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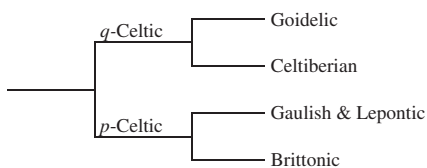
PETRA NOVOTNÁ – VÁCLAV BLAŽEK

ON APPLICATION OF GLOTTOCHRONOLOGY FOR CELTIC LANGUAGES

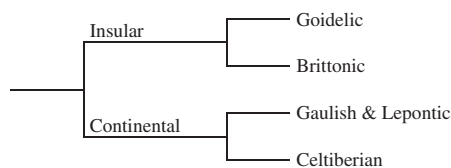
Dedicated to the memory of Sergei Starostin
(March 24, 1953 – September 30, 2005)

The present article continues in the series of studies published in this journal, demonstrating the application of lexicostatistics and glottochronology for various Indo-European branches, namely Germanic (Blažek & Pirochta 2004), Slavic (Novotná & Blažek 2005). Especially in the latter study the various modifications of glottochronology are explained in details.

For Celtic languages two main alternative models of their internal classification were proposed. The traditional, *p/q*-model, is based especially on phonology, the Insular/Continental dichotomy has been argued by morphology.



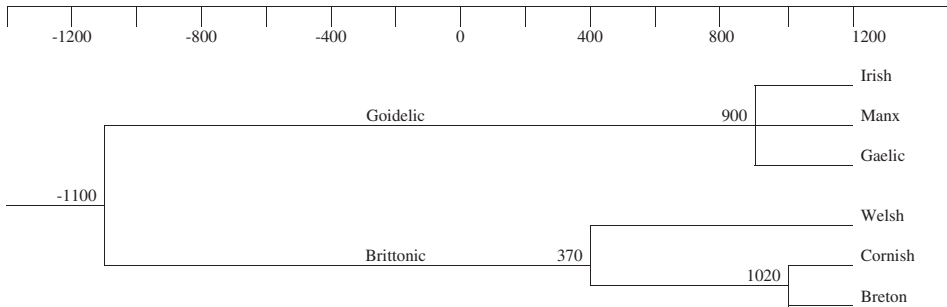
(H. Pedersen, K.H. Schmidt)



(P. Schrijver, C. Watkins)

The lexicostatistic approach for a study of genetic relations of the Celtic languages was introduced by Robert Elsie (1979; 1986; 1990). Applying lexicostatistic method with 100–word-list and excluding synonyms, he has got the following results for the Brittonic languages: Breton-Cornish 84.8%, Cornish-Welsh 78.8%, Breton-Welsh 73.7% (Elsie 1979, 48). In the case of the Goidelic languages, Elsie studied in details together 58 various Goidelic dialects and varieties on the basis of 184–word-list. He concludes that Manx is closer to any of the dialect group of Irish than to any of the dialect group of Scottish Gaelic (Elsie 1986, 244).

The second attempt to apply the lexicostatistic approach for classification of the Celtic languages was realized, unfortunately not published, by Sergei Starostin, who used his own modification of glottochronology. The tree-diagram presented here was kindly offered by Starostin to the authors in June 2005.



In the present study the ‘recalibration’ of glottochronology developed by Sergei Starostin (1989, 1999) is applied. The main difference against the ‘classical’ method formulated by Morris Swadesh consists in the following points:

(i) Change of the constant of disintegration λ from 0.14 to 0.05 per millennium in the development of one language.

(ii) Systematic elimination of borrowings from the test-list, i.e. already from N_0 . In the tables the loans are underlined.

(iii) Change of the basic formula in the form of the exponential function $N(t) = N_0 \cdot e^{-\lambda t}$ (Swadesh) for the transcendent function $N(t) = N_0 \cdot e^{-\lambda \cdot c(t) \cdot t^2}$ (Starostin), where $c(t) = N(t)/N_0$ (see Novotná & Blažek 2005, 54–57).

(iv) In the present study the synonyms are systematically included in the etymological and quantitative analysis.

Starostin’s results can be summarized in the table, where c_1 expresses the share of preserved test lexicon in the development of one language, c_2 for two languages and t is a corresponding time interval from their disintegration.

c_1	0,99	0,97	0,95	0,90	0,85	0,80	0,75	0,70	0,65	0,60	0,55	0,50	0,45	0,40	0,35	0,30	0,25	0,20	0,15	0,10
c_2	0,97	0,94	0,90	0,81	0,72	0,64	0,56	0,49	0,42	0,36	0,30	0,25	0,20	0,16	0,12	0,09	0,06	0,04	0,02	0,01
t	0,3	0,8	1,0	1,5	2,0	2,4	2,8	3,2	3,7	4,1	4,7	5,3	6,0	6,8	7,8	9,0	10,7	12,7	16,6	21,5

Goidelic languages

English	Irish	Old Irish	Manx	Gaelic	Etymology
1a. all	<i>uile</i>	<i>uile</i>	<i>ooilley</i>	<i>uile</i>	*[p]olyo-; cf. Hamp, 2000, 181–2
2a. ashes	<i>luathreach</i>	<i>lúath</i>	<i>leoie</i>	<i>luathre</i>	*[p]loutwi-
3a. bark		<i>risc</i>	<i>roost</i>	<i>rüs</i>	*rüs-
3b. bark	<u><i>coirt</i></u>	<u><i>coirt</i></u>		<u><i>cairt</i></u>	< Lat. <i>cortex</i>
4a. belly	<i>bolg</i>	<i>bolg</i>	<i>bolg</i>		*bolgo-
4b. belly		<i>brú</i> , gen. <i>bronn</i>		<i>brù</i>	*brusō, gen. °snos
4c. belly	<i>tarr</i>	<i>tarr</i>			*tarru- < *(o)r-su-
4d. belly	(<i>mionach</i> bowels)			<i>mionach</i>	
5a. big	<i>mór</i>	<i>már</i> , <i>mór</i>	<i>mooar</i>	<i>mòr</i>	*mōros
5c. big		<i>maige</i>			*magios

English	Irish	Old Irish	Manx	Gaelic	Etymology
6a. bird	<i>éan</i>	<i>én</i>	<i>eean</i>	<i>eun</i>	*[p]etnos
6b. bird			<i>ushag</i>		
6c. bird		(<i>isseniu pullo</i>)		<i>isean</i>	*eks-[p]etnio-?
7. bite	<i>bain- greim</i>	-	<i>greim</i>	<i>thor gréim</i>	*gre[s]men-
8a. black	<i>dubh</i>	<i>dub</i>	<i>doo</i>	<i>dubh</i>	*dubus
9a. blood	<i>fuil</i>	<i>fuil</i>	<i>fuill</i>	<i>fuil</i>	*woli-
10. bone	<i>cnámh</i>	<i>cnáim</i>	<i>craue</i>	<i>cnámh</i>	*knāmi-
11a. breast	<i>cíoch</i>	<i>cích</i>			*kīkā
11b. breast		<i>bruinne</i>		<i>broilleach</i>	*brusnio-
11c. breast			<i>sheeiney</i>		
11d. breast			<i>cleeau</i>		
11e. breast			<i>oghrish</i>		
12a. burn	<i>dóighim</i>		<i>dóu</i>		*deg ^w -eye/o-
12b. burn	<i>loiscim</i>	<i>loscim</i>		<i>loisg</i>	*la[p]-sk-e/o-
13a. claw	<i>crúb</i>	<i>crob & crúb</i>	<i>croob</i>		*kr[a]bo-
13b. claw	<i>spág</i>		<i>spaag</i>	<i>spòg, spàg</i>	cf. W. <i>ysbach</i>
13c. claw		<i>ingen</i>	<i>ingin, yngin</i>		*engwīnā
14a. cloud	<i>néal(l)</i>	<i>nél</i>	<i>neal, niaul</i>	<i>neul</i>	*neblo-
14b. cloud	<i>scamall</i>				
14d. cloud			<i>bodjal</i>		
14e. cloud				<i>sgòth</i>	lit. swarm
14f. cloud	<i>spéir</i>				< Lat. <i>sphaera</i> < Gr.
15a. cold	<i>fuar</i>	<i>úar</i>	<i>feayr</i>	<i>fuar</i>	*ougros
16a. come	<i>tig-</i>	<i>do-téit, tiag-</i>	<i>çheet</i>	<i>thig</i>	*[s]teig-e/o-
17a. die	<i>faigh- bás</i>		<i>baase y gheddyn</i>	<i>faigh bas</i>	*bato- < *g ^w ₂-to-
17b. die		<i>at-bail(l)</i>			*balli- < *g ^w [-ni-
17c. die	<i>cailleadh</i>	(<i>con-im-chloí</i> changes)		<i>caochladh</i>	< *k ^w leu- turn
17d. die	(<i>eug</i> death)	(<i>éc</i> death)		<i>eug</i>	*enku-
18a. dog	<i>madra</i>	<i>madrad & matad</i>	<i>moddey</i>	<i>madadh</i>	*maddo- & *masdo-
18b. dog		<i>cú</i>	<i>coo</i>	<i>cù</i>	*ku(w)ōn, gen. <i>kunós</i>
18c. dog	<i>gadhar</i>				
19a. drink		<i>ibid</i>	<i>iu</i>		*[p]ib-e/o-
19b. drink	<i>ól-</i>			<i>òl</i>	*[p]otlo-
19c. drink	(<i>deoch</i> , gen. <i>dighe</i>)	(<i>deug</i> , gen. <i>dige</i>)		<i>gabh deoch</i>	*degu- n.
20a. dry	<i>tirim</i>	<i>tírim</i>	<i>çhirrym</i>	<i>tioram</i>	*tērsmi-
20b. dry	<i>seasc</i>	<i>sesc</i>	<i>shias</i>	<i>seasg</i>	*sisk ^(w) us
21a. ear	<i>cluas</i>	<i>clúas</i>	<i>cleaysh</i>	<i>cluas</i>	*kloustā
21c. ear		<i>au</i>			*aus-os, -esos
22a. earth	<i>talamh</i>	<i>talam</i>	<i>thalloo</i>	<i>talamh</i>	*talamon-
22b. earth	<i>tír</i>	<i>tír</i>		<i>tír</i>	*tīr-os
23a. eat	<i>ith-</i>	<i>ithid</i>	<i>ee</i>	<i>ith</i>	*id-e/o-
24a. egg	<i>ubh</i>	<i>og</i>	<i>ooh</i>	<i>ubh ~ ogh</i>	*og-os, gen. -esos
25a. eye	<i>súil</i>	<i>súil</i>	<i>sooill</i>	<i>súil</i>	*sūli- or *sok ^w eli-

