

THE MULTISPECTRAL RECOVERY OF *TRIOEDD CERDD*
IN NLW PENIARTH 20

The text presented here is part of *trioedd cerdd* preserved on pp. 348–9 at the end of NLW Peniarth 20. The last few folios of the manuscript have been subjected to extensive physical damage, leaving the last three pages of *trioedd cerdd* in various states of legibility. In 2015, the Lazarus Project traveled to The National Library of Wales to image these damaged pages on location. Subsequent processing of the data has led to the recovery of much of the previously illegible text.

Manuscript, Text, and Damage

Peniarth 20 has been digitized.¹ The manuscript was written at the Cistercian monastery of Valle Crucis, near Llangollen in northeast Wales² and contains the earliest texts of *Brut y Tywysogyon* and of a bardic grammar. Although the *Brut* ends with three annals in different ink, which Daniel Huws takes as an indication of contemporary entries, the main texts date to approximately 1330.³ Peniarth 20 contains four individual texts: *Y Bibyl Ynghymraec* (pp. 2–64), *Brut y Tywysogion* (pp. 65–302), *Kyvoesi Myrddin a Gwenddydd* (pp. 303–4), and *Gramadeg Barddal* (pp. 305–50). With the exception of *Kyvoesi Myrddin a Gwenddydd*, the main text is written in two columns throughout the manuscript, with most of the folios being ruled for 28 lines.

The last five pages of the manuscript (pp. 346–50) contain *trioedd cerdd*, the first two pages of which are legible and have been previously edited along with a partial editing of the third by G. J. Williams and E. J. Jones in 1934.⁴ On p. 348, the editors note for column a, ‘Nid oes fodd darllen odid ddim o’r golofn gyntaf, ac y mae’r rhan fwyaf o’r ail hefyd yn dra aneglur’ (‘Hardly anything of the first column can be read, and most of the second is also very unclear’), and at the end of the

¹ The MS can be viewed at <http://digidol.llgc.org.uk>. The first two sections of this were drafted by Brian Cook and the latter sections by Paul Russell. We are grateful for assistance in various forms from the Department of English at the University of Mississippi, Lindy Brady, Gregory Heyworth, Ann Parry Owen, and Myriah Williams.

² Charles-Edwards (2016).

³ Huws (2003: 47).

⁴ Williams & Jones (1934: 57–8).

transcription of column b, they note, ‘Nid oes fodd darllen dim o hyn ymlaen’ (‘Nothing can be read from here on’).⁵

The folio containing pp. 347–8 has been physically damaged at the bottom. A piece of the folio has been torn off beneath the outside columns, and there are two tears that penetrate into the text area (figures 1 and 2).⁶ Extension of the tears has been prevented by the addition of a paper mount pasted to the bottom third of the page on the verso of the folio, partially obscuring the text of column a on p. 348. Both sides of the folio are noticeably darkened from the first letters of the outside column, i.e. column b on p. 347 and column a on p. 348, to the edge of the page. With the exception of the first three lines at the top, the darkening follows the inner edge of the outside column closely on p. 347, with a similar appearance on p. 348, although here the edges are less carefully defined. Striations, defined edges, and uneven darkening give the overall impression of something having been brushed over the text of the outside column on both sides of the folio. On p. 347, and on parts of p. 348 where the text is still visible, it is noticeably darker than that of the untreated column.

The folio containing pp. 349–50 is in worse condition (figures 3 and 4). There are several holes in the lower half of the text area of p. 349 column a, and pieces have been torn off of the folio, damaging the text area of column b. The folio has been mounted on paper, which has been pasted to the verso. With the exception of the lower third of column b, both columns of text are almost totally obliterated on p. 349. The text on p. 350 is totally obliterated. Both folios appear to have already been at or near their present state in 1898 when volume one of J. Gwenogvryn Evans’s *Report on Manuscripts in the Welsh Language* was published: ‘The MS. ends with “Trioed kerd”, but as pages 349–350 are illegible it is not possible to say whether the text is complete’.⁷

The darkened areas on the folios are the result of a chemical reagent. The reagent was used with the intention of causing a reaction with metal ions in the ink, ultimately resulting in increased contrast between ink and parchment. The main chemical reagents used for this purpose can be grouped into three categories: oak gall

⁵ Williams & Jones (1934: 58).

