

Y GADAIR DDU / THE BLACK CHAIR

Ail-greu Campwaith Re-creating a Masterpiece

Mae'r Gadair Ddu yn un o ddarnau dodrefn mwyaf eiconig Cymru. Byddai'r dodrefnyn hwn, sy'n enghraifft wych o grefftwaith dechrau'r 20fed ganrif, â'i gerfiadau addurnol yn cynnwys symbolau Cristnogol, Groegaidd a Cheltaidd, yn nodedig yn ei hawl ei hunan. Fodd bynnag, mae stori bersonol y gadair ymhlith hanesion mwyaf ingol y Rhyfel Byd Cyntaf.

Y Gadair Ddu (The Black Chair) is one of the most iconic pieces of furniture in Wales. This superb example of early 20th century furniture, with its ornate carvings reflecting Christian, Greek and Celtic symbols, would be notable in its own right. However its personal story is associated with one of the most poignant histories of the First World War.





© Eugeen Vanfleteren

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Comisiynwyd y gadair farddol gan David Evans, adeiladwr cyfoethog o Benbedw a ddeuai'n wreiddiol o Ynys Môn, ar gyfer yr Eisteddfod Genedlaethol oedd i'w chynnal ym Mhenbedw ym mis Medi 1917. Yn ôl yr arfer, cadair wedi'i chynllunio'n bwmpasol oedd y wobwr ym mhrif gystadleuaeth farddol gŵyl flynyddol llenyddiaeth a diwylliant Cymru. Byddai seremoni cadeirio'r bardd, gerbron cynulleidfa o filoedd, yn un o uchafbwyntiau'r Eisteddfod. Cafodd y Gadair ei chynllunio a'i chreu gan grefftwr o'r enw Eugeen Vanfleteren o Mechelen, Gwlad Belg. Yn ôl erthygl ym mhapur newydd y Brython ar y pryd, roedd wedi ffoi o Wlad Belg gan adael busnes dodrefn oedd yn cyflogi 40 o bobl. Roedd Mechelen yn adnabyddus am greu dodrefn addurniadol o safon uchel, oedd yn aml yn cynnwys cerfiadau o anifeiliaid a phlanhigion.

Gosodwyd y Gadair yng nghanol llwyfan yr Eisteddfod ym Mharc Penbedw ar 6 Medi 1917, gyda phwysigion fel y Prif Weinidog, David Lloyd George o'i chwmpas, i ddisgwyl am ei pherchennog newydd. Roedd y beirniaid wedi dyfarnu'r wobwr i'r bardd â'r ffugenw 'Fleur de Lis' am awdl, sef cerdd hir mewn gwahanol fathau o gynghanedd, ar y pwnc 'Yr Arwr'. Yn unol â'r traddodiad, seiniwyd y Cymry Gwlad, a gofynnodd yr Archdderwydd Dyfed, i'r buddugol sefyll. Ond, y prynhawn hwnnw, ni safodd neb a bu'n rhaid i Dyfed gyhoeddi bod yr enillydd, Ellis Humphrey Evans, wedi'i ladd ers 6 wythnos, ar 31 Gorffennaf, yn Fflandrys. Roedd y mab ffarm o Drawsffynydd, Sir Feirionnydd, yn fardd ifanc uchel ei barch a oedd yn fwy adnabyddus o dan ei enw barddol, Hedd Wyn. Roedd trychineb marwolaeth Hedd Wyn, wythnosau cyn ei fuddugoliaeth fawr, yn rhywbeth a darodd dant gyda'r Cymry a daeth y Gadair yn symbol o'r holl gadeiriau gwag ar aelwydydd Cymru – y genhedlaeth o ddynion ifanc llawn addewid a gollwyd.