English	Irish	Old Irish	Manx	Gaelic	Etymology
25c. eye	<i>dearc</i>	<i>derc</i>			* <i>derkos</i>
26a. fat	<i>geir</i>	<i>geir</i>	<i>geirr</i>	<i>geir</i>	* <i>ger-et(s)</i>
26b. fat		<i>béoil</i> , gen. <i>béla</i>			
27a. feather	<i>cleite</i>	<i>cleitte</i>	<i>clooie</i>		* <i>kleitio-</i>
27b. feather	<i>iteóg</i>	<i>eite</i>		<i>ite</i>	* <i>ettiā</i>
27c. feather			<i>fedjeen</i> , <i>fedjag</i>		
27d. feather		<i>clú(i)m</i>			< Lat. <i>plūma</i>
28a. fire	<i>tine</i>	<i>tene</i>	<i>çhenney</i>	<i>teine</i>	* <i>te[p]nos</i> & * <i>te[p]net-</i>
28b. fire		<i>aed</i>			* <i>aidu-</i>
29a. fish	<i>iasc</i>	<i>íasc</i>	<i>eeast</i>	<i>iasg</i>	* <i>[p]eiskos</i>
30a. fly v.	<i>eil-</i>	<i>etelaigim</i>	<i>etlagh</i>	<i>tha air iteig</i>	* <i>ettiā</i> „feather“ & * <i>leg-</i> „to lie down“
30b. fly v.	<i>imeacht san aer</i>				
30c. fly v.				<i>sgéith</i>	
30d. fly v.				<i>siubhal</i>	
31a. foot	<i>cos</i>	<i>cos(s)</i>	<i>cass</i>	<i>cas</i>	* <i>koksā</i>
31b. foot	<i>troigh</i>	<i>traig</i> , g. <i>traiged</i>	<i>trie</i>	<i>troigh</i>	* <i>trogets</i>
32. full	<i>lán</i>	<i>lán</i>	<i>lane</i>	<i>làn</i>	* <i>[p]lānos</i>
33a. give	<i>tabhairt</i>	<i>do-beir</i>	<i>toyr</i>	<i>thoir(t)</i>	* <i>to-ber-e/o-</i>
33b. give			<i>cur</i>		
34a. good	<i>maith</i>	<i>maith</i>	<i>mie</i>	<i>math</i>	* <i>matīs</i>
34b. good		<i>dag</i>			* <i>dagos</i>
34c. good		<i>den</i>			* <i>dwenos?</i>
35a. green	<i>glas</i>	<i>glas(s)</i>	<i>glass</i>	<i>glas</i>	* <i>glastos</i>
35b. green	<i>uaine</i>	<i>úaine</i>	<i>eyney</i>	<i>uaine</i>	* <i>ugnios</i>
35c. green	(<i>gorm</i> „blue“)			<i>gorm</i>	* <i>gorsmos</i>
36a. hair	<i>gruaig</i>		<i>gruag</i>	<i>gruag</i>	* <i>grunkā</i>
36b. hair	<i>-folt-</i>	<i>folt</i>	<i>folt</i>	<i>falt</i>	* <i>woltos</i>
37a. hand	<i>lámh</i>	<i>lám</i>	<i>laue</i>	<i>lámh</i>	* <i>[p]lāmā</i>
38a. head	<i>ceann</i>	<i>cenn</i>	<i>kionne</i>	<i>ceann</i>	* <i>k^venġno-</i>
38b. head	<i>cloigeann</i>				
39. hear	<i>clois-</i>	<i>ro-cluinethar</i>	<i>clashtyn</i>	<i>cluinn</i>	* <i>kluni-</i> < * <i>klinu-</i>
40a. heart	<i>croi</i>	<i>críde</i>	<i>cree</i>	<i>crídhe</i>	* <i>kridion</i>
41a. horn	<i>adharc</i>	<i>adarc</i>	<i>eairk</i>	<i>adharc</i>	* <i>ad-ark-ā</i>
41b. horn		<i>corn</i>			< Lat. <i>cornu</i>
42. I	<i>mé</i>	<i>mé</i>	<i>mee</i>	<i>mi</i>	* <i>mē</i>
43a. kill	<i>marbh-</i>	<i>marbaid</i>	<i>marroo</i>	<i>marbh</i>	* <i>marw-</i>
43b. kill		<i>orgo</i> , <i>orcaid</i>			* <i>org-e/o-</i>
44. knee	<i>ghlúin</i>	<i>glún</i>	<i>glioon</i>	<i>glùn</i>	* <i>glūnos</i>
45a. know	<i>fios</i>	<i>ro-fitir</i>	<i>fys</i>	<i>f(h)ios</i>	* <i>wid-</i>
45b. know				<i>aithnich</i>	* <i>ati-gn-</i>
46a. leaf	<i>duilleog</i>	<i>duille</i>	<i>duilley</i> , <i>duil-</i> <i>lag</i>	<i>duilleog</i>	* <i>doliā</i>
46b. leaf	<i>billeog</i>	<i>bileóc</i>		<i>bileag</i>	

English	Irish	Old Irish	Manx	Gaelic	Etymology
47a. lie	<i>luigh-</i>	<i>laigid</i>	<i>lhie</i>	<i>laige</i>	* <i>leg-e/o-</i>
47b. lie				<i>sineadh</i>	
48a. liver	<i>ae</i>	<i>óa</i>	<i>aane</i>	<i>atha</i>	* <i>awu?</i>
48b. liver	<i>crúóg,</i> <i>cruadhae</i>				
48c. liver	<i>trommchride</i>				heavy (<i>tromm</i>) heart
48d. liver				<i>grù(th)an</i>	* <i>grūso-</i>
49a. long	<i>fada</i>	<i>fotae</i>	<i>foddey</i>	<i>fada</i>	* <i>wasd-</i>
49b. long		<i>sír</i>			* <i>sēros</i>
49c. long			<i>liauyr</i>		
49d. long		<i>cían</i>			* <i>kēno-</i>
50a. louse	<i>míol</i>	<i>míl</i>	<i>meeyl</i>	<i>mial</i>	* <i>mēlon</i>
50b. louse	<i>leamhan</i>				
50c. louse	<i>sneá</i>		(<i>snieg</i> louse egg)		
50d. louse	<i>dearnad</i>			<i>deargann</i>	Old Irish. <i>derg</i> red?
50e. louse	<i>saor</i>				
51a. man	<i>fear</i>	<i>fer</i>	<i>fer</i>	<i>fear</i>	* <i>wiros</i>
51b. man			<i>dooinney</i>	<i>duine</i>	* <i>gdonios</i> = #64a.
52a. many	<i>mórán</i>		<i>mooaran(e)</i>		Old Irish. <i>mór</i> & <i>már</i> big
52b. many	<i>iol-</i>	<i>il</i>		<i>iol-</i>	*[<i>p</i>]elu-
52c. many	<i>ioma, iomdha</i>	<i>immde multus</i>		<i>iomadh</i>	Old Irish. <i>imbed copia,</i> <i>multitudo</i> < * <i>imbeto-</i> * <i>ambi-</i> .?
53a. meat	<i>feoil</i>	<i>feúil</i>	<i>feill</i>	<i>fëoil</i>	* <i>we[p]oli-</i>
53b. meat		<i>cicce & cích</i>			* <i>kikā</i>
54a. moon	<i>gealach</i>		<i>giallagh</i>	<i>gealach</i>	Old Irish. <i>gel</i> „white“
54b. moon		<i>ésca(e)</i>	<i>eaYST</i>		
55a. mountain	<i>sliabh</i>	<i>sliab</i>	<i>slieau</i>		* <i>sleibos</i>
55b. mountain	<i>cnoc</i>	<i>cnocc</i>			* <i>knokko-</i>
55d. mountain		<i>benn</i>	<i>beinn</i>	<i>beinn</i>	* <i>bandnā</i> < * <i>bñdnā</i>
55e. mountain				<i>monadh</i>	< Pict. < Brit. * <i>moniyo-</i>
56a. mouth	<i>béal</i>	<i>bél</i>	<i>beeal</i>	<i>beul</i>	* <i>be[t]lā</i>
57. name	<i>ainm</i>	<i>ainm</i>	<i>ainm(m)</i>	<i>ainm</i>	* <i>anman</i>
58a. neck	<i>muineál</i>	<i>muinél</i>	<i>mwannal</i>		* <i>moniklo-</i>
58b. neck				<i>amhach</i>	* <i>omākā</i>
59a. new	<i>nua</i>	<i>nue</i>	<i>noa</i>	<i>nodha</i>	* <i>nowiyos</i>
59b. new	<i>úr</i>	<i>úr</i> new, fresh	<i>oor</i>	<i>ùr</i>	* <i>ugro-</i> or *(<i>p</i>) <i>ūro-</i>
60a. night	<i>oíche</i>	<i>adaig</i>	<i>oie</i>	<i>oidhche</i>	* <i>yadōkī</i>
61a. nose	<i>srón</i>	<i>srón</i>	<i>stroin</i>	<i>sròn</i>	* <i>srognā</i>
61b. nose	<i>gaothsán</i>				
62a. not	<i>ní</i>	<i>ní</i>	<i>ny</i>	<i>cha ni</i>	* <i>nī</i> < * <i>nē</i>
62ab. not	<i>cha(n)</i>		<i>cha</i>	<i>cha</i>	
63. one	<i>aon</i>	<i>oín, oén</i>	<i>nane</i>	<i>aon</i>	* <i>oino-</i>
64a. person	<i>duine</i>	<i>duine</i>	<i>dooinney</i>		* <i>gdonios</i>
64b. person				<i>neach</i>	Old Irish. <i>nech</i> aliquis

English	Irish	Old Irish	Manx	Gaelic	Etymology
65a. rain		Mlr. <i>frass</i>			*wros-tā
65b. rain	<i>báisteach</i>				
65c. rain	<i>fearthainn</i>				
65d. rain		<i>flechod</i>	<i>fliaghey</i>		
65e. rain				<i>uisge</i> = 94	
65f. <u>rain</u>				<i>bùrn</i>	< Scottish English <i>burn</i> spring-water
66a. red	<i>ruadh</i>	<i>rúad</i>	<i>ruy</i>	<i>ruadh</i>	*roudos
66b. red	<i>dearg</i>	<i>derg</i>	<i>jiarg</i>	<i>dearg</i>	*dergos
67a. road	<i>bóthar</i>		<i>bayr</i>		*bou-itro-
67b. road	<i>séad</i>	<i>sét</i>			*sentu-
67c. <u>road</u>	<i>ráthad</i>		<i>raad</i>	<i>rathad</i>	< MEng. <i>roade</i>
67d. road	<i>bealach mór</i>				big path (*belāko-)
68a. root	<i>fréamh</i>	<i>frén / frém</i>	<i>fraue</i>	<i>freumh</i>	*wri(d)-mā < *wrd-mā
68b. root	(<i>rúta</i>)				< Eng. <i>root</i>
68c. root		(Mlr. <i>bun</i> „base“)	<i>bun</i>	<i>bun</i>	*bonus
69a. round	<i>cruinn</i>	<i>cruind</i>	<i>cruinn</i>	<i>cruinn</i>	*krundis
69b. round	<i>rabhanáilte</i>				
69c. round			(<i>runt</i>)		< Eng. <i>round</i>
70a. sand	<i>gaineamh</i>	<i>gainem</i>	<i>geinnagh</i>	<i>gaineamh</i>	*ganimā?
71a. say	<i>rá(dh)/deir- /abair</i>	<i>as-beir</i>	<i>gra / abbyr</i>	<i>gradh / ràdh/ abair</i>	*(eks-)ber-e/o-
71b. say	<i>labhram</i>	<i>labrathar</i>		<i>labhair</i>	*[p]labr-a-
71c. say		(<i>canim</i> I sing)		<i>can / canail</i>	*kan-e/o-
72a. see	<i>feic-</i>	<i>im aci</i>	<i>faik, fakin</i>	<i>faic</i>	*(ad-)k*is-
72ab. see	<i>cionn/tchionn</i>	<i>ad-cí</i>			*(ad-)k*is-
72c. see				<i>a dhamhairc</i>	
72d. see				<i>cai(mh)ead</i>	
73a. seed	<i>siol</i>	<i>sil</i>	<i>sheel</i>	<i>siol</i>	*sīlon
73b. seed			<i>rass</i>	<i>fras</i>	
74a. sit	<i>suidh-/sui(gh)</i>	<i>saidid</i>	<i>soie</i>	<i>suidh</i>	*sed-e/o- // *sod-eye/o-
75a. skin	<i>craiceann</i>	<i>croiccenn</i>	<i>crackan</i>	<i>craiceann</i>	*krokkenno-
75b. skin	<i>cneas</i>	<i>cnes</i>			*knid-to-
76a. sleep	<i>codl-</i>	<i>con-tuili</i>	<i>cadley</i>	<i>cadal</i>	*kon-tuli-
77a. small	<i>beag</i>	<i>bec(c)</i>	<i>beg</i>	<i>beag</i>	*biggos
78a. smoke n.		<i>dé, gen. diad</i>			*diyot-s
78ab smoke n.	<i>deatach</i>		<i>jaagh</i>	<i>deathach</i>	*dettakos
78c. smoke n.	<i>múch</i>	<i>múch</i>		(<i>múch</i> smother)	*mük-
78d. smoke n.	<i>tóit</i>	Mlr. <i>tutt</i>		<i>toit</i>	*tuttos
79a. stand	<i>seas-</i>	<i>siss-</i>	<i>shassoo</i>	<i>seas</i>	*sist-a/o-
80a. star	<i>réaltóg</i>	<i>rétglu, pl. réglainn</i>	<i>rollage</i>	<i>reul, pl. re- ultan</i>	*rentu-gland- shining thing
80b. star		(<i>rind</i> constella- tion)	<i>rontage</i>	<i>rionnag, rean- nag</i>	*rendu-
80c. star		<i>ser</i>			*ster-