⁶ The images can be found here:

https://www.llgc.org.uk/fileadmin/fileadmin/docs_gwefan/amdanom_ni/cylchgrawn_llgc/cgr_earth_XX_XVI_rh4_2017_7.1.pdf

⁷ Evans (1898: 347).

tinctures, liver of sulphur tinctures, and the ‘Giobert tincture’, each of which caused its own distinctive form of damage.⁸ Of the three, the damage caused by oak gall tinctures most closely matches the darkening seen on pp. 347 and 348.⁹ When p. 348 is viewed under multispectral lighting, it becomes immediately apparent that a liquid had been purposefully applied to the parchment (figure 5). Robert Vaughan (c. 1592–1667) was a known user of a probably gallic acid reagent,¹⁰ and Daniel Huws has identified the damage on pp. 347–50 of Peniarth 20 as gall stains.¹¹

*Lazarus Project Methodology and the Recovery of Trioedd Cerdd*¹²

The Lazarus Project (www.lazarusprojectimaging.com) uses a bespoke portable multispectral imaging system designed to travel to the manuscripts and image them on site, with image processing done after returning to the lab. A high-resolution monochromatic digital camera is suspended above the object while the object itself is placed on a copy stand for stability. Then, using custom build lights containing LEDs that emit in only one wavelength, the object is illuminated with narrowband wavelengths in the visible and near-visible spectrum – infrared to ultraviolet, spanning the range of 940–365 nanometers. After the visible and near visible spectrum sequence, a second sequence is run, this time only with ultraviolet and royal blue illumination. Light in the ultraviolet and royal blue ranges (365–450nm) causes the manuscript pages to fluoresce. The fluorescing wavelengths are then passed through a series of filters placed in front of the lens that only allow certain wavelengths to pass. Narrowband wavelengths are a great advantage over other systems, as they both limit unnecessary damage caused by exposing the manuscript to otherwise superfluous heat and light, and allow further filtering of the reflecting and fluorescing light. Simply put, this allows the Lazarus Project’s system to collect more

⁸ Albrecht (2012).

⁹ Albrecht (2012: 148), ‘[oak gall tincture] renders the unwritten-on parchment a brownish color, sometimes quite strongly’. Liver of sulfur tinctures leave white mineral deposits on the parchment, and the use of the Giobert tincture results in blue and bluish-green discolorations of the parchment.

¹⁰ Huws (2003: 262).

¹¹ See Huws (forthcoming), NLW Peniarth 20.

¹² We are indebted to the Department of English at the University of Mississippi for supporting Brian Cook’s travel to the National Library of Wales. Many thanks are due to the Gregory Heyworth of the Lazarus Project for providing him with this opportunity and Lindy Brady for reading drafts of his sections.

data while doing less damage than a full-spectrum imaging system that filters only reflected light.

After taking the series of monochromatic images, the images are then combined into pseudo-color images in ENVI image analysis software. With ENVI, each monochromatic image can be loaded into one of three channels – the standard red, green, and blue channels of digital displays. ENVI's software also allows users to run various algorithms to further enhance contrast. Once a pseudo-color image with high contrast has been produced, that image is then imported into Photoshop where image properties can be manipulated, RGB channels can be remixed, the image made monochromatic again, and several images can be combined and overlaid, all with the goal of producing the most legible text. It is important here to stress that Photoshop is only used to adjust the contrast between the writing and the substrate, never to 'enhance' any image, portion of an image, or particular reading of the text. The data itself was not modified, only the way in which the data was displayed. Because all images are monochromatic and taken in narrowband spectra, Lazarus Project images must be mixed to approximate natural lighting conditions (figure 6).

