of the total supply is metered, all the rest being unmetered. The unmetered includes supply to small shops, to households, to builders for stand pipe purposes, the fire brigade and that used for the flushing of mains, with the balance of some 22% assumed to be distribution mains leakage. Actually this latter it is called "unaccounted for water", for no one really knows what it is, because a very large proportion of the total consumption is associated with unmetered supplies to households. This is what causes the difficulty when trying to determine precise leakage levels.

A survey of 1500 households in Anglia Water produced the typical results shown in Figure 2.

This is the consumption per capita, and it ranges from 100 litres per capita per day for 140 households to nearly 600 litres per capita per day for a very small number of households at the other extreme. (On one such survey I did, one house used over 1000 litres per person per day. This is not normal and turned out to be a Muslim who was rather zealous with his personal washing for they must only wash in running water.)

To meter the households in the above survey would probably cost at least £M if not £1M if every house had to have a meter installed. Anglia had 7 engineers working on it for at least 1 year. The difficulty is having done this exercise it is past history. For the survey was undertaken in 1994 with the results available in 1996. Meantime all sorts of changes may have occurred so you never really know the up to date situation. The annual growth rate of water consumption is about 1 litre per capita per day, but one summer may be dry and the next wet. There is also the problem that each year on average 6% of people move house. Thus an accurate assessment of the level of unmetered consumption is fraught with difficulty.

One of the attendant problems is that domestic water meters are not very accurate. Figure 3 shows the accuracy limits of a domestic water meter, highlighting the error curve for a typical 1/2 inch domestic meter.

Below about 11 litres per hour such a meter under registers by more than 10%. The domestic meter works on the principle of a rotating plastic cylinder which fills with water from an inlet port. The water pushes the cylinder round and empties it through a second port. Typically such meters are prone to stopping, particularly if maintenance is poor. In National metering trials in England when approximately 100,000 meters were installed in different parts of the country; to try to find what effects metering would have on customers habits; 25% of the meters removed for annual testing were found to have stopped! This arises because of grits in the water and in pipes. The Americans don't use this type of meter, they use a vane system, the Class B meter, that is even more inaccurate. The problem is that a dripping tap of 4 to 5 drips per second leaks about 4 to 5 litres of water per hour. This is well below the range which a domestic meter will register. Hence many of the Water Authorities make an allowance for low flows, but there is no uniform approach, for some make no allowance, whilst others allow 3% and some 6% for under registration. What always puzzles me is that although we are able to send people to the moon we don't seem able to make an accurate water meter.

Fig 5 shows the leakage losses for the various water companies. The left group are the Large Water and Sewerage Companies and the right group are the smaller Water only Companies. The estimate of domestic consumption is reasonably similar, but the leakage rate of the Larger Authorities is on average significantly greater than those of the smaller Water only Companies. The reasons for this are not clear; and this illustrates the difficulty in estimating the losses with any degree of confidence. The one conclusion that can be drawn is that the Water only Companies appear to better at estimating their losses than do their larger cousins!

The supply pipe leakage of both sets of Companies are very similar whereas the distribution losses are very different. OFWAT - or more particularly the newspapers that take the figures from OFWAT - quote the total figure, such as Thames that lose 38% of its total water, of which about 18% is directly due to the customer's supply pipes, many of which were installed in the 1930's. This may explain the difference, for the Water only Companies right from the start in the 1850's were profit motivated and only supplied the smaller wealthy developments in the South of England and not the large metropolitan conurbations. A further point is that the Large Water Company systems are in general older than the Water only Company systems so one would expect them to have higher losses. An interesting fact is that the average domestic consumption in the Large Water Companies is 149 lcd whereas for the Water only Companies its 170 lcd. That again may reflect that the Water only Companies are principally in the South and typically supply the wealthier parts of the country. This illustrates the problem of determining the real figures for what constitutes leakage and losses and what can be done to improve the situation. Thus the difficulty facing OFWAT is in setting realistic targets that have any meaning and which avoids "creative accounting".

In summary if the total losses can be restricted to say 16 or 17% of the total supply then that's pretty good. If the losses exceed about 25%, then it's time to take action to determine where the water is going. Overseas figures of 35% are not uncommon, although they often claim only 10% .