English	Irish	Old Irish	Manx	Gaelic	Etymology
81a. stone	<i>cloch</i>	<i>cloch</i>	<i>clagh</i>	<i>clach</i>	* <i>klukā</i>
82a. sun	<i>grian</i>	<i>grian</i>	<i>grian</i>	<i>grian</i>	* <i>greinā</i>
83. swim	<i>snámh-</i>	<i>snaid</i>	<i>snaue</i>	<i>snámh</i>	* <i>snā-</i>
84a. tail	<i>eireaball</i>	<i>erball</i>	<i>arbyl</i>	<i>earball</i>	* <i>(p)ari-ballos</i>
84b. tail		<i>los</i> (m./f.)			* <i>lusto-/-ā</i>
84c. tail	<i>(feam men-tula)</i>		<i>famman</i>	<i>(f)eamann</i>	* <i>engwo-</i>
85. that	<i>sin</i>	<i>sin</i>	<i>shen</i>	<i>sin ud</i>	* <i>sindos</i>
86a. this	<i>seo/so</i>	<i>so</i>	<i>shoh</i>	<i>so</i>	* <i>sos</i>
87. thou	<i>tú</i>	<i>tú</i>	<i>oo</i>	<i>thu</i>	* <i>tū</i>
88. tongue	<i>teanga</i>	<i>tengae</i>	<i>çhengey</i>	<i>teanga</i>	* <i>tengwat-</i>
89a. tooth	<i>fiacail</i>	<i>fec</i>	<i>feeackle</i>	<i>fiacail</i>	* <i>weikkā</i>
89b. tooth	<i>déad</i>	<i>dét</i>		<i>deud</i>	* <i>dentā</i> < * <i>dnt-</i>
90a. tree	<i>crann</i>	<i>crann</i>		<i>crann</i>	* <i>k^wrannos</i> < * <i>k^wr̥sno-</i>
90b. tree		<i>bíle</i>	<i>billey</i>		* <i>belion</i>
90c. tree		<i>cráeb</i> , dat. <i>croib</i>		<i>craobh</i>	* <i>kroib-?</i>
91. two	<i>dhá</i>	<i>da</i>	<i>jees</i>	<i>dà</i>	* <i>duwa</i>
92a. walk	<i>siúl-</i>	<i>sibal</i>	<i>shooyll</i>	<i>siubhal</i>	* <i>stebulo-</i>
92b. walk	<i>(coiseachd n.)</i>		<i>cosheeght</i>	<i>coisich</i>	Ir. <i>cos</i> foot, leg
92c. walk	<i>eathaim</i>	<i>ethaim</i>		<i>eith</i>	* <i>i-to-</i>
93a. warm	<i>te/té</i>	<i>té, tee</i>	<i>çheh</i>		* <i>te[p]ent-</i>
93b. warm	<i>(bláith soft)</i>		<i>blah-</i>	<i>blàth</i>	* <i>blāti-</i>
94a. water	<i>uisce</i>	<i>uisce</i>	<i>ushtey</i>	<i>uisge</i>	* <i>udenskios</i> < * <i>udŋ-</i>
94b. water		<i>dobur</i>			* <i>dubron</i>
94c. <u>water</u>				<i>bùrn</i>	< Scottish English <i>burn</i> spring-water
95a. we	<i>sinn</i>	<i>sní</i>	<i>shin</i>	<i>sinn</i>	* <i>snīs</i> < * <i>snēs</i>
95b. we	<i>mid/muid(e)</i>				
96a. what	<i>cad</i>	m./f. <i>cía</i> , ntr. <i>cid</i>	<i>cre</i>	<i>ciod</i>	* <i>k^wei</i> & * <i>k^wid(ā)</i>
96b. what	<i>caidé</i>			<i>de/dé</i>	from <i>ciod</i> è what is it
97a. white	<i>bán</i>	<i>bán</i>	<i>bane</i>	<i>bàn</i>	* <i>bānos</i>
97b. white		<i>gel</i>	<i>gial</i>	<i>geal</i>	* <i>gelos</i> or * <i>gilos</i>
97c. white	<i>fionn</i>	<i>find</i>		<i>fionn</i>	* <i>windos</i>
98. who	<i>cé</i>	<i>cía</i>	<i>quoi</i>	<i>cò</i>	* <i>k^wei</i>
99a. woman	<i>bean</i>	<i>ben</i>	<i>ben</i>	<i>bean</i>	* <i>benə</i> < * <i>g^wen-H_a</i>
99ab. woman	<i>boinionn</i> female			<i>boireannah</i>	* <i>bani-</i>
99c. woman	<i>fracc</i>				* <i>w(i)r-ák(k)ā</i>
100a. yellow	<i>buidhe</i>	<i>buide</i>	<i>buigh</i>	<i>buidhe</i>	* <i>badios</i>
100b. yellow		<i>blá</i>			* <i>blāwos</i>

Brittonic languages

English	Breton	O ^M Breton	Cornish	OCornish	Welsh	O ^M Welsh	Etymology
1b. all	<i>holl</i>	^M <i>holl</i>	<i>holl</i>		<i>holl</i>	<i>hol</i>	* <i>solnos</i> , cf. Osc. <i>sullus omnes</i>
1c. all	<i>kement</i>						MBr. <i>quemant</i> so many
1d. all					<i>i gyd</i>		lit. together
2a. ashes	<i>ludu</i>		<i>lüsow</i>		<i>lludw</i>		*[p]loutwo-
3a. bark	<i>rusk</i>	<i>rusc</i>	<i>rüsk</i>	<i>rusc</i>	<i>rhisg(l)</i>		* <i>rusk-</i>
4a. belly					<i>bol(a)</i>	<i>boly, bola</i>	* <i>bolgo-</i>
4c. belly	<i>tor/teur</i>	^M <i>torr</i>	<i>tor</i>	<i>tor</i>	<i>tor</i>	<i>torr</i>	* <i>torr-</i> /* <i>tarr-</i>
4e. belly	(kof)						< VLat. * <i>cofus</i>
5a. big	<i>meur</i>	<i>mor</i>	<i>mür</i>	<i>maur</i>	<i>mawr</i>	<i>maur</i>	* <i>mōros</i>
5b. big	<i>bras</i>		<i>brās</i>				* <i>brassos</i>
6a. bird	<i>evn</i>	<i>etn, ^Mezn</i>	<i>edhen</i>	<i>hethen</i>	<i>edn</i>	<i>etn</i>	*[p]et-n-
6d. bird	(labous)						< OEng. <i>lopust</i> or VLat. <i>loquusta</i>
7b. bite					N. <i>brathu</i>		* <i>brasd-</i>
7c. bite					S. <i>choi</i>		* <i>knā-ye/o-</i>
7d. bite			<i>dynsel</i>				
7e. bite	<i>kreğiñ</i>						< Fr. <i>croc</i>
8a. black	<i>du</i>	<i>du</i>	<i>du</i>	<i>duw</i>	<i>du</i>	<i>dub</i>	* <i>dubos</i>
9b. blood	<i>gwad</i>		<i>gōs</i>	<i>guit</i>	<i>gwaed</i>		* <i>waito-</i>
10b. bone	<i>askorn</i>		<i>ascorn</i>		<i>asgwrn</i>		* <i>as(t)-kornos</i>
11b. breast	<i>bronn</i>	<i>bronn</i>	<i>bron</i>	<i>bron</i>	<i>bron</i>	<i>bronn</i>	* <i>brusnā</i>
11c. breast	<i>bruched</i>						< OFr. <i>bruchet</i>
12a. burn	<i>deviñ</i>		<i>dywy</i>		<i>deifio</i>		* <i>deg^w-eye/o-</i> // * <i>daw-ye-</i>
12b. burn	<i>leskiñ</i>	<i>lescsit</i>	<i>lesky</i>		<i>llosgi</i>	^M <i>lloski</i>	* <i>la[p]-sk-eye/o-</i>
13a. claw	(<i>kraf</i> touch)				<i>craf-anc</i>		* <i>krab-</i> ; W. <i>crabu</i> <i>radere</i> , <i>scalpere</i>
13c. claw	<i>ivin</i>		<i>ewyn</i>		<i>ewin</i>	<i>eguïn</i>	* <i>angwīnā</i>
13d. claw	<i>kraban</i>						< Fr. <i>crabe</i>
14c. cloud	<i>koumoul</i>		<i>comol</i>		<i>cwmwl</i>		cf. Lat. <i>cumulus</i> ,heap‘
15a. cold				<i>oir</i>	<i>oer</i>		* <i>o(u)gros</i>
15b. cold	<i>yen</i>		<i>yeyn</i>				* <i>yagnyos</i> : * <i>yag-</i> ice
16b. come	<i>deuaf</i>	^M <i>deuaf</i>	<i>dōf(f)</i>		<i>deuan</i>	<i>deuaff</i>	* <i>do-ag-a-</i>
17d. die	<i>merwel</i>		<i>mervel</i>		<i>marw</i>		* <i>marw-</i>
18b. dog	<i>ki</i>		<i>kȳ</i>	<i>ki</i>	<i>ci</i>	^M <i>ki</i>	* <i>kūn</i>
19a. drink	<i>evañ</i>	^M <i>euaff</i>	<i>eva</i>		<i>yfed</i>	<i>iben</i>	*[p]ib-e/o-
20b. dry	<i>hesp</i>				<i>hysb</i>	<i>hysp</i>	* <i>sisk^(w)us</i>
20c. dry	(sec’h)		(<i>sēgh</i>)		(<i>sych</i>)		< Lat. <i>siccus</i>
21a. ear					<i>clust</i>		* <i>klous(s)tā</i>
21b. ear	<i>skouarn</i>	<i>scobarn</i>	<i>scovarn</i>	<i>scouarn</i>			* <i>skobarnā</i> , cf. OW. <i>eskeuarn</i> , Ir. <i>scibhearnach</i> hare