For the pages in Peniarth 20, twenty-three separate monochromatic images were taken under various lighting and filter combinations. ENVI can process each of these images individually or as part of a group consisting of anywhere between two to twenty-three images. Combined with the numerous statistical analyses ENVI can run on the data, and the fact that the data can be processed multiple times, the number of image and statistical process combinations grows exponentially, quickly moving beyond the point where running every possible combination is feasible. Moreover, each manuscript page presents its own set of challenges – there is no single procedure that produces results across every manuscript, or even across individual pages within a given manuscript. As it is often the case that what produces good results on one page does not produce the same results on the facing page, each page must be thought of as its own unique problem to solve. It goes without saying, then, that taking detailed notes throughout the process is required in order to later reconstruct the method used on each individual page.

I began the processing of p. 348 by constructing and calibrating an image cube. I then selected the images that already contained the most contrast and ran ENVI's principle and independent component statistical analyses, each time selecting a new data set from among the results of the previous statistical analysis. Once I had a

sizable collection of images that had undergone various processes, I used ENVI to create pseudo-color images in a digital color space, rendering the text and substrate in different colors of the visible spectrum (figure 7). Then, I imported the image into Photoshop where I manipulated the color space by altering hue, contrast, saturation, and used a method of overlaying images being refined by Helen Davies for use on Lazarus Project images, resulting in an image from which to transcribe the text (figure 8). As no single image provided the best legibility for every section of the text, transcriptions were taken by collating several images. Somewhat unexpectedly, a few processed images allowed us to read through the paper mount covering column a. The letters are by no means distinct, but the number of letters and their general shapes can be discerned, providing a useful guide when attempting to reconstruct the text (figures 9 and 10). The same basic technique was used on p. 349, although the more advanced state of degradation made the recovery of text more difficult. While even a single statistical process can greatly improve legibility (figure 11), producing images clear enough to transcribe was more challenging and time consuming than with p. 348. As with p. 348, transcriptions were taken from multiple images (figures 12 and 13). So far p. 350 has proven totally unrecoverable.

The Recovered Text

There follows the text recovered from Peniarth 20, pp. 348–9.¹³ It is first presented in a diplomatic form, followed by an edited text and translation, and then discussion. For p. 348 almost all the text is recoverable (except where there has been physical damage to the leaf), but for p. 349 where much less continuous text can be seen, only the legible continuous sections are printed, edited and partially translated.

[...] indicates more or less illegible passages; any text printed within [] is proposed tentatively either on the basis of sense or context.

Diplomatic text

p. 348, col. a

Tri phe]th a beir āg

¹³ We are very grateful to Ann Parry Owen and Myriah Williams for their input into transcribing and reading these pages.

hanmawl kerd nyt amgen amherthy nas ac eissyeu yst yr a drycdatl anya[l]	5
Tri pheth a hoffa ke rd yn well noc y bo nyt amgen vrdas y phrydyd a cherdw ryaeth y gwaranda	10
w[y]r a dayoni yneb [y ka]ner ydaw. Tri pheth a anhoffa ke rd yn waeth noc y bo eissyeu kerdwyr yw gwarandaw ay dat kanu yn auesur ac anvrdas y phry d[yd] Tri anvrdas kerd ysyd nyt am	15
gen y āghanma wl] ay gwrthot ac nas gwrandawer [Tri ...] kerd ysyd ythalu ay gwaran	20
da]w ay chanmawl Tri] atkas kerd ysyd]aglwadeid	25

p. 348, col. b amilein. Tri chary at dyn kerd. hael a bonhedic. a cherdwr anyanawl. digrif Tri anhepkor kerd	5
---	---

ysyd. nyt amgen.
 medwl digrif. ames
 sureu kerdwryaeth
 a thauawt eglur
 wrth y datkanu. 10
 Tri pheth ny ch̄yge
 in ymywn kerd y
 syd. nyt amgen. torr
 messur. ac amherthy
 nas a dryc kerdwr 15
 yaeth. Tri pheth a
 lwygyr kerd. nyt
 amgen. eissyeu en
 eit ac andigrifwch
 athorri messur. 20
 Tri pheth a weryt¹⁴
 ystyr. adychymic
 a cherdwryaeth.
 Tri gwarthrud ke
 rd ysyd. ygoganu 25
 yny gwyd ac nas
 taler. a sarhau ydy
 gyawdyr. Tri lle

p. 349, col. a
 [a]s [y...]yd kerd ysyd.
 nyt amgen ythu¹⁵
 lw [...]ny chanmawl a
 pherth[,] syberw dygy
 awdyr. Teir bud 5
 ygoly[aeth] kerd ysyd