Pollution

There are many types of micropollutants, some examples are given below:

1. Disinfection by-products : Chlorine, Trihalomethanes (THMs) eg trichloromethane, chloroform and bromate, chlorite, chlorate, etc.

sources : Chlorine + organic matter

Ozone. *Sources : ozone + ?*

2. Hydrocarbons : Aromatic, Polynuclear (PAN's), Chlorinated benzines etc.

Sources : Coal, oils, petroleum, tar lining old water mains, road washings

3. Chlorinated solvents : eg Carbon tetrachloride, chlorinated ethanes and ethenes etc
Sources : Dry cleaning fluids, metal cleaners, paint thinners (many others)
4. Pesticides : Alachlor, aldicarb, aldrin, altrazine.....simazine, silvex, trifluralin....
Sources : Herbicides, fungicides, timber preservatives.....

The World Health Organisation (WHO) and Americans list standards for about 150 of them. Many micropollutants are, or believed to be either carcinogenic (cancer causing) or mutagenic (changing the hereditary genes of a species). Assessing their effect on human health is not possible directly. Instead tests for mutagenicity are carried out on cells in the laboratory, and tests for cancer on animals, rats and mice etc. Allowance has then to be made for animal test weight as compared with human average weight; time for the adverse effect to occur as compared with the 70 year human life span; and the intake of a pollutant from food. After this a safety factor is applied. Hence standards are precautionary and not exact, and sometimes views concerning the standard to be set can vary by two orders of magnitude.

Trihalomethanes complicate water supply treatment as they are produced by the reaction of chlorine with organic matter - that is with compounds from decaying vegetation, manures etc. It used to be the case that water was often chlorinated when it entered the treatment works. This eased the problems of contamination within the works and made it easier to finally disinfect the water at the end. The production of trihalomethanes means that chlorine is now seldom added to the raw water and this is a nuisance since further processes have to be added which introduce further problems.

Hydrocarbons, which result from coal, oil or petroleum contamination, do not present much of a problem for they are not usually present in a raw water, but come from the old coal tar lining of pipes used up to about 1970. Such lining was discontinued after 1970. Hydrocarbons are reduced by ozone followed by granular activated carbon.

At the present time the two main contaminants in water are Chlorinated solvents and Pesticides. There is a vast range of Chlorinated solvents used by industry (including metal cleaners, dry cleaning fluids, and paint thinners), and many pesticides of which a Department of the Environment booklet lists about 50. Such pollutants are treated with Ozone which is a strong oxidant. Sometimes ozone alone is not adequate and Hydrogen Peroxide has to be used to give it a boost, after which the water is passed through a bed of granular activated carbon.

Activated carbon is made from carbonised wood or coconut shells, and only lasts for a limited period depending on what it has to deal with, so its life may be quite short, sometimes as short as three months. Then it has to be taken out and sent back for 'reactivation' which is done by passing steam through it. In that process 25% of the original bulk is lost; so the process is not cheap.

Fluoride can occur naturally in water; there is an area in Essex where fluoride is too high and it has to be defluoridated which is rather difficult to achieve. The idea that fluoridated water - which reduces tooth decay - is unnatural is therefore wrong. It is put in artificially at the request of some Public Health Authorities, but not by Southern Water.

Iron and manganese are easy to reduce by aeration with filtration to remove the precipitated particles.

The great difficulty is Lead, for which the present EC standard is 50 micrograms per litre of water. The WHO has advised this be reduced to 10 microgram, and it is said a new EC standard will be 25 micrograms to be achieved in 15 years and 10 microgram in 20 years. This poses a vast problem because, although acid treatment of a water can reduce lead uptake to about 25, it can't always reduce it much more. The only answer - because this is a contaminate that enters the end of the pipeline, and not at the treatment works - is to replace lead piping. It is believed there are 11 million houses with lead piping and it will cost £8 billion to change them. The only thing I would advise if you have lead pipes, is to run the tap for a couple of

minutes to clear water standing overnight in lead pipes and so bring water through from the mains which, of course, are made of iron.

Nitrates in water come mostly from the use of fertilisers on the land. There is no record of any adult being ill from nitrates but very young babies can be affected by an excessive amount. The EC standard of 50
milligrams per litre has necessitated some Authorities adopting processes that involve much expense to reduce nitrates. The average adult consumes around 75 milligrams of nitrate per day from food and vegetarians about 200 milligrams. Four ounces of spinach, for instance, will contain 250 milligrams of nitrates! A litre of water will usually contain 20 to 30 milligrams per litre. Hence some views are held that the EC standard is too rigid.

Pathogenic organisms

Cryptosporidium presents quite a puzzle because no certain means of eliminating it is currently available, yet it is frequently present in small numbers in rivers and streams which run through livestock farming areas. It causes diarrhoea which can be dangerous for the sick or infirm. There have been several small outbreaks in UK but none resulting in any deaths. In USA there have been some very large outbreaks but again no deaths were reported.