English	Breton	O ^M Breton	Cornish	OCornish	Welsh	O ^M Welsh	Etymology
22b. earth	<i>tir</i>	<i>tir</i>	<i>tȳr</i>	<i>tir</i>	<i>tir</i>	<i>tir</i>	*tīr-os : *ters- dry
22c. earth	<i>douar</i>	<i>doiar</i>	<i>dōr</i>	<i>doer</i>	<i>daear</i>	<i>dayr</i>	*diyar-
23b. eat	<i>debriñ</i>	<i>diprim</i>	<i>dybry</i>				*dik ^m -r- (Ped. I, 111: Gr. δεῖπνον food)
23c. eat					<i>bwyta</i>		*bit-
24a?/b?. egg	<i>vi</i>		<i>oy</i>		<i>wy</i>		*ōyu-
25b. eye	<i>lagad</i>	^M <i>lagat</i>	<i>lagas</i>	<i>lagat</i>	<i>llygad</i>	^M <i>lygat</i>	*lukatos
26c. fat			<i>blonek</i>	<i>blonec</i>	<i>bloneg</i>	^M <i>bloneg</i>	*blonekos
26d. fat					<i>braster</i>		
26e. fat					<i>saim</i>		
26f. fat	<i>lard</i>						< Fr. <i>lard</i>
27d. feather	<i>plu</i>		<i>plūf</i>		<i>plu</i>		< Lat. <i>pluma</i>
28a. fire	<i>tan</i>		<i>tān</i>		<i>tān</i>		*to[p]nos
29. fish	<i>pesk</i>		<i>pysk</i>		<i>pysgod</i>		< Lat. <i>piscis</i>
30e. fly v.					<i>(e)hedeg</i>	^M <i>ehedec</i>	*(eks-)[p]et-e/o-
30f. fly v.	<i>n(e)ijal</i>		<i>nyja</i>		<i>(naid jump)</i>		*snat- < *sn ₂ -
31b. foot	<i>troad</i>	<i>treit</i>	<i>trōs</i>	<i>truit</i>	<i>troed</i>	^M <i>troet</i>	*trogets
32. full	<i>leun</i>	<i>-lon</i>	<i>lūn</i>		<i>llawn</i>	<i>laun</i>	*[p]lānos
33c. give	<i>reiñ</i>	<i>reiff</i>	<i>rȳ</i>		<i>rho(d)i</i>	<i>rodesit</i>	*[p]ro-dī- < *d ^m ē-
34a. good	<i>mat</i>	<i>mat</i>	<i>mās</i>	<i>mat</i>	<i>mad</i>	^M <i>mad</i>	*matis
34b. good	<i>da</i>	<i>da</i>	<i>da</i>	<i>da</i>	<i>da</i>	<i>dag</i>	*dagos
34c. good					<i>mawn-</i>		*māno-/u-
35a. green	<i>glas</i>		<i>glās</i>		<i>glas</i>		*glastos
(35d. green)	<i>(gwer)</i>		<i>(gwēr)</i>		<i>(gwyrdd)</i>		< Lat. <i>viridis</i>
36b. hair		<i>guolt</i>		<i>gols</i>	<i>gwallt</i>	^M <i>gwallt</i>	*woltos
36c. hair	<i>blev</i>	<i>bleu</i>	<i>blew</i>	<i>bleu</i>	<i>blew</i>	<i>bleu</i>	*bleus
37a. hand		<i>lom-/lou-</i>	<i>lūf</i>	<i>lau/lof</i>	<i>llaw</i>	<i>lau</i>	*[p]lāmā
37b. hand	<i>do(u)rn</i>	<i>durn</i>	<i>dorn</i>				*durnos
38a. head	<i>penn</i>		<i>pen</i>		<i>pen</i>		*k ^w ennon
39. hear	<i>klevout</i>		<i>clewes</i>		<i>clywed</i>	^M <i>clyw-</i>	*klus-ī-
40a. heart	<i>(kreiz centre)</i>		<i>(creys centre)</i>		<i>craidd</i>		*kridion
40b. heart	<i>kalon</i>	<i>calonn</i>	<i>colon</i>	<i>colon</i>	<i>calon</i>		*kalonā
41b. horn	<i>korn</i>	<i>corn</i>	<i>corn</i>	<i>corn</i>	<i>corn</i>	^M <i>corn</i>	*kornos
42. I	<i>me</i>	<i>me</i>	<i>mȳ</i>		<i>mi</i>	<i>mi</i>	*me
43c. kill	<i>lazhañ</i>	<i>ladam</i>	<i>ladha</i>		<i>lladd</i>	<i>ledit</i>	*slad-ye/o-, cf. OIr. <i>slaidid</i> strikes
44. knee	<i>glin</i>		<i>glyn</i>	<i>pen-glin</i>	<i>glin</i>	^M <i>glin</i>	*glūnos
45a. know	<i>gouzout</i>	<i>gudbut</i>	<i>gothvos</i>		<i>gwybod</i>	^M <i>gwybot</i>	*woid-butā
46a. leaf	<i>deil</i>	<i>dol</i>	<i>dēl</i>	<i>del-en</i>	<i>dail</i>	^M <i>deil</i>	*doliā
47c. lie	<i>gour-vezet</i>	<i>gouruez</i>	<i>growedha</i>		<i>gorwedd</i>	^M <i>gorwed</i>	*u[p]or-wed-a-
48a. liver	<i>avu</i>	^M <i>avu</i>	-	<i>auu</i>	N. <i>iau</i> S. <i>afu</i>	^M <i>afu</i>	*avu?

English	Breton	O ^M Breton	Cornish	OCornish	Welsh	O ^M Welsh	Etymology
49b. long	<i>hir</i>	<i>hir</i>	<i>hȳr</i>	<i>hir</i>	<i>hir</i>	<i>hir</i>	* <i>sīros</i> , cf. OIr. <i>sír</i> 'late, longlasting'
50f. louse	<i>laou</i>	^M <i>lou-enn</i>	<i>low</i>	<i>low-en</i>	<i>llau</i>	^M <i>lleu</i>	* <i>luwā</i>
51a. man	<i>gour</i>	<i>gur</i>	<i>gour</i>	<i>gur</i>	<i>gŵr</i>	<i>gur</i>	* <i>wuros</i> < * <i>wiros</i>
51b. man	<i>den</i>						* <i>gdonios</i>
51c. man	<i>gwaz</i>	(<i>guas</i>)	(<i>guas</i>)				* <i>wastos</i> servant
52bb. many	<i>lies</i>	<i>lios</i>	<i>lȳes</i>		<i>lliaws</i>	<i>liaus</i>	*[<i>p</i>]liāstos, cf. OIr. <i>líá</i> 'more'
52d. many			<i>lower</i>		<i>llawer</i>		* <i>loweros</i> < * <i>r-</i> , cf. OIr. <i>roar</i> 'enough'
52e. many	<i>kalz</i>						B. <i>kalet</i> 'hard'
53b. meat	<i>kig</i>	<i>cic</i>	<i>kȳk</i>	<i>chic/kig</i>	<i>cig</i>	^M <i>kic</i>	* <i>kīkos</i>
54c. moon	<i>loar</i>	<i>loir</i>	<i>lōr</i>	<i>luir</i>	<i>lloer</i>	<i>loyr</i>	* <i>lugrā</i>
55c. mountain	<i>menez</i>	<i>monid</i>	<i>meneth</i>	<i>menit</i>	<i>mynydd</i>		* <i>moniyos</i>
56b. mouth	<i>genou</i>	<i>genou</i>	<i>ganow</i>	<i>genau</i>	<i>genau</i>		* <i>genowes</i>
56c. mouth					<i>mant</i>		* <i>manti-</i> < * <i>mṁti-</i>
57. name	<i>anv</i>	^M <i>hanff</i>	<i>hanow</i>		<i>enw</i>	<i>anu</i>	* <i>anman</i>
58c. neck	<i>gouzoug</i>				<i>gwddw(g)</i>		
58d. neck			<i>conna</i>				
58a. neck		<i>mun</i>			<i>mwnwgl</i>	^M <i>mwn</i>	* <i>moni-(klo-)</i>
59a. new	<i>nevez</i>	<i>nouuid</i>	<i>noweth</i>		<i>newydd</i>	<i>nouid</i>	* <i>nowiyos</i>
60b. night	<i>noz</i>	<i>nos</i>	<i>nōs</i>		<i>nos</i>	<i>nos</i>	* <i>noχts-</i> , cf. OIr. <i>in-nocht</i> 'to-night'
61a. nose	<i>fron</i>	<i>fron</i>	<i>frygow</i>	<i>frūic</i>			* <i>srognā</i> / * <i>sregos</i>
61b. nose				<i>trein</i>	<i>trwyn</i>		* <i>trugnī-</i>
62a. not	<i>ne</i>	<i>ni / ne</i>	<i>ni(ns)</i>		<i>ny(ns)</i>	<i>ni</i>	* <i>ni</i>
63. one	<i>eun</i>	<i>unan</i>	<i>ūn</i>		<i>un</i>	<i>un</i>	* <i>unos</i> < * <i>oinos</i>
64a. person	<i>den</i>	<i>don / den</i>	<i>dēn</i>	<i>den</i>	<i>dyn</i>	^M <i>dyn</i>	* <i>gdonios</i>
65g. rain	<i>glav</i>	^M <i>glau</i>	<i>glaw</i>	<i>glau</i>	<i>glaw</i>		* <i>glaw-</i>
66a. red	<i>ruz</i>	<i>rud(d)</i>	<i>rūth</i>	<i>rud</i>	<i>rhudd</i>	^M <i>rud</i>	* <i>roudos</i>
66c. red			<i>coch</i>		<i>coch</i>		< Lat. <i>coccum</i> < Gr.
67b. road	<i>hent</i>	<i>hint</i>	<i>hens</i>	-	<i>hynt</i>	^M <i>hynt</i>	* <i>sentu-</i>
67e. road					<i>S. heol</i>		* <i>siglo-</i> : OIr. <i>séol</i> 'sail'
67f. road					<i>llwybr</i>		* <i>leikw-</i>
67g. road			<i>forth</i>		<i>N. ffordd</i>		< OEng. <i>ford</i>
68aa. root	<i>gwri-zienn</i>	<i>ureid</i>	<i>gwrȳth</i>	<i>grueiten</i>	<i>gwraidd</i>	^M <i>gwreid</i>	* <i>wradio-</i>
69a. round	<i>krenn</i>	<i>cron</i>	<i>cren</i>		<i>crwn</i>	<i>crunn</i>	* <i>krundis</i>
70b. sand	<i>traezh</i>		<i>trēth</i>	<i>trait</i>			cf. OIr. <i>tráig</i> 'beach', influenced by Lat. <i>tractus</i> 'tract of land'
70c. sand			<i>tewas</i>		<i>tywod</i>		
71b. say	<i>lavared</i>		<i>leverel</i>				*[<i>p</i>]labaros: Welsh <i>llefaru</i> 'to speak'
71d. say					<i>dweud</i>		* <i>do-wed-</i>