¹⁴ *added in right margin: kerd*

¹⁵ *Final letter looks may be a but it is not the usual two-compartment a, perhaps u?*

nyt amgen y chanu
¹⁶del[...] gyda [...] ay dys
 gu [.....]yd ay gwy
 bot o doeth p[...] digrif 10
¹⁷Teir budygolyaeth
 kerdwyr ysyd nyt
 amgen [...s]wth
 anyanawl a boned
 [ai]le[.....] u ay ch 15
 y[.....] Tri pheth
 a beir anryded ker
 dawr nyt amgen [iselv
 haelon[u....]
¹⁸ar ad wn[..Tri] 20
 phe]th [....]or
]nyt
 amgen [....a]
 eth [.]anor[.]au
¹⁹a[.nat] Tri ph 25
 eth a g[a]r kerdawr
 nyt amgen haely
 oni kywoethog y

p. 349, col. b
 [.....]da[.....]
 wr ogy[.....] all
 wrwyd [...]
 tegwch Tri ph
 eth a gan[... wran] 5
 dawr nyt amgen

¹⁶ y in left margin?

¹⁷ letters in left margin, perhaps t ...

¹⁸ letters in left margin.

¹⁹ a series of minims in the left margin, perhaps iii?

kyb[yd]yaeth [ath
 g[.....] a wladi
 a g[.....] a ma[w]l
 eid [.....]aget 10
 Tri pheth a [.... w]
 ar.] [gy]
 eru.... ny] byd [.....]
 [.....]wd ai [nu]
 Tri pheth a gar[.] 15
 [...]kerdawr ny[t am]
 gen. hael a deled[a]
 wc a digrif. Tri
 pheth a lwgyr ke[r]
 dawr. [..]nyt amgen 20
 andissy[f.]²⁰ y[...w...]
 dryc ānyan a [...]
 Tri pheth a w[.....]
 kerdawr [..] ay l[...]
 wenhau [.] nyt 25
 amgen. [.] b[or..]
 ..] y ā[.....]
 yd ān[.....].

Edited text

For p. 348 the complete text of the page is edited, but for p. 349 only the sections where sense can be extracted are edited.

p. 348a1

Tri phe]th a beir *anghanmawl* kerd, nyt amgen, amherthynas ac eissyeu ystyr a drycdatl anya[1].

Tri pheth a hoffa kerd yn well noc y bo, nyt amgen, vrdas y phrydyd a cherdwryaeth y gwarandawyr a dayoni y neb [y ka]ner²¹ ydaw.

²⁰ *I tentatively read ss here but it may be ll or w.*

Tri pheth a anhoffa kerd yn waeth noc y bo, eissyeu kerdwyr y'w gwarandaw a'y datkanu yn a[n]uesur²² ac anvrda y phry[dyd]

Tri anvrda kerd ysyd, nyt amgen, y anghanma[wl] a'y gwrthot ac nas gwrandaer.

[Tri vrdas²³] kerd ysyd y'i thalu a'y gwan[da]w a'y chanmawl

[Tri] atkas kerd ysyd [kybyd²⁴] a gwlaeid²⁵ [348b1] a milein.

Tri charyatdyn kerd hael a bonhedic a cherdwr anyanawl. (digrif)²⁶

Tri anhepkor kerd ysyd, nyt amgen, medwl digrif a messureu kerdwryaeth a thauawt eglur wrth y datkanu.

Tri pheth ny chyngein y mywn kerd ysyd, nyt amgen, torr messur ac amherthynas a dryc kerdwryaeth.

Tri pheth a lwgyr kerd, nyt amgen, eissyeu eneit ac andigrifwch a thorri messur.

Tri pheth a weryt [kerd]²⁷ ystyr a dychymic a cherdwryaeth.