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The bardic chair was commissioned by a wealthy builder in Birkenhead, David Evans, originally from Anglesey, for the National Eisteddfod to be held in Birkenhead in September 1917. As was the custom, the main prize for the annual celebration of Welsh literature and culture would be a specially designed chair which the winning poet would be ceremonially awarded as a highlight of the Eisteddfod in front of an audience of thousands. The Chair was designed and created by a Belgian craftsman from Mechelen, Eugeen Vanfleteren, who, according to a contemporary article in the Brython newspaper, had fled from Belgium leaving behind a furniture business which had employed 40 people. Mechelen was very well known for high quality and ornate furniture often decorated with animals and plants.

In centre stage in Birkenhead Park on 6 September 1917, surrounded by dignitaries including the Prime Minister, David Lloyd George, the Chair awaited its new owner. The judges had awarded the prize to the poet 'Fleur de Lis' for an awdl, a poem composed cynghanedd (traditional strict Welsh metre), entitled 'Yr Arwr' (The Hero) and, as was the tradition, the trumpets sounded as the Archdruid Dyfed asked the winner to stand. But that afternoon no one stood and Dyfed announced solemnly that the winner, Ellis Humphrey Evans, had been killed 6 weeks previously on 31 July in Flanders. He had been better known by his bardic name, Hedd Wyn, and had been a well respected young poet, the son of a farmer in Trawsfynydd, Merionethshire. Hedd Wyn's tragic death weeks before his greatest triumph struck a chord with Welsh people and the Chair became a symbol for all the empty chairs in Welsh homes – the loss of a generation of young men of unfulfilled promise.

Rhodddwyd gorchudd du dros y Gadair ac fe gyfeirir ati byth ers hynny fel 'Y Gadair Ddu'. Aed â hi i gartref teulu Hedd Wyn, Yr Ysgwrn, ac yno y mae hyd heddiw, yn dal yn symbol pwerus o'r golled.

Yn 2012, gyda chymorth Cronfa Goffa'r Dreftadaeth Genedlaethol a Llywodraeth Cymru, prynodd Awdurdod Parc Genedlaethol Eryri yr Ysgwrn oedd erbyn hynny'n eiddo i Mr Gerald Williams, nai Hedd Wyn. Y nod yw agor amgueddfa a chyfleusterau i ymwelwyr erbyn 2017, sef canmlwyddiant marwolaeth Hedd Wyn. Bydd y Gadair gywrain yn dal yn ganolbwynt i stori Hedd Wyn. Er mwyn dysgu rhagor am yr Ysgwrn a threfnu ymweliad, ewch i: www.eryri-npa.gov.uk/yrysgwrn.

Yn 2013, dechreuwyd trafod y posibilrwydd o ddefnyddio technoleg fodern i ail-greu'r Gadair, gan ddefnyddio'r ddelwedd i adrodd y stori mewn manau heblaw'r ffermdy. Gan fod angen copi o'r Gadair wreiddiol, roedd rhaid dewis rhwng cofnodi manylion y Gadair a gwneud copi confensiynol ohoni, h.y. tynnu lluniau digidol a chael rhywun i greu copi pren o'r gadair, neu ddefnyddio proses sganio 3D fel y gellid gwneud print 3D a fyddai, gobeithio, yn dal rhywfaint o rin gwaith y crefftwr gwreiddiol, yn hytrach na dim ond copio'r mesuriadau.

Bob blwyddyn, mae camp enillydd cadair yr Eisteddfod Genedlaethol yn cael cryn sylw ond, yn aml, caiff camp gwneuthurwr y gadair ei hanwybyddu i raddau helaeth. Yng ngeiriau'r Athro Hywel Teifi Edwards, 'dylai fod cydraddoldeb, cydbwysedd mewn bri rhwng gwneuthurwr y gadair ac enillydd y gadair yn nhermau eu cyrhaeddiad'.

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The Chair, draped in a black cloth and thereafter known as 'Y Gadair Ddu' (The Black Chair), was taken to Hedd Wyn's family farmhouse, Yr Ysgwrn, where it remains today, still a potent symbol of loss.