English	Breton	O ^M Breton	Cornish	OCornish	Welsh	O ^M Welsh	Etymology
72e. see	<i>gwelout</i>	<i>guel/guil</i>	<i>gweles</i>		<i>gweld</i>	^M <i>gulet</i>	*wel-eye/o-
73ab. seed	<i>had</i>	<i>att /^Mhat</i>	<i>hās</i>		<i>had</i>		*satos
74ab. sit	<i>azezañ</i>		<i>esedha</i>		<i>eistedd</i>		*ad-sed-e/o-
75a. skin	<i>kroc'hen</i>	<i>crochenn</i>	<i>croghen</i>	<i>croin</i>	<i>croen</i>	^M <i>croen</i>	*krokkeno-/*krokno-
76b. sleep	<i>kousked</i>		<i>cusca</i>		<i>cysgu</i>		< Lat. <i>quiescere</i>
77a. small	<i>bihan</i>	<i>bican</i>	<i>bȳghan</i>	<i>boghan</i>	<i>bach</i>	<i>bichan</i>	*bikkanos-/*bakkos
77b. small					<i>llaw</i>		*lagwo-
78c. smoke n.	<i>moged</i>	<i>moguet</i>	<i>mōk</i>		<i>mwg</i>		*mukos
79ab. stand	<i>sevel</i>	<i>sab</i>	<i>sevel</i>		<i>sefyll</i>	^M <i>seuyll</i>	*stab-eye/o-
80b. star	<i>sterenn</i>	<i>sterenn</i>	<i>stēr</i>	<i>steren</i>	<i>sēr/seren</i>	<i>sseren</i>	*sterinnā
81b. stone	<i>karreg</i>	<i>carrec</i>	<i>carrek</i>		<i>carreg</i>	<i>carrecc</i>	*karrikā
81c. stone	<i>maen</i>	<i>main</i>	<i>mēn</i>		<i>maen</i>	<i>mein</i>	*magnos
82b. sun	<i>heol</i>	<i>houl</i>	<i>howl</i>	<i>heuul</i>	<i>haul /huan</i>	^M <i>heul</i>	*sāulios / [*] sowonā
83. swim	<i>neuñviñ</i>		<i>nyja</i>		<i>nofio</i>		*snā-
84b. tail	<i>lost</i>	^M <i>lost</i>	<i>lost</i>	^M <i>lost</i> m.	<i>llost</i> f.		*lusto-/-ā
84c. tail					<i>cynffon</i>		
85. that	<i>hennezh</i>		<i>henna</i>		<i>hwnnw</i>		*sondos/-ā : [*] sindon
86ab. this	<i>hemañ</i>		<i>hemma</i>		<i>hwn</i>		*so/ind ^h +mañ here
87. thou	<i>te</i>	<i>te</i>	<i>ty</i>		<i>ti</i>	<i>ti</i>	*tū
88. tongue	<i>teod</i>	^M <i>teaut</i>	<i>tavas</i>	<i>tauot</i>	<i>tafod</i>	<i>tauawt</i>	*tangwātos
89b. tooth	<i>dant</i>	<i>dant</i>	<i>dans</i>	<i>dans</i>	<i>dant</i>		*dant-
90a. tree	<i>prenn</i>	<i>pren</i>	<i>pren</i>	<i>pren</i>	<i>pren</i>		*k ^w rennos < *k ^w resno-
90d. tree	<i>gwez</i>	<i>guid</i>	<i>qwȳth</i>	<i>guiden</i>	<i>gwydden</i>		*widus
90e. tree					<i>coeden</i>		*kaitos
91. two	<i>daou</i>	<i>dou</i>	<i>deu / dow</i>		<i>dau</i>	<i>dou</i>	*dwāu
92d. walk	<i>kerzhout</i>	<i>cerd</i>	<i>kerdhes</i>	<i>kerd</i>	<i>cerdded</i>	<i>kerdet</i>	*kerdetos, cf. OIr. <i>ceird</i> step
92e. walk	<i>bale</i>						< Fr. <i>bal</i>
93ac. warm	<i>tomm</i>	^M <i>toem</i>	<i>tomm</i>	<i>toim</i>	<i>twym</i>		*iēmmos < *iē[p]-m ^o
93d. warm	<i>gwrezek</i>		<i>gwresak</i>		<i>gwresog</i>		*g ^w ressākos < *g ^{wh} rens-: OIr. <i>gris</i> fire
93e. warm					<i>cynnes</i>		
94b. water	<i>dour</i>	^M <i>dour</i>	<i>dowr</i>	<i>douer</i>	<i>dŵr</i>	^M <i>dwyyr</i>	*dubron
95a. we	<i>ni</i>	<i>ni</i>	<i>nȳ</i>		<i>ni</i>	<i>ni</i>	*nī(s)
96a. what	<i>pe</i>	<i>pi / pe</i>	<i>py</i>		<i>pa</i>	<i>pa / pi</i>	*k ^w ei
97c. white	<i>gwenn</i>	<i>guinn</i>	<i>gwyn</i>	<i>guyn</i>	<i>gwyn</i>	<i>gwynn</i>	*windos
98. who	<i>piou</i>	<i>piv</i>	<i>pyu</i>		<i>pwy</i>	<i>pui</i>	*k ^w oi
99a. woman		<i>ban-</i>	<i>benen</i>	<i>benen</i>	<i>benyw</i>	<i>ben</i>	*benā < *g ^w enā
99c. woman	<i>gwreg</i>	^M <i>gru.ec</i>	<i>gwreċ</i>	<i>gr(u)eg</i>	<i>gwraig</i>	^M <i>gwreic</i>	*w(i)rakī
99d. woman	<i>maouez</i>						*magw-issā
100c. yellow	<i>melen</i>	<i>milin</i>	<i>melen</i>	<i>milin</i>	<i>melyn</i>	<i>melyn</i>	*melinos

Gaulish

English	Gaulish
1. all	
2. ashes	
3b. bark	* <i>ruska</i> > Lat. (9th cent.) <i>rusca</i> , NIt. <i>rüsca</i> , Fr. <i>ruche</i> , Occ. <i>rusc(a)</i> , Cat. <i>rusca</i> (D 223; ML 7456)
4. belly	
5a. big	* <i>māro-</i> : NV <i>Marus</i> , <i>Maros</i> ; <i>Maro-uiros</i> ; <i>Catu-marus</i> (D 184; S 72–74)
5c. big	* <i>magi(o)-</i> : NV <i>Magius</i> , <i>Magiononus</i> , <i>Magio-rix</i> , <i>Esu-magius</i> ; NL * <i>Magio-dunum</i> > <i>Magedon</i> (9th cent.) > <i>Médan</i> , <i>Magid[unum]</i> (AD371) > <i>Magden</i> (D 180)
5d. big	<i>ollon</i> n. (Chamalières); NV <i>Ollo-dagus</i> , <i>Bitu-ollus</i> ; NL Ὀλό-δορις, * <i>Ollo-briga</i> > <i>Olbrück</i> (D 203; S 250–51)
6a. bird	* <i>etno-</i> : ND (Bourges) <i>Etnosus</i> (D 141)
7. bite	
8a. black	* <i>dubu-/i-</i> : NF <i>Dubis</i> > <i>Doubs</i> , * <i>Dubīnā</i> > <i>Douyne</i> , * <i>Dubisamā</i> > <i>Duesme</i> ; NL <i>Tob/pp-wald</i> (D 128)
8b. black	* <i>atro-</i> (B 18; RC 1933, 266)
9. blood	
10. bone	
11b. breast	* <i>brunnio-</i> > Fr. dial. (Maine) <i>bronne</i> , (Berry) <i>abrō tétton</i> , Pr. <i>brunbrun boire</i> (ML 119; D 78)
12. burn	
13. claw	
14. cloud	
15a. cold	* <i>ougro-</i> > * <i>ōgro-</i> > * <i>Ogronos</i> 5th month of the Calendar from Coligny; NV <i>Ogri-genus</i> (D 202)
15c. cold	* <i>kukso-</i> (B 60; FEW II, 1492; ZCP 1984, 254)
16. come	
17. die	
18b. dog	* <i>kuno-</i> : <i>Cuno-pennus</i> = W. <i>cynnbenn</i> , OIr. <i>coinchenn</i> , <i>Cuno-belinus</i> = W. <i>Cynfelyn</i> , gen. <i>Cuno-mori</i> , <i>Cunopus</i> (S 186; D 110)
19a. drink	<i>ibetis</i> 2 pl. imper. (Limé) (D 157)
20a. dry	* <i>tarto-</i> : NV (Reims) <i>Tartos</i> < * <i>tr̥sto-</i> , NV <i>Tartus</i> ; cf. OIr. <i>tart</i> thirst < * <i>tr̥stu-</i> (D 246; E 377)
21c. ear	* <i>aus(i)-</i> : NV <i>Ausios</i> , <i>Ausicus</i> ; NM <i>Su-ausia</i> ; NL <i>Arausio</i> > <i>Orange</i> (D 53; S 142)
22c. earth	* <i>diarā</i> : NP <i>Diarensium</i> (CIL XII 2370; Elsie 1979, 90; B 63)
22a. earth	* <i>talamo-</i> : NL <i>Talamone</i> , <i>Talmun</i> (D 244; B 142; FEW XIII/1, 35; XXI, 14)
23b. eat	* <i>depro-</i> : NV (La Graufesenque) <i>Depro-sagios</i> (D 116; B 62; E 80–81; S 191)
24. egg	
25c. eye	* <i>derko-</i> : <i>in mon derco</i> in my eye (Marcellus of Bordeaux); NV <i>derco-iedus</i> , NM <i>Dercina</i> ; NL <i>Con-dercum</i> (D 116; S 179, 192; E 344); cf. also OB. <i>derch</i> aspect
26. fat	<i>galba</i> ‘praepinguis’ (Suetonius, <i>Galba</i> III, 3; B 77), NV <i>Galba</i> prince of Suessiones (H I, 1622; E 349–50; D 147)
27. feather	
28b. fire	* <i>aidu-</i> : NP <i>Aedui</i> < * <i>aidwoi</i> (D 31)
28a. fire	* <i>ten-</i> in <i>ten-edon</i> (Elsie 1979, 95)
29. fish	