Tri gwarthrud kerd ysyd y goganu yn y gwyd ac nas taler a sarhau y dygyawdyr. #

Tri lle[p. 349a1]as [y....]yd kerd ysyd, nyt amgen, [ythu lw y]²⁸ny chanmawl apherth[.] syberw dygyawdyr.

p. 349a.5–18

Teir budygoly[aeth] kerd ysyd, nyt amgen, y chanu [...]y del[...] gyda [...] ay dysgu [.....]yd ay gwybot o doeth p[...] digrif.

Teir budygolyaeth kerdwyr ysyd, nyt amgen, [...s]wth anyanawl a boned [...]

Tri pheth a beir anryded kerdawr nyt amgen [...]

...

p. 349a25–8

Tri pheth a g[a]r kerdawr, nyt amgen, haelyoni kywoethog y [...]

...

²¹ The reading here is uncertain; some of the letters in [...] are faintly visible.

²² The text reads *auetur* but it may be that a suspension mark has been omitted above the *a*.

²³ I am grateful to Ann Parry Owen for this suggestion.

²⁴ I am grateful to Ann Parry Owen for this suggestion; cf. also the triad at p. 349b4–7 below.

²⁵ *glwadeid MS*.

²⁶ The second adjective is unexpected here; it comes after the stop which tends to mark the end of a triad, and may be a copying error arising from eye-skip to *medwl digrif* (l. 7). On the other hand Ann Parry Owen suggests to me that the scribe may have felt that *digrif* would be a better contrast with *milain* in the preceding triad and so added it as a suggestion.

²⁷ The scribe seems to have skipped a word and then added it in the right margin.

²⁸ The text is unclear here.

p. 349b4–7

Tri pheth a gan[... wran]daw, nyt amgen, kyb[yd]yaeth [...

...

p. 349b15–19

Tri pheth [a] gar[...] kerdawr, ny[t am]gen, hael a deled[a]wc a digrif.

Tri pheth a lwygwr [...

...

p.349b23–6

Tri pheth a w[ella]²⁹ kerdawr [... lla]wenhau [.], nyt amgen, [...

Translation

p. 348a1

‘Three things which cause criticism of a poem, namely, impropriety, and lack of sense, and a terrible poor argument.

Three things which embellish a poem so that it is better than it might be otherwise, namely, the status of its poet, and the poetical knowledge of its listeners, and the nobility of the one to whom it is sung.

Three things which spoil a poem, so that it is worse than it might be otherwise, lack of those expert in poetical composition³⁰ to listen to it, and its unmetrical rendition, and the dishonour of its poet.

There are three disgraces of a poem, namely, it being criticized, and it being rejected, and that it not be listened to.

[There are three honours] of a poem, its being paid for, and its being listened to, and its being praised.

There are three haters of verse, [a miser], and rustic man [348b1], and a boorish man.³¹

²⁹ Only the *w* is clear but a verb such as *wella* might explain the presence of the verbal noun, *llawenhau* (especially if there were a preposition in the gap preceding it) and also contrast with the *lwygwr* of the previous triad. Ann Parry Owen has suggested that the verb might be *weryt/waret* (as in 348b20) but there the syntax is different. Another possibility is that there is a copying error and that it should be read as ... *a wella/weryt kerdawr nyt amgen ... llawenhau*.

³⁰ In these translations I tentatively take both *cerddwr* and *cerddawr* as ‘poet’ but it is possible that a distinction is being made between the poet and the performer, or perhaps between the poet in terms of his composition and in terms of how he performs it.

The three lovers of verse are a generous man, and a nobleman, and a natural poet (a pleasant man).

There are three things a poem cannot do without, namely, pleasant thought, and the poetical metres, and a clear tongue to recite it.

There are three things which are not fitting in a poem, namely, violating the metre, and impropriety, and poor poetic skill.

Three things which spoil a poem, namely, lack of soul, and unpleasantness, and violating the metre.

There are three things which enhance [*right margin* a poem] sense, and imagination, and poetic skill.

There are three insults of a poem, to mock it openly, and that it not be paid for, and to insult the performer.