Figure 7 shows the magnitude of sand grains in a sand filter relative to certain pathogens.

The E.Coli bacteria in animal and human intestines results in millions per cubic centimetre existing in sewage; hence this is the bacterium for which water is tested. Even one E.Coli present in water indicates possible contamination by sewage. About the same size is the cryptosporidium cyst (called 'oocyst'); and an even smaller organism is the Enterovirus which is about 1/50th of the E.Coli size. If tests show even one E.Coli bacterium in a sample of treated water, the water supplier must take immediate emergency action to ensure a safe supply, and report to OFWAT and the Drinking Water Inspectorate. The incident has to be investigated to track down where the contamination has arisen. E.Coli is killed easily enough by chlorine. But Cryptosporidium oocysts will not be killed by any reasonable amount of chlorine. The usual dose of chlorine seldom exceeds 2 milligrams per litre. Cryptosporidium oocysts can withstand 8000 milligrams per litre of chlorine. One result is that because the oocysts can breed in the sand bed of the filter, re-use of some of the filter washwater is no longer practised.

Dave Lewis

If only we had...An Engineer's view of the Jumbo Jet

-Talk by K.J. Wheeler, member, at Field Place on 6th January, 1998 at 2.30 p.m.

In about 1937 my father took me and my brother to the Royal Air Force Air Show at Kenley which was a fighter station at the time and ever since I have been hooked on aviation. There has been professional involvement several times during of my career and I have always kept up to date with developments. It was an observation on the similarity between most large commercial jet powered aircraft which led me to ponder on why this might be and this talk is the outcome of my research into the matter. I have derived much pleasure in its preparation and I hope that you will find what I have to say and depict on the graphics of interest to you.

The overriding theme is that development of a winning concept leads to optimisation and a trend to a common solution. It was the development of the Boeing B-47 bomber in the early 1950's whose configuration was determined by the US Air Force refusing to accept a bomber with jet engines mounted directly on or within the wing and the realisation that highly swept wings of high aspect ratio would be required to sustain high sub-sonic cruising speeds. The solution with engines mounted on pylons under and forward of the leading edge of the wing proved to be a difficult design problem but wind tunnel tests showed that the ideal aerodynamic location for the engine pod was in the position described with the bonus that the weight moment and inertia damping of the engine modified the dynamics of a flexible wing reducing the onset of torsional -flexural flutter which would destroy the wing at the Mach numbers required. The results of tunnel and flight tests and the associated theoretical work for this wing/ engine configuration remained a closely guarded Boeing secret for many years. No one else knew how to do it and Boeing must have realised that a commercial airliner with wing mounted jet engines in pods offering ready access to servicing and engine change together with the prospect of interchanging a higher rated engine as development progressed was a winner and this proved to be the case. This approach was not adopted on the de Havilland Comet which had a somewhat conventional wing with engines buried in the wing roots inhibiting the subsequent installation of bigger and more powerful engines with attendant servicing difficulties. If the Comet's career had not been cut short by the unforseen structural failure hundreds would have been in airline service due to the lead de Havilland had until a time came when the Boeing 707 exhibiting in its configuration its superior potential was realised by the airlines. As the graphics show the market is dominated by wide bodied aircraft having two high bypass ducted fan engines pylon mounted on high aspect ratio"super critical"wings with winglets at the tips with a crew of two on the flight deck.

The graphic **Fig.1.** illustrates what makes up the optimum aircraft and you will see that the principle features are the engine and the wing and I propose to deal with the engine first.

The graphic **Fig.2.** illustrates that propulsive efficiency and hence fuel consumption is independent of the mass flow passing through the engine but is dependent on the jet velocity and aircraft velocity only. Subsonic aircraft velocity is limited by the acceptable Mach number at cruising speed which leaves reducing jet velocity as the only option. However, reducing jet velocity to achieve fuel economy means substantially increasing the mass flow to restore the thrust and this is where the high bypass engine has provided the solution. (author's note-Members may like to try out their algebra in reducing the power ratio formula stated to give the elegantly simple 2Va/(Va+Vj) result; its similar to the "and this leads to" expressions we used to find baffling in text books from our student days).

The graphic **Fig.3.** shows a high bypass engine in simple form. This type of ducted fan engine has a bypass ratio of around 5 to 1. Earlier bypass engines such as the Spey had the duct enclosing the entire engine with the fan flow mixing with the jet exhaust at the rear and had bypass ratios of less than unity. **Fig.3.** also illustrates the fuel saved as a result of changing the original turbo jet engines on a Boeing 707 to fan jet engines and the order of bypass ratios required to achieve this saving. The general public have no idea of the reduction in noise levels achieved by using ducted fan engines. A Boeing 747 fitted with turbo-jets having the

same power rating as its current engines would produce a noise level far greater than Concorde at take off. Also the fact that aircraft are now substantially larger and hence more powerful seems lost on them.