English	Gaulish
30. fly v.	
31a. foot	* <i>kokso-</i> : NV gen. <i>Bon(o)-coxxi</i> , <i>Coux-olli</i> , NM <i>Dia-coxie</i> (S 185; D 107)
31b. foot	* <i>traget-</i> : <i>treide</i> ‘pede’ (Glossar of Vienne), <i>uer-tragus</i> hound, OFr. <i>triège</i> trace, road; NF * <i>Tragisamā</i> > <i>Trigisamum</i> > <i>Traisen</i> (Austria), <i>Dreisima</i> (864) > <i>Dreisam</i> (Germany) (D 253)
32c. foot	* <i>ādes</i> pl.: Galatian <i>αδες · πόδες</i> (Hesych.) (D 28)
32. full	* <i>lāno-</i> : NV <i>Uisu-lanius</i> , <i>Urido-lanos</i> , dat. <i>Lano-ualo</i> ; NL <i>Erco-lana</i> , <i>Uindo-lana</i> (S 229; D 166)
33d. give	<i>dedor</i> is given (Calendar of Coligny: <i>pogdedortonin</i> ; O 202; D 213)
34b. good	* <i>dago-</i> : <i>geneta imi daga uimpi</i> girl I am good (&) nice (Sense); NV <i>Dago</i> , <i>Dagus</i> , <i>Dagis-sius</i> , <i>Dagonus</i> , <i>Dago-marus</i> , <i>Dago-rigis</i> , gen. <i>Ollo-dagi</i> , <i>Bitu-Daga</i> (D 112; E 79, 188–89; S 186)
34a. good	* <i>matu-</i> : <i>matu</i> , <i>mat</i> , <i>m</i> vs. <i>am[atu-]</i> (calendar of Coligny; D 186)
34ad. good	* <i>manu-/o-</i> : NV <i>Ario-manus</i> , <i>Cata-manus</i> , gen. <i>Ceno-mani</i> (D 182; S 236; E 223)
35a. green	* <i>glasto-</i> : <i>Similis plantagini glastum</i> in <i>Gallia uocatur</i> (Pliny, <i>NH</i> 22, 2); Friul <i>glazinis</i> bilberry (ML 3779a; D 152)
36b. hair	* <i>uolto-</i> : NV <i>Uoltius</i> (1152), <i>Uoltinus</i> (420), <i>Uolto-dagae</i> , <i>Uolto-gnas</i> (S 300; D 275)
37a. hand	* <i>lama</i> : NV <i>Coro-lamus</i> , <i>Lama-tutus</i> , <i>Lama-uerus</i> ; NL <i>Lamatis</i> (D 165).
38a. head	* <i>penno-</i> : Lat. gl. <i>pen(n)is</i> ‘caput’; NV <i>Cuno-pennus</i> , Πεννο-ουινδος = OIr. <i>cenand</i> , B. <i>Pen-ven</i> , <i>Are-penino</i> ; NL <i>Penne-locos</i> , <i>Penno-crucium</i> ; * <i>talo-pennos</i> > Fr. dial. (Dauphine) <i>talapent</i> , (Savoyard) <i>talapon</i> (ML 8544b; D 210)
38c. head	* <i>barro-</i> : NV <i>Cuno-barrus</i> , <i>Su-barus</i> , <i>Uendu-barrus</i> = OIr. <i>Findbarr</i> ; NL: <i>Bar-le-Duc</i> , <i>Bar-sur-Aube</i> (D 59; S 144)
39. hear	<i>chuiou</i> 1 sg. pres. or fut. (Châteaubleau) (Schrijver 2001, 138)
40a. heart	* <i>krid(io)-</i> : NV dat. <i>Cridianto</i> ; NL <i>Crideciaco Vico</i> (D 107)
41b. horn	* <i>karnon</i> : dat. <i>καρνονου</i> (Montagnac); ND <i>Carnonos</i> ; NP <i>Carni</i> , <i>Carnutes</i> , <i>Carnonacae</i> (D 91)
41c. horn	* <i>banno-</i> > Occ. <i>banno</i> , Pr. <i>bana</i> horn; * <i>ande-banno-</i> > Fr. <i>auvent</i> , OPr. <i>amban</i> ; NV <i>Bannus</i> ; NL <i>Bannaciacus</i> > <i>Banassac</i> , <i>Bannobriga</i> > <i>Bannovre</i> (D 57; L 187–88)
42. I	acc. <i>mi</i> : <i>uediiu-mi</i> , <i>pissiu-mi</i> (Chamalières) < * <i>mē</i> (L 66)
43b. kill	<i>orge</i> 2 sg. imper.; cf. NV <i>Orgeto-rix</i> , <i>Orgetius</i> , ND <i>Orgeno</i> (D 206; L 36)
44. knee	
45a. know	* <i>uid-</i> : NV abl. <i>Uidi-macle</i> < * <i>Widi-maglos</i> , <i>Epotso-ro-uidi</i> (S 295, 210; D 267–68)
46a. leaf	* <i>dola</i> : <i>πεμπεδουλα · πεντάφυλλον</i> (Dioscoride 4, 42) = <i>pempedula · quinquefolium</i> (Ps.-Apuleus 2, 32; see D 122, 209–10)
47. lie	
48. liver	
49b. long	* <i>siro-</i> : NV <i>Sirus</i> , <i>Sirinus</i> , Κριτά-σιρος; NL <i>Siro-ialum</i> > <i>Sireuil</i> (D 234; S 269)
50. louse	
51a. man	* <i>uiro-</i> : NV <i>Uiros</i> ,-us, <i>Uironus</i> , <i>Uiro-cantus</i> = OW <i>Gurcant</i> , OIr. <i>Fer-chéte</i> (D 270; S 296–98)
52b. many	* <i>elu-</i> : NV <i>Eluo-rix</i> , <i>Eluio-maros</i> , <i>Eluontiu</i> < * <i>pelu-pontīō</i> , (D 136; Elsie 1979, 111)
53b. meat	* <i>kiko-</i> : NV <i>Cic-ollus</i> , <i>Cice-lauus</i> , <i>Cicetius</i> ; ND <i>Marti Carro Cicino</i> (D 97–98; S 171)
54. moon	
55e. mountain	* <i>bergona</i> / * <i>briga</i> : NL <i>Bergonna</i> > <i>Bergonne</i> , <i>Bergantinum</i> > <i>Berganty</i> ; <i>Uindo-briga</i> (D 63, 74)

English	Gaulish
55f. mountain	* <i>barro-</i> : cf. #38
55g. mountain	* <i>kalma</i> & * <i>kalmis</i> (B 39; FEW II, 100–01)
56d. mouth	* <i>bokka-</i> : <i>bocca</i> (Larzac); Lat. <i>bucca</i> > Fr. <i>bouche</i> , It. <i>bocca</i> , Sp. <i>boca</i> ; NV <i>Boccus</i> , <i>Bocco</i> (D 69)
56c. mouth	* <i>manto-/i-</i> : NV <i>Mantus</i> , <i>Mantounus</i> , <i>Cara-mantius</i> , gen. <i>Ueni-mantii</i> (D 182; S 237)
56b. mouth	* <i>genu-</i> : NL <i>Genaua</i> > <i>Genève</i> , <i>Genua</i> > <i>Gêne</i> , <i>Aregenua</i> > <i>Arguenon</i> (D 149)
56e. mouth	* <i>gobbo-</i> > Fr. <i>gober</i> , <i>gobelet</i> , OFr. <i>gobel</i> , <i>gobet</i> mouthful (ML 3814; D 154)
57. name	<i>anuan</i> : in <i>eanom anuana</i> ‘in earum nomina’ (Larzac; D 43); dat./instr. (pl?) <i>anmanbe</i> (Châteaubleau; Schrijver 2001, 135, 138)
58a. neck	* <i>man-</i> : <i>μανιάκαι</i> necklace of Galatians (Polybius II, 31, 5; D 182)
59a. new	* <i>nouio-/*neuio-</i> : <i>gandobe inte nouiio</i> (Lezoux); NL <i>Neuio-dunon</i> (Pannonia), <i>Nouio-dunum</i> , <i>Nouio-magus</i> , <i>Nouio-regum</i> (D 199)
60b. night	* <i>noxt-</i> : <i>tri-nox[tion]</i> , <i>decam-noct-iacis</i> (Calendar of Coligny; D 200)
61a. nose	* <i>srogna</i> : OFr. <i>froigne</i> mine renfrognée, Fr. <i>froigner</i> , dial. <i>frognon</i> groin (ML 3529; D 237)
62a. not	<i>ne</i> (Lezoux), <i>ni</i> (Larzac) (D 196–97)
63. one	* <i>oino-</i> : NV <i>Oinos</i> , <i>Oinencilo</i> (D 202)
64a. person	* <i>gdonio-</i> : <i>teuoxtonion /dēwo-gdonio-</i> gods & men (Vercelli; D 148)
65. rain	
66a. red	* <i>roudo-</i> : NV <i>Roudius</i> , <i>Ande-roudus</i> , <i>Rudus</i> ; ND <i>Rudianus</i> epithet of Mars (D 223)
67h. road	* <i>kammino-</i> > MLat. (7th cent.) <i>camminus</i> , It. <i>cammino</i> , Fr. <i>chemin</i> , Sp. <i>camino</i> (D 85)
67b. road	* <i>sentu-</i> : NL gen. <i>Gabro-senti</i> , <i>Sentiniacus</i> > <i>Santenay</i> ; NV <i>Sinto-rigis</i> (D 230; S 269)
68. root	
69b. round	* <i>kurro-</i> (B 60; <i>Vox Romanica</i> 1960, 256)
70d. sand	<i>graua</i> > Cat., Pr. <i>grava</i> , Fr. <i>grève</i> , <i>gravier</i> , dial. <i>groue</i> , Friul <i>grave</i> (ML 3851; D 155)
71b. say	* <i>labaro-</i> : NV <i>Labarus</i> , <i>Labrios</i> , <i>Λαβροδμος</i> (D 164)
72a/ab. see	* <i>(ad-)piss-</i> : 1sg. fut. <i>pissiiumi</i> (Chamalières) < * <i>kissiō-mi</i> , 3sg. imp. fut. <i>appisetu</i> (Thiaucourt) < * <i>ad-k^wissjetō</i> (D 212; 44)
73a. seed	* <i>silo-</i> : NV <i>Σιλου-κνος</i> (Cavaillon), <i>Silus</i> , <i>Silo</i> (D 231; E 112)
74a/ab. sit	* <i>sed-</i> : (E 254–57; B 133)
75. skin	
76. sleep	
77b. small	* <i>lagu-</i> : <i>lau</i> (Marcellus of Bordeaux), cf. NV <i>Lagu-audus</i> , NM <i>Lagussa</i> (D 164–65)
77c. small	<i>meion</i> (Chamalières), cf. NV <i>Meius</i> (D 189)
77a. small	* <i>bikko-</i> : NV <i>Biccus</i> (B 28; <i>Vox Romanica</i> 1960, 247)
78. smoke n.	
79. stand	
80c. star	* <i>s(t)ir-</i> : ND <i>Sirona</i> & <i>Dirona</i> (D 239; B 137, 150; CIL XIII, 582 & 3143)
81. stone	* <i>akaunon</i> : <i>acaunus</i> <i>petra</i> (Vita Patr. 3.1), <i>agaunum</i> <i>saxum</i> , <i>agaunus</i> <i>petra</i> (Passio Maurit. et Thebae, 345D); <i>acaunomarga</i> <i>argile pierreuse</i> (Plin. NH 17.44); NL <i>Acaunus</i> , <i>Acunum</i> , ND <i>Agaunus</i> (D 26; B 1, 4) < Celt. * <i>akannon</i> < * <i>ak^{mno}</i> -
81e. stone	* <i>artu-</i> (B 15; H I, 228)
81f. stone	* <i>kaliauo-</i> (B 39; FEW II, 96–97)
81g. stone	* <i>karn(o)-</i> (B 44; E 328)
81h. stone	* <i>krako-</i> (B 58; FEW II, 1266)
81i. stone	* <i>gallo-</i> (B 80; FEW IV, 42; XXI, 366; XXII/I, 196)
82b. sun	* <i>sonno</i> : <i>sonnociingos</i> road of a sun (Calendar of Coligny; D 236)