There are three ...'

p. 349a1–18

'... destructions of a poem, namely, ... in praising it, and ..., and an arrogant performer.

There are three victories of a poem, namely, it being sung ..., it being learned, ... and it being known wisely and [...] pleasant.

There are three victories of poets, namely, fine ..., and nobility, ...

Three things which cause a poet to be honoured, namely [...

...

p. 349a25–8

'Three things which ... a poet, namely, copious generosity towards ...'

...

p. 349b4–7

'Three things which ... listening, namely, miserliness'

...

p. 349b15–19

'Three types of people which ... a poet cherishes, namely, a generous man, and a nobleman, and a pleasant man.

Three things which spoil ...'.

³¹ The adjectives here are taken as nouns so as to match with the following triad with which it contrasts.

...

p. 349b23–6

‘Three things which make a poet more joyful, namely, ...’

Discussion

Williams & Jones (1934: 58) succeeded in transcribing all or part of several triads, especially from p. 348b; their printed text corresponds to p. 348a6–11 and p. 348b1–26. We now have all of p. 348 and at least a sense of the contents of p. 349, if not a complete running text. Consequently, we have a much better understanding of how the Peniarth 20 *trioedd cerdd* continue after the first page.

It is well known that the Peniarth 20 version of *Gramadegau Penceirddiaid* represents a revised and redrafted version of the text preserved in the form of the grammar associated with Einion Offeiriad.³² The revised version has been linked with Dafydd Ddu of Hiraddug.³³ In a recent discussion of *trioedd cerdd*, I suggested that, in contrast to *trioedd cerdd* in the group of grammars, the triads in Peniarth 20 have a much closer connection to the contents of the preceding grammar and ‘to be concerned to rehearse the details on diphthongs and syllables in a triadic structure’.³⁴ I went on to propose that the lost section of the triads might have followed the other collections in its listing of the more ‘conceptual’ triads.³⁵ Now that the following page or so of the Peniarth 20 triads have been brought out into the light, it is clear that the innovative approach of the redactor evident in the reworking of the ‘factual’ triads has continued; not only has he restructured and rewritten the triads on syllables and diphthongs and arranged them in an hierarchical order, but he has gone on to rewrite the following ‘conceptual’ triads.

³² Jones (1922–3); Saunders Lewis (1937); Parry (1961); Smith (1962–4); Ceri Lewis (1979); Gruffydd (1995; 1996). For discussion of *trioedd cerdd* in the context of other triad collections, see Owen (2007). The standard edition of *Gramadegau Penceirddiaid* remains that of Williams & Jones (1934); for discussion of its structure and methodology, see Matonis (1981, 1989, 1990, 1995).

³³ The primary discussions are Gruffydd (1995, 1996); for recent discussions, see Charles-Edwards (2016) and Russell (2016), Parry Owen (2012, 2016).

³⁴ Russell (2016: 177).

³⁵ For the distinction between ‘factual’ and ‘conceptual’ triads, see Russell (2016: 164).

The shift to ‘conceptual’ triads comes at the bottom of p. 347: *Tri pheth a beir kanmawl kerd*,³⁶ *nyt amgen, dychymycvawr ystyr, ac odidawc kerdwryaeth, ac eglur datkanyat* ‘three things which cause a poem to be praised, namely, a highly imaginative content, and outstanding poetical skill, and a clear rendition.’ The next page begins with the negative triad of the pair: *Tri pheth a beir anghanmawl kerd ...* ‘the three things which cause a poem to be criticized...’. The next pair of triads is similar: *tri pheth a hoffa kerd .../ ... a anhoffa kerd ...* ‘three things which embellish a poem .../ which spoil a poem’, a pairing familiar from the other redactions of *trioedd cerdd*. However, the Peniarth 20 versions are distinguished by the addition of the comparative phrase *... yn well noc y bo .../... yn waeth noc y bo ...* ‘better/worse than it might be ...’. Positive and negative pairs continue throughout: *Tri anvrdas ... Tri [vrdas] ...* (348a19–26) ‘There are three disgraces .../There are three [honours]...’; *Tri atkas kerd ... Tri charyatdyn kerd ...* (348a26–348b6) ‘There are three haters of verse .../There are three lovers of verse ...’; *Tri pheth a lwygwr kerd ... Tri pheth a weryt [kerd]...* (348b16–23), ‘Three things which spoil a poem .../Three things which enhance [a poem] ...’. But we also find pairs which make a different contrast between the *cerdd* and the *cerddwr*, e.g. *Teir budugolyaeth kerd ...Teir budugolyaeth kerdwyr ...* (349a5–16) ‘There are three victories of a poem .../There are three victories of poets’.