In 2012, with the support of the National Heritage Memorial Fund and the Welsh Government, Yr Ysgwrn was purchased by the Snowdonia National Park Authority from Mr Gerald Williams, Hedd Wyn's nephew. The aim being to open a museum and visitor facilities by the centenary of Hedd Wyn's death in 2017. The magnificent Chair will remain at the centre of Hedd Wyn's story. To discover more about Yr Ysgwrn and to arrange a visit, go to: www.eryri-npa.gov.uk/yrysgwrn.

In 2013, discussions began on the possibility of using modern technology to replicate the Chair which could then be used to tell the story beyond the farmhouse. Due to the fact that a copy of the original Chair was required, a choice had to be made between recording and replicating the Chair in a more conventional way, i.e. using digital photography and producing a wooden copy by a third party, or the 3D scanning process which would allow a 3D print to be made which would hopefully capture something of the essence of the original craftsman's work, instead of only copying the proportions of its imagery.

Any National Eisteddfod chair reflects the achievement of the winning bard, but also, often overlooked the achievement of the chair's maker. In the words of Professor Hywel Teifi Edwards, 'there should be a parity, balance of reputation between the maker of the chair and the winner of the chair in terms of their achievement'.

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Am yn agos i ganrif, mae camp weledol a thechnegol y gwneuthurwr, Eugeen Vanfleteren, bron wedi'i bwrw i'r cysgod gan amgylchiadau ennill y Gadair. Penderfynwyd gwneud sgan 3D o'r Gadair wreiddiol er mwyn cofnodi mor gywir ag oedd modd, am y tro cyntaf, elfennau addurnol y Gadair a medrusrwydd y gwneuthurwr. Mae datblygu a defnyddio'r broses hon (sganio ac argraffu 3D) ar gyfer eitemau sy'n perthyn i'n hetifeddiaeth ddiwylliannol, yn enwedig eitemau o'r maint hwn, yn awgrymu y gellir ei defnyddio at ddibenion sy'n cyfateb yn llwyr i'r gofynion cadwraethol, gan ei bod yn cyfleu ymddangosiad yr eitem wreiddiol, yn cynnwys unrhyw namau neu waith adfer. Mae hyn, yn ei dro, yn golygu y gellir ail-greu darnau coll gan ddefnyddio data gwreiddiol, neu astudio'r eitem heb beryglu'r gwreiddiol. Roedd sganio'r Gadair ag offer arbenigol yn gryn her mewn ffermdy heb drydan na golau da. Fodd bynnag, llwyddwyd i wneud hynny. Y cwestiwn wedyn oedd a fyddai modd ail-greu'r Gadair gan ddefnyddio'r sgan ddigidol.

Bu Ysgol Beirianneg Prifysgol Caerdydd, Awdurdod Parc Cenedlaethol Eryri ac Amgueddfa Cymru'n cydweithio ar gynllun i geisio ail-greu'r Gadair gan ddefnyddio technoleg fodern. Roedd Ysgol Beirianneg Prifysgol Caerdydd o'r farn y byddai modd cynhyrchu data 3D solet trwy Gynllunio Gyda Chymorth Cyfrifiadur (CAD) a chreu copi o'r Gadair gan ddefnyddio technoleg gweithgynhyrchu adioli (argraffu 3D) a elwir yn Sinteru Laser Detholus (SLS). Ar ôl gwneud tipyn o waith ymchwil i weld pa mor ymarferol fyddai adeiladu cydrannau mawr gydag ychydig iawn o ystumio, aeth y fîm o Labordai Gweithgynhyrchu Adiol (AM Laboratories) Prifysgol Caerdydd ati i adeiladu nifer o samplau prawf a bu'r rhain yn llwyddiannus. Mae'n bwysig nad yw'r ddelwedd wedi'i hystumio fwy nag sydd raid fel y gall y darnau a dorrir gael eu huno yn fanwl gywir. Bu myfyriwr ail flwyddyn yn cydweithio â'r arbenigwyr gweithgynhyrchu adioli yn y Labordai AM yn ystod yr haf gan ddefnyddio'i hyfforddiant peirianyddol i rannu'r Gadair yn adrannau a chael gwell dealltwriaeth a sgiliau wrth addasu'r gwaith Cynllunio gyda Chymorth Cyfrifiadur.