English	Gaulish
83. swim	
84b. tail	* <i>losto</i> -: NV Λοστοιεκο from Galatia (D 175)
85. that	<i>se, so, san(a)</i> (Larzac; D 228)
86a/ab. this	<i>sinde</i> : loc. in <i>sinde</i> (Larzac), cf. <i>sindiu</i> today, i.e. * <i>sind(o)-dijū</i> this day (D 232); <i>sendi</i> (Châteaubleau) < acc. * <i>sindin</i> (Schrijver 2001, 138)
87. thou	* <i>tū</i> : <i>lexstumisendi</i> say you me that (Châteaubleau; Schrijver 2001, 138)
88. tongue	* <i>tengua</i> : Lep. (?) <i>pompeteguaios</i> quinquelingual (Prodocimi 1984, 432–37)
89. tooth	
90a. tree	* <i>prenno</i> - < * <i>k^wresno</i> - (McManus 1992, 205): <i>prenne</i> gl. ‘arborem grandem’ (Glossar of Vienne); NL <i>Prenicus mons</i> (H II, 1042); NV <i>Prini-lettius, Com-prinnus, Com-priniaco</i> > <i>Compreignac</i> (D 213)
90d. tree	* <i>uidu</i> -: NL <i>Uidua</i> > <i>Veuve</i> , * <i>Uidulion</i> > <i>Uodulium</i> > <i>Vou</i> , * <i>Sapa-widiā</i> > <i>Sapaudia</i> > <i>Savoie</i> ; NF <i>Uiduvia</i> > <i>La Vouge</i> , * <i>Uidunna</i> > <i>La Veauve, La Vonne</i> (Vienne); NP <i>Uiducasses</i> > <i>Vieux</i> ; NV <i>Uiducus</i> ; ND * <i>Olo-uidius</i> > <i>Olloudios</i> epithet of Mars (D 268; S 295)
90b. tree	* <i>bilio</i> - > Fr. <i>bille, billot</i> section de tronc d’arbre, Pr. <i>bilha</i> id.; cf. NV <i>Billiomagus</i> = OIr. <i>Mag m-Bili</i> , motivating the NL <i>Billom, Corobilium</i> > <i>Corbeil</i> = OIr. <i>Corrbile</i> (D 64–65; E 149–51; ML 1104)
91. two	(<i>uo</i> -) <i>dui</i> (Larzac) two times < * <i>u[p]o-dwī</i> (L 167)
92. walk	
93a/ac. warm	* <i>tess(i)-/*teđđ(i)-</i> < * <i>te[p]sti</i> -: NV <i>Tessi-gnius</i> , gen. <i>Tedsi-cnati, Ad-tettius, Con-tess(i)o</i> - = W. <i>cynnes</i> (D 248; S 278)
94a. water	* <i>unna</i> - < * <i>udnā</i> : <i>onno</i> gl. ‘flumen’ (Glossar of Vienne); cf. ND dat. pl. Ανδουναβο (Collias) < * <i>ande-unna</i> lit. ‘under water’ vs. ND <i>Uxouna</i> , fontaine-divinity, lit. ‘upper water’ (D 42)
94b. water	* <i>dubron</i> , pl. * <i>dubra</i> : NL/NF <i>Douvres, Dèvre, Dobra, Dubra-gave</i> (807) > <i>Tauber</i> , * <i>Dubro-dūnon</i> > <i>Dubridun</i> > <i>Doevern</i> (D 127–28; Hamp 1972, 233–37 on relation to Goid. * <i>udenski</i> -)
94d. water	* <i>apsa</i> - (B 13; FEW XXI, 7–8)
94ae. water	* <i>uadana</i> (B 151; FEW XIV, 111–12)
95a. we	<i>sni</i> : <i>snieθθic</i> (Chamalières) < * <i>sni[s] esti-k^we</i> , where the pronoun is in acc. (D 235)
96. what	
97d. white	* <i>albo</i> - (B 5; E 303–04); cf. * <i>albena</i> white partridge (FEW I, 60; XXIV, 300)
97e. white	* <i>argio</i> -: NV <i>Ardiu-talus</i> , cf. W <i>Talorgan</i> (D 47)
97f. white	* <i>kando</i> - (B 41; <i>Vox Romanica</i> 1960, 248)
97c. white	* <i>uindo</i> -: NV <i>Uindus, Uindiacos, Penno-uindos</i> ; NM <i>Uindona, Uindama</i> ; NL <i>Uindo-ialum</i> > <i>Vendeuil, Venteuges, Uindo-briga</i> > <i>Vendoeuvres, Uindonissa</i> > <i>Windisch, Uindo-bona</i> > <i>Vienne</i> ; cf. also Fr. <i>vendoise, vandoise</i> white-fish < * <i>uindesiā</i> (D 269)
98. who	<i>po[s?]</i> - < * <i>k^wos</i> : <i>ponne</i> (Larzac) (L 171)
99a. woman	<i>bena, bna</i> -: gen. pl. <i>bnanom</i> , acc. pl. <i>mnas</i> (Larzac); cf. NM <i>Seno-bena, Uitu-bena</i> (D 62)
100a. yellow	* <i>bodio</i> - (B 31; S 151–52)
100d. yellow	* <i>gelamo</i> - (B 81; FEW XXI, 481)
100c. yellow	* <i>melino</i> -: Lat. <i>melinus</i> gl. ‘color nigrus’, Romanch <i>mélen</i> yellow; NL <i>Melina</i> > <i>Mehlenbach</i> ; NV <i>Melinus</i> (D 190)

Abbreviations: B. Breton; C. Cornish; Cat. Catalanian; Fr. French; Ir. Irish; It. Italian; Lat. Latin, Lep. Lepontic, N North; ND Nomen dei; NF Nomen fluminis; NL Nomen loci; NM Nomen mulieris; NP Nomen populi; NV Nomen viri; O Old; Occ. Occitan; Pr. Provençal; Sp. Spanish, W. Welsh.

Symbols:

N_0 = number of all unborrowed semantic units attested in both compared languages.

N_1 = number of the inherited cognates.

N_2 = number of the inherited cognates, including the uncertain cases.

N_3 = number of the inherited cognates, including the uncertain cases and paired synonyms, indicated by „+“.

$c_1 = N_1 / N_0$

$c_2 = N_2 / N_0$

$c_3 = N_3 / N_0$

Results:

Inner Goidelic cognates

Irish – Manx – Loanwords: Irish 3b; paired synonyms: 9.

Cognates: 1a, 2a, 4a, 5a, 6a, 7, 8a, 9a, 10, 12a, 13a, 14a, 15, 16, 17a, 18a + 18b, 20a + 20b, 21, 22a, 23, 24, 25, 26, 27a, 28a, 29, 30a, 31a + 31b, 32, 33a, 34a, 35a + 35b, 36a + 36b, 37a, 38a, 39, 40a, 41a, 42, 43a, 44, 45a, 46a, 47a, 48a, 49a, 50a, 51a, 52a, 53a, 54a, 55a, 56, 57, 58, 59a + 59b, 60, 61a, 62a/b, 63, 66a + 66b, 67a, 68a, 69a, 70, 71a, 72a, 73a, 74, 75a, 76, 77a, 78b + 78c, 79, 80a + 80b, 81, 82, 83, 84a, 85, 87, 88, 89a, 91, 92a, 93, 94, 95, 96a, 97a, 98, 99a, 100a.

Results: $c_1 = 93/99 = 0.939$; $c_3 = 102/108 = 0.944$. $\emptyset = (c_1 + c_3)/2 = 0.942$.

Irish – Gaelic – Loanwords: Irish 3b, Gaelic 67c; paired synonyms: 16.

Cognates: 1a, 2a, 5a, 6a, 7, 8a, 9a, 10, 12b, 14a, 15, 16, 17a, 18a + 18b, 20a + 20b, 22a + 22b, 23, 24, 25, 26a, 27b, 28a, 29, 30a, 31a + 31b, 32, 33a, 34a, 35a + 35b, 36a + 36b, 37a, 38a, 39, 40a, 41a, 42, 43a, 44, 45a, 46a + 46b, 47a, 48a, 49a, 50a + 50d, 51a, 52b + 52c, 53a, 54a, 56, 57, 59a + 59b, 60, 61a, 62a/b, 63, 66a + 66b, 68a, 69a, 70, 71a + 71b, 72a, 73a, 74, 75a, 76, 77a, 78b + 78b, 79, 80a, 81, 82, 83, 84a, 85, 86, 89a + 89b, 90a, 91, 92a+92c, 94a, 95a, 96a, 97a + 97c, 99a/b, 100a.

Results: $c_1 = 87/98 = 0.888$, $c_3 = 103/114 = 0.904$. $\emptyset = 0.896$.

Manx – Gaelic – Loanwords: Gaelic 67c; paired synonyms: 14.

Cognates: 1a, 2a, 3a, 5a, 7, 8a, 9a, 10, 14a, 15, 16, 17a, 18a + 18b, 20a + 20b, 21, 22a, 23, 24, 25, 26a, 29, 30a, 31a + 31b, 32, 33a, 34a, 35a + 35b, 36a + 36b, 37a, 38a, 39, 40a, 41a, 42, 43a, 44, 45a, 46a, 47a, 48a, 49a, 50a, 51a + 51b, 53b, 54a, 55d, 56, 57, 59a + 59b, 60, 61a, 62a/b, 63, 66a + 66b, 68a + 68c, 69a, 70, 71a, 72a, 73a + 73b, 74, 75a, 76, 77a, 78b, 79, 80a + 80b, 81, 82, 83, 84a + 84c, 85, 86, 87, 88, 89, 91, 92a + 92b, 93b, 94a, 95a, 96a, 97a + 97b, 98, 99a, 100a.

Results: $c_1 = 86/99 = 0.869$, $c_3 = 100/113 = 0.885$. $\emptyset = 0.877$

Inner-Brittonic cognates

Breton – Cornish – loanwords: 7e, 20c, 26f, 27d, 29, 76b; #48 is not known in Cornish; paired synonyms: 6.

1b, 2a, 3a, 4c, 5a+5b, 6a, 8a, 9, 10, 11b, 12a+12b, 13c, 14c, 15b, 16b, 17d, 18b, 19a, 21b, 22c, 24a/b, 25b, 28a, 30f, 31b, 32, 33c, 34a+34b, 35a, 36c, 37b, 38a, 39, 40b, 41b, 42, 43c, 44, 45a, 46a, 47c, 49b, 50f, 51a, 52bb+52d, 53b, 54c, 55c, 56b, 57, 59a, 61ac, 62a, 63, 64a, 65g, 66a, 67b, 68a,

69a, 70a, 71b, 72e, 73ab, 74ab, 75a, 77a, 78c, 79ab, 80b, 81b+81c, 82b, 83, 84b, 85, 86ab, 87, 88, 89b, 90a+90d, 91, 92, 93ac+93c, 94b, 95a, 96a, 97c, 98, 99c, 100c.

Results: $c_1 = 90/93 = 0.968$; $c_3 = 96/99 = 0.970$. $\emptyset = 0.969$.

Breton – Welsh – loanwords: 7e, 26f, 27d, 29, 76b; paired synonyms: 6.

1b, 2a, 3a, 4c, 5a, 6a, 8a, 9, 10, 11b, 12a+12b, 13c, 14c, 16b, 17d, 18b, 19a, 20b, 22b+22c, 24a/b, 25b, 28a, 31b, 32, 33c, 34a+34b, 36c, 38a, 39, 40b, 41b, 42, 43c, 44, 45a, 46a, 47c, 48a, 49b, 50f, 51a, 52bb, 53b, 54c, 55c, 56b, 57, 58c, 59a, 60b, 62a, 63, 64a, 65g, 66a, 67b, 68a, 68a, 72e, 73ab, 74ab, 75a, 77a, 78a, 79ab, 80b, 81b+81c, 82b, 83, 84b, 85, 86ab, 87, 88, 89b, 90a+90a, 91, 92b, 93ac+93d, 94b, 95a, 96a, 97c, 98, 99c, 100c.

Results: $c_1 = 86/95 = 0.905$; $c_3 = 92/101 = 0.911$. $\emptyset = 0.908$.

Cornish – Welsh – loanwords: 20b, 27d, 29b, 76b; #48 is not known in Cornish; paired synonyms: 8.