A very striking feature of this triad-collection is that that only a few have any correspondence at all with triads elsewhere. Where there is any kind of match it rarely extends beyond the opening phrase of the triad; for example, *tri pheth ny chyngain y mywn kerd ...* ‘the three things which are not fitting in a poem ...’ (p. 348b11–16) corresponds in terms of its opening with a triad in the other versions (Williams & Jones 1934: 17.28–9 (Red Book of Hergest), 37.33–4 (NLW Llanstephan 3)), but the elements of the triad in Peniarth 20 are different; similarly, *tri anhepkor kerd ...* ‘the three things which a poem cannot do without ...’ (p. 348b5–10) is also found in Oxford, Balliol 353, but again the elements differ.³⁷

In addition to these textual differences, there is a number of more substantive differences. These triads are striking for the presence not only of the poet as composer

³⁶ Williams & Jones (1934: 58.19) printed *kerdawr* in error.

³⁷ The text of Oxford, Balliol College MS 353 is not printed in Williams & Jones (1934), but I am grateful to Ann Matonis for allowing me sight of her transcription of it.

and perhaps as the performer but also that of the patron and the audience; two of three things which embellish a poem are *cerdwryaeth gwarandawyr* ‘the poetical knowledge of the listeners’ and *dayoni y neb [y ka]ner ydaw* ‘and the nobility of the one to whom it is sung’ (p. 348a9–12). A triad unique to this redaction is *tri caryatdyn kerd* ... ‘the three lovers of verse ...’ (p. 348b1–4), the generous man, the nobleman, and a natural poet; the first two presumably refer to the patron. A more pragmatic and harder-headed element, which is not found in the other *trioedd cerdd*, is brought into the rarified atmosphere of poetical composition by mention of the possibility that a poet might not be paid for his composition; one of *tri gwarthrud kerd* ‘the three insults of a poem’ is *nas taler* ‘that is might not be paid for’ (348b24–8); and in an acephalous (but clearly positive) triad that a poem is paid for (*y thalu*) is regarded as a good thing (p. 348a24–6). In addition to the skill of the poet and his composition, there seems to be a recognition that poetical composition and performance is a collaborative activity which depends at least as much on a generous patron and an appreciative audience.

In comparison with the other sets of triads, such as the literary or legal triads, it is possible to argue that the *trioedd cerdd* did not assume a life of their own; that is, they were not transmitted independently of the grammatical texts with which they are linked. That said, there is something interesting going on in the Peniarth 20 triads; while the ‘factual’ triads are re-ordered hierarchically, the ‘conceptual’ ones seem to have been completely rewritten. But that did not simply involve a reshaping of the phrasing but also the incorporation of a wider range of features relevant to poetical performance: the reaction of the audience and the patron which were the mainstays of successful poetical composition and performance. The Peniarth 20 *trioedd cerdd*, then, remained closely connected to the text of the *gramadegau* but their redactor still nevertheless was innovating in terms of content and organization.

References

- Albrecht, Felix. 2012. ‘Between Boon and Bane: The Use of Chemical Reagents in Palimpsest Research in the Nineteenth Century’ in *Care and Conservation of Manuscripts 13: Proceedings of the Thirteenth International Seminar Held at the University of Copenhagen 13th–15th April 2001*, ed. M.J. Driscoll, 147–165. Copenhagen.