Ar ôl rhannu'r Gadair yn adrannau, cafodd yr 20 darn mawr eu rhoi at ei gilydd yn y Labordai AM gan ddefnyddio peiriant SLS mawr EOS P700. Cafodd yr adrannau hyn eu cynhyrchu mewn cyfnod o dair wythnos a'u gwerthuso'n barhaus i wneud yn siwr eu bod yn fanwl gywir ac o safon ddigon uchel i'w hadeiladu. Mae gan y Labordai Gweithgynhyrchu Adiol yn yr Ysgol Beirianneg enw da am waith ymchwil a datblygu ym maes

gweithgynhyrchu adirol gan ddefnyddio metel a pholymerau ers canol y 1990au. Yn y Labordai, mae nifer o wahanol dechnolegau argraffu 3D sy'n gallu creu darnau bach a mawr. Mae'r gwaith ymchwil yn parhau i gyfansoddiad deunyddiau fel y gellir cynhyrchu cydrannau o ansawdd eithriadol o dda ar gyfer prototeipiau a darnau cynhyrchu terfynol.

Anfonwyd yr ugain darn o'r Gadair at Drumlord Ltd, sef cwmni yn Aber-carn sy'n arbenigo mewn gorffen eitemau a gynhyrchir trwy argraffu 3D. Mae Drumlord Ltd yn gwmni Prototeipio Cyflym ail genhedlaeth sydd wedi cynnig gwasanaethau prototeipio, gwneud modelau a chynhyrchu fesul tipyn bach i gwmnïau ledled y Deyrnas Unedig ers bron 35 mlynedd. Roedd sawl her yn codi wrth roi'r darnau at ei gilydd a pharatoi'r Gadair derfynol. Roedd rhaid asesu pob darn i sicrhau bod y mesuriadau'n gywir a'r llinellau'n syth a sythu unrhyw ddarnau oedd yn dangos arwyddion camu. Cafodd y darnau hyn eu gwresogi ar dymheredd uchel mewn jigiau pwrpasol a'u dal yn dynn yn ystod y broses oeri i'w hadfer i'w siâp cywir. Cynlluniwyd rhwydwaith barrau a bolltau cribog cudd i gael ei ddrilio yn adeiladwaith y Gadair fel bod modd bolltio'r holl ddarnau at ei gilydd a sicrhau bod y Gadair orffenedig yn gadarn. Bu crefftwyr medrus yn defnyddio technegau traddodiadol ar gyfer gwneud modelau i lenwi a blendio'r holl uniadau er mwyn sicrhau dilyniant y patrymau cywrain a chymhleth yn y cerfiadau gwreiddiol. Ar ôl cwblhau'r gwaith blendio a gorffen, cafodd y Gadair ei chwistrellu â phaent yn y lliw a ddewiswyd mewn tair adran. Yna, cafodd y darnau a baentiwyd eu caledu dros nos mewn ffyrnau a'u rhoi yn ôl at ei gilydd yn barod i fynd i ben ei thaith.

Ar ôl cael cyngor gan Amgueddfa Cymru, paentiwyd y Gadair yn lliw golau i ddangos manylion y cerfiadau yn well gan fod y Gadair wreiddiol wedi tywyllu dros amser. Mae'r copi o'r Gadair Ddu yn fanwl gywir, gan gynnwys ôl traul bron 100 mlynedd o fodolaeth. Caiff ei ddefnyddio i adrodd stori nid Hedd Wyn yn unig, ond hefyd Eugeen Vanfleteren, y saer o Fflandrys, a greodd gampwaith teilwng i Brifardd yn bell o'i famwlad. Yng nghanmlwyddiant y rhyfel a newidiodd Gymru am byth, mae'r bartneriaeth hon rhwng arbenigwyr treftadaeth a pheirianwyr dyfeisgar yn ffordd deilwng o ddangos sut y gallwn ddefnyddio'r dechnoleg ddiweddaraf i ddehongli stori eitemau eiconig sydd wedi'u gwreiddio yn hanes a diwylliant Cymru.