I now move on to aspects of high performance wings;the provision of "winglets" fitted to the wing tips and the"super critical"wing. On a swept wing in particular the higher pressure airflow on the underside of the wing tends to run towards the wing tip and spill over to mix with the lower pressure airflow on the top side causing a vortex stream to trail from the wingtip. It is the energy loss from this vortex which produces the induced drag. It is high at low speeds where the wing is generating a high lift co-efficient but still present at a reduced value at cruising speed. The addition of winglets to what is already a high aspect ratio wing converts some of the vortex flow into a lift and hence a thrust component at the expense of a small increase of profile drag from the winglet; the winglet acts in the same manner as a sail on a ship.

The graphic **Fig.4.** illustrates the feature. Turning to the super critical wing one has to remember that at cruising speeds with high sub-sonic Mach numbers (in the order of 0. 8 Mach) some of the localised airflow over parts of the aircraft including the wing will be transonic producing turbulence called wave drag which has a marked effect on fuel consumption.

The graphic **Fig.5.** depicts the strong shock wave generated on a body in an airstream approaching 0. 8 Mach where the local airflow has accelerated to sonic speed. Immediately behind a shock wave the Mach number is always less than unity with attendant drop in airflow velocity. However,the pressure rises dramatically across the very thin shock wave as does the temperature producing the familiar"bang"and wave drag. The elongated wedge in the same airstream gives the clue whereby spreading the airflow acceleration over a greater length produces a weaker shock. The 1970 form of aerofoil as used on the Boeing 747 appears to have inhibited the aircraft's future development in terms of increased numbers of passengers that may be carried the task now passing to the new Boeing 777-300 which has a supercritical wing. The super critical wing section illustrated has a flat top aft of the leading edge and a cusp near the trailing edge to recover most of the lift lost by the flattened area at the front. Airbus aircraft use supercritical wings designed and built by British Aerospace(Hawker Siddley) and these wings gave Airbus an overiding advantage when they were first introduced. Finally I conclude with repeating the theme of this talk where we have seen that from the development of the winning format represented by the current similarity of jet liners of different make and how optimisation coupled with enhancement is the current activity with no major techno-shift in sight. What airlines want from the makers are significant reduction in tare weight,more reliability and reduction in noise and emissions,lower first cost and subsequent maintenance costs for engines having a 25 year life span and airframes having 40 year lives. Whats on offer from the makers are more fuel efficient engines with lower noise and emission with the prospect of using hydrogen fuel in the long term. Improved wing designs using laminar flow, the replacement of the multitude of electrical wiring by a dedicated fibre-optic data bus for all systems including primary controls and the greater use of composites in structures with consequent reduction in the number of component parts and weight.

Ken Wheeler

To: D.M. Lewis, 8 Arlington Avenue, Goring by Sea, Worthing, BN12 4TA Tel: 01903 249726

I wish to participate in the **Lunch** on Thursday 30th April,1998.

Full Name .....(Block capitals)

Address .....

.....

Phone No..... **Applications by 30th April, 1998**

Number of persons..... Cheque payable to RCEA at £11 per person enclosed

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To: D.M. Lewis, 8 Arlington Avenue, Goring by Sea, Worthing, BN12 4TA Tel: 01903 249726

I wish to participate in the outing to **Ordnance Survey** on Tuesday, 12th May, 1998.

Full Name .....(Block capitals)

Address .....

.....

Phone No..... **Applications by 30th April, 1998**

Number of persons wishing to use the OS canteen.....

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To: D.M. Lewis, 8 Arlington Avenue, Goring by Sea, Worthing, BN12 4TA Tel: 01903 249726

I wish to participate in the outing to **Dungeness Magnox Station** on Tuesday, 9th June, 1998.

Full Name .....(Block capitals)

Address .....

.....

Phone No..... **Applications by 30th April, 1998**

Number of persons..... Cheque payable to RCEA at £10 per person enclosed

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To: D.M. Lewis, 8 Arlington Avenue, Goring by Sea, Worthing, BN12 4TA Tel: 01903 249726

I wish to participate in the outing to **Hampton Court** on Tuesday, 14th July, 1998.

Full Name .....(Block capitals)

Address .....

.....

Phone No..... **Applications by 30th April, 1998**

Number of persons..... Cheque payable to RCEA at £20 per person enclosed

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