- Charles-Edwards, Thomas. 2016. 'The Welsh Bardic Grammars on *Litterae*', in Hayden & Russell 2016: 148–60.
- Evans, J. Gwenogvryn. 1898. *Report on Manuscripts in the Welsh Language I*. London.
- Gruffydd, R. Geraint. 1995. 'Dafydd Ddu o Hiraddug'. *Llên Cymru* 18. 205–20.
- Gruffydd, R. Geraint. 1996. 'Wales's Second Grammarian: Dafydd Ddu o Hiraddug'. *Proceedings of the British Academy* 90: 1–28.
- Hayden, Deborah & Paul Russell (eds). 2016. *Grammatica, Gramadach, Gramadeg: Vernacular Grammar and Grammarians in Medieval Ireland and Wales*, SIHOLS 125. Amsterdam.
- Huws, Daniel. 2003. *Medieval Welsh Manuscripts*. Cardiff.
- Huws, Daniel. Forthcoming. *Repertory of Welsh Manuscripts and Scribes*.
- Jones, J. T. 1922–3. 'Gramadeg Einion Offeiriad'. *Bulletin of the Board of Celtic Studies* 2: 184–200.
- Lewis, Ceri. 1979. 'Einion Offeiriad and the Bardic Grammar', in *A Guide to Welsh Literature. Vol. 2*, ed. A. O. H. Jarman & G. R. Hughes, 58–87. Swansea.
- Lewis, Saunders. 1937. *Gramadegau'r Penceirddiaid*. Darlith Goffa G. J. Williams. Cardiff.
- Matonis, Ann T. E. 1981. 'The Welsh Bardic Grammars and Western Grammatical Tradition'. *Modern Philology* 79: 121–45.
- Matonis, Ann T. E. 1989. 'The Concept of Poetry in the Middle Ages: the Welsh Evidence from the Bardic Grammars'. *Bulletin of the Board of Celtic Studies* 36: 1–12.
- Matonis, Ann T. E. 1990. 'Problems Relating to the Composition of the Welsh Bardic Grammars'. *Celtic Language, Celtic Culture. A Festschrift for Eric P. Hamp*, ed. Ann T. E. Matonis & Daniel F. Melia, 279–91. Van Nuys.
- Matonis, Ann T. E. 1995. 'Literary Taxonomies and Genre in the Welsh Bardic Grammars'. *Zeitschrift für celtische Philologie* 47: 211–34.
- Owen, Morfydd E. 2007. 'Welsh Triads: an Overview'. *Celtica* 25: 225–50.
- Parry, Thomas. 1961. 'The Welsh Metrical Treatise attributed to Einion Offeiriad'. *Proceedings of the British Academy* 47: 177–95.
- Parry Owen, Ann. 2012. 'Gramadeg Gwysanau (Archifdy Sir y Fflint, d/gw 2082)'. *Llên Cymru* 33: 1–31.

- Parry Owen, Ann. 2016. ‘*Gramadeg Gwysanau*: A Fragment of a Fourteenth-Century Welsh Bardic Grammar’, in Hayden & Russell 2016: 181–200.
- Russell, Paul. 2016. ‘Poetry by Numbers: the Poetic Triads in *Gramadegau Penceirddiaid*’, in Hayden & Russell 2016: 161–80.
- Smith, J. Beverley. 1962–64. ‘Einion Offeiriad’. *Bulletin of the Board of Celtic Studies* 20: 339–47.
- Williams, G. J. & E. J. Jones (eds). 1934. *Gramadegau'r Penceirddiaid*. Cardiff.

Brian Cook
University of Mississippi

Paul Russell
University of Cambridge

Multispectral imagery can be provided at different resolutions and may contain different bands or types of light. Learn about spectral vs spatial resolution as it relates to spectral data. In this module, you will learn how to use multispectral imagery, a type of remote sensing data, to better understand changes in the landscape and how to calculate NDVI using various multispectral datasets. You will also review spectral remote sensing as a passive type of remote sensing and how to work with space-borne vs airborne remote sensing data in R. Additionally, we will cover raster stacks in R, plotting multi-band composite images, calculating vegetation indices and creating functions to make the processing more efficient in R. In This Lesson. Learning Objectives.