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For nearly a hundred years, the visual and technical achievement of the maker, Eugeen Vanfleteren, has almost been overshadowed in the public perception by the circumstances surrounding the winning of the Chair. The 3D scanning of the original was a decision to record as accurately as possible, for the first time, the design elements and level of skill employed in the making of the Chair. The development and application of this process (3D scanning and printing) in relation to objects within cultural heritage, particularly on this scale, suggests possibilities of application which are entirely in line with the conservational requirements, as it remains faithful to the original surface including any imperfections or restoration issues. This in turn allows replication of missing parts using original data, or allows access for study without risking the original. Completing the scan using specialist equipment was a major challenge in a farmhouse with no electricity and poor lighting. However, its successful completion posed the question of whether it would be possible to physically re-create the Chair from the digital scan.

A partnership between Cardiff University's School of Engineering, the Snowdonia National Park Authority and the National Museum Wales jointly developed a plan to attempt to re-create the Chair using modern technology. Cardiff University School of Engineering proposed that it would be possible to generate solid 3D Computer Assisted Design (CAD) data and to create a reproduction of the Chair using an additive manufacturing (3D printing) technology known as Selective Laser Sintering (SLS). The team, based in the Additive Manufacturing Laboratories (AM Laboratories) at Cardiff University, after conducting some research into the feasibility of building large components while keeping distortion to a minimum, built some trial samples which proved successful. It is important that distortion is minimal so that the cut sections can be joined accurately. A second year undergraduate worked alongside the additive manufacturing specialists in the AM Laboratories during the summer applying his engineering training to the sectioning of the Chair to improve understanding and skills in the modification of 3D computer aided design.

Once the sectioning process was completed the Chair, broken down into 20 large parts, was built in the AM Laboratories using an EOS P700 large format SLS machine. The sections were produced in a three week period and continuously evaluated for accuracy and appropriate build quality. The AM Laboratories at the School of Engineering have

an established track record in additive manufacturing research and development in metal and polymers beginning in the mid-1990s. At the AM Laboratories, there are a wide range of 3D printing technologies with the ability to produce both macro and micro components. Ongoing research continues into material composition to enable the production of extremely high quality components for both prototypes and full production parts.

All 20 pieces of the Chair were sent to Drumlord Ltd, a company based in Abercarn which specialises in finishing objects produced by 3-D printing. Drumlord Ltd is a second generation Rapid Prototyping company which has provided prototyping, model making and small batch production services to companies across the UK for almost 35 years. There were particular challenges for re-assembling and preparing the finished Chair. Each part had to be assessed for dimensional accuracy and straightness with any parts showing signs of warping straightened. These parts were heated at high temperatures in specially manufactured jigs and braced during the cooling process to bring them back into their correct shape. A hidden threaded bar and bolt network was designed to be drilled within the structure of the Chair to enable all parts to be bolted together and ensure the finished Chair was structurally sound. Skilled craftsmen used traditional model making techniques to fill and blend all jointed areas to ensure the continuity of the intricate and complex patterns within the original carvings. Once the blending and finishing was complete the Chair was spray painted the chosen colour in three separate sections, the painted sections were then cured overnight in ovens and then re-assembled for shipping.

Following advice from the National Museum, the Chair was painted a light colour to highlight the detail of the carving as the original chair has darkened over time. The copy of Y Gadair Ddu is exact, down to the wear and tear of nearly 100 years of existence. It will be used to re-tell not only the story of Hedd Wyn but also of Eugeen Vanfleteren, the Flemish carpenter who created a masterpiece worthy of an Eisteddfod winner far from his native home. In the year which commemorates the centenary of the war which changed Wales for ever, this partnership between heritage experts and innovative engineers is a fitting demonstration of how we can use cutting edge technology to interpret the story of important iconic objects rooted in Wales' history and culture.



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Yr Athro/Professor Hywel Teifi Edwards