1b, 2a, 3a, 4c, 5a, 6a, 8a, 9b, 10b, 11b, 12a+12b, 13c, 14c, 16b, 17d, 18b, 19a, 22b+22c, 24a/b, 25b, 26c, 28a, 31b, 32, 33c, 34a+34b, 35a, 36c, 37a, 38a, 39, 40b, 41b, 42, 43c, 44, 45a, 46a, 47c, 49b, 40b, 50f, 51a, 52bb+52d, 53b, 54c, 55c, 56b, 57, 59a, 60b, 62a, 63, 64a, 65g, 66a, 67b, 68a, 69a, 70c, 72e, 73ab, 74ab, 75a, 77a, 78a, 79ab, 80b, 81b+81c, 82b, 83, 84b, 85, 86ab, 87, 88, 89b, 90a+90d, 92b, 93ac+93d, 94b, 95a, 96a, 97c, 98, 99a+99c, 100c.

Results: $c_1 = 87/95 = 0.906$; $c_3 = 95/103 = 0.922$. $\emptyset = 0.914$.

Goidelic – Brittonic

Irish – Breton – loanwords: 3b, 7e, 26f, 27d, 29, 76b; paired synonyms: 1.

2a, 4c, 5a, 6a, 8a, ?12a+12b, 20b, 22b, ?24a/ab, 28a, 31b, 32, 34a, 35a, 36b, 38a, 39, 42, 44, 45a, 46a, 48a, 51a, 52ba(b), 57, 59a, 61a, 62a, 63, 64a, 66a, 67b, 68a(a), 69a, 71b, 73a/ab, 74a/ab, 75a, 77a, 78c, 79a/ab, 83, 85, 86a/ab, 87, 88, 89b, 90a, 91, 93a/ac, ?94a/b, 95a, 96a, 97c, 98, 99c.

Results: $c_1 = 53/94 = 0.564$; $c_2 = 56/94 = 0.596$; $c_3 = 57/95 = 0.600$. $\emptyset = [(c_1 + (c_2 + c_3))/2] = 0.581$.

Irish – Cornish – loanwords: 3b, 20c, 27d, 29, 76b; #48 is not known in Cornish; paired synonyms: 2.

2a, 3a, 4c, 5a, 6a, 8a, ?12a+12b, 22b, ?24a/ab, 28a, 31b, 32, 34a, 35a, 37a, 38a, 39, 42, 44, 45a, 46a, 45a, 51a, 52b(b), 57, 59a, 61a, 62a, 63, 64a, 66a, 68a(a), 69a, 71b, 73a/ab, 74a/ab, 75a, 77a, 78c, 79a/ab, 83, 85, 86a/ab, 87, 88, 89b, 90a, 91, 93a/ac, ?94a/b, 95a, 96a, 97c, 98, 99a+99c.

Results: $r_1 = 53/94 = 0.564$; $r_2 = 56/94 = 0.596$; $r_3 = 58/96 = 0.604$. $\emptyset = 0.582$.

Irish – Welsh – loanwords: 3b, 27d, 29, 76b; paired synonyms: 2.

2a, 3a, 4a+4c, 5a, 6a, 8a, ?12a+12b, 13a, 15a, 20b, 21a, 22b, ?24a/ab, 28a, 31b, 32, 34a, 35a, 36b, 37a, 38a, 39, 42, 44, 45a, 46a, 48a, 51a, 52a, 52b(b), 57, 59a, 61a, 62a, 63, 64a, 66a, 68a(a), 69a, 73a/ab, 74a/ab, 75a, 77a, 79a/ab, 85, 86a/ab, 87, 88, 89b, 90, 91, 93a/ac, ?94a/b, 95a, 96a, 97c, 98, 99a.

Results: $c_1 = 56/96 = 0.583$; $c_2 = 58/96 = 0.604$; $c_3 = 60/98 = 0.612$. $\emptyset = 0.596$.

Manx – Breton – loanwords: 7e, 26f, 27d, 29, 76b; paired synonyms: 1.

2a, 3a, 5a, 6a, 8a, ?12a, 13c, 18b, 19a, 20b, ?24a/ab, 28a, 31b, 32, 34a, 35a, 36b, 37a, 38a, 39, 42, 44, 45a, 46a, 48a, 51a+51b, 57, 59a, 61a, 62a, 63, 64a, 66a, 68a(a), 69a, 73a/ab, 74a/ab, 75a, 77a, 79a/ab, 83, 85, 86a/ab, 87, 88, 93a/ac, ?94a/b, 95a, 96a, 98.

Results: $c_1 = 48/95 = 0.505$; $c_2 = 50/95 = 0.526$; $c_3 = 51/96 = 0.531$. $\emptyset = 0.517$.

Manx – Cornish – loanwords: 20b, 27d, 29, 48a, 76b.

2a, 3a, 5a, 6a, 8a, ?12a, 13c, 18b, 19a, ?24a/ab, 28a, 31b, 32, 34a, 35a, 37a, 38a, 39, 42, 44, 45a, 46a, 51a, 57, 59a, 61a, 62a, 63, 64a, 66a, 68a(a), 73a/ab, 74a/ab, 75a, 77a, 79a/ab, 83, 85, 86a/ab, 87, 88, 91, 93a/ac, ?94a/b, 95a, 96a, 98, 99a.

Results: $c_1 = 46/95 = 0.484$; $c_2 = 48/95 = 0.505$. $\emptyset = 0.495$.

Manx – Welsh – loanwords: 27d, 29, 76b; paired synonyms: 1.

2a, 3a, 4a, 5a, 6a, 8a, 12a, 13a+13c, 15a, 18b, 19a, 20b, 21a, 22b, ?24a/ab, 28a, 31b, 32, 34a, 35a, 36b, 37a, 38a, 42, 44, 45a, 46a, 48a, 51a, 57, 58a, 61a, 62a, 63, 64a, 66a, 68a(a), 69a, 73a/ab, 74a/ab, 75a, 77a, 79a/ab, 83, 85, 86a/ab, 87, 88, 91, 93a/ac, ?94a/b, 95a, 96a, 98, 99a.

Results: $r_1 = 53/97 = 0.546$; $r_2 = 55/97 = 0.567$; $r_3 = 0.571$. $\emptyset = 0.558$.

Gaelic – Breton – loanwords: 7e, 26f, 27d, 29, 67c, 76b; paired synonyms: 1.

2a, 3a, 5a, 6a, 8a, 11b, 12b, 18b, 20b, 22b, ?24a/ab, 28a, 31b, 32, 34a, 37a, 38a, 39, 42, 44, 46a, 48a, 51a+51b, 52b(b), 57, 59a, 61a, 63, 66a, 68a(a), 69a, 71b, 73a/ab, 74a/ab, 75a, 77a, 79a/ab, 83, 85, 86a/ab, 87, 88, 89b, 90a, 91, ?94a/b, 95a, 96a, 97c, 98.

Results: $c_1 = 48/94 = 0.511$; $c_2 = 50/94 = 0.532$; $c_3 = 51/95 = 0.537$. $\emptyset = 0.523$.

Gaelic – Cornish – loanwords: 2b, 27d, 29, 67c, 76b; #48 is not known in Cornish.

2a, 3a, 5a, 6a, 8a, 11b, 12b, 18b, 22b, ?24a/ab, 28a, 31b, 32, 34a, 35a, 37a, 38a, 39, 42, 44, 45a, 46a, 51a, 52b(b), 57, 59a, 61a, 62a, 63, 64a, 66a, 68a, 69a, 71b, 73a/ab, 74a/ab, 75a, 77a, 79a/ab, 83, 85, 86a/ab, 87, 88, 89b, 90a, 91, ?94a/b, 95a, 96a, 97c, 98, 99a.

Results: $c_1 = 51/94 = 0.543$; $c_2 = 53/94 = 0.564$. $\emptyset = 0.554$.

Gaelic – Welsh – loanwords: 27d, 29, 67c, 76b.

2a, 3a, 5a, 6a, 8a, 11b, 12b, 15a, 18b, 20b, 21a, ?24a/ab, 28a, 31b, 32, 34a, 35a, 36b, 37a, 38a, 39, 42, 44, 45a, 46a, 48a, 51a, 52b(b), 57, 59a, 61a, 62a, 66a, 68a(a), 69a, 73a/ab, 74a/ab, 75a, 77a, 79a/ab, 83, 85, 86a/ab, 87, 88, 89b, 90a, 91, ?94a/ab, 95a, 96a, 97c, 98, 99a.

Results: $c_1 = 52/96 = 0.542$; $c_2 = 54/96 = 0.563$. $\emptyset = 0.553$.

The average results can be summarized :

<i>Language</i>	Manx	Gaelic	Breton	Cornish	Welsh
Irish	0.942	0.896	0.581	0.582	0.596
Manx		0.877	0.517	0.495	0.558
Gaelic			0.523	0.554	0.553
Breton				0.969	0.908
Cornish					0.914

The studied languages are asynchronous, it means, the data presented here reflect the different time: Irish ± 1950 (= 50BP); Welsh ± 1950 (= 50BP); Gaelic ± 1900 (= 100BP); Breton ± 1900 (= 100BP); Manx ± 1800 (= 200BP); Cornish ± 1600 (= 400BP).

M. Swadesh offered a simple approximation for the case of the asynchronously attested languages. If t_A and t_B are time intervals of recording of the compared languages A & B respectively before present, it is necessary to add the arithmetic average $(t_A + t_B)/2$ to the calculated time of their divergence. E.g. in the case of the pair Breton & Cornish it is necessary to shift the date of their separation $(400+100)/2 = 250$ years in past. Concretely 0.969 corresponds to the end of the 14th cent. according to Starostin's method. After the correction, the definitive separation of Breton and Cornish could be realized in the middle of 12th cent. Similarly, for Irish and Manx the share of the common cognates, 0.942, corresponds to the middle of the 12th century. The correction $(200 + 50)/2 = 125$ years shifts the divergence of these two languages to the beginning of the 11th

cent. The chronology of the Brittonic disintegration is determined by the shares 0.914 for the pair Welsh-Cornish and 0.908 for the pair Welsh-Breton, it means 980AD and 940AD respectively. Taking in account the correction, these data should be shifted $(50+400)/2 = 225$ and $(100+50)/2 = 75$ years respectively in the past, i.e. between c. AD755 and AD865. The probable disintegration of the Brittonic languages may be so dated around AD800. In the case of the Goidelic, the Irish-Gaelic share 0.896 corresponds to AD860, the Gaelic-Manx share 0.877 corresponds to AD760, with the correction $(50+100)/2 = 75$ and $(100+200)/2 = 150$ years respectively to the past, it means between AD 785 and AD610, i.e. around AD700. The disintegration of both insular branches should be dated to the interval determined by two extremous results, 0.495 for the pair Manx-Cornish, corresponding to 1210BC, and 0.596 for the pair Irish-Welsh, corresponding to 640BC. Taking in account the asynchronic correction, the data should be shifted to $(400+200)/2 = 300$ and $(50+50)/2 = 50$ years in the past, i.e. to 1510BC and 690BC respectively, i.e. approximately to 1100BC. The arithmetic average of all shares between all Goidelic vs. all Brittonic languages gives 0.551, reflecting the dating 890BC. If the time shift is also estimated as the arithmetic average, i.e. $(50+50+100+100+200+400)/6 = 1000/6 = c. 167$ years, the disintegration of the Celtic languages should be dated to the middle of the 11th cent. BC. The difference from the first approximation, i.e. 1100BC, is negligible.

Gaulish vs. Insular Celtic

The comparison of the Insular Celtic languages with Gaulish (better than Continental Celtic, regarding the apparent difference of Gaulish from Celtiberian) is difficult for various reasons. There are only a limited capacity of sources or contexts, where it is possible to identify the Gaulish words with their semantics: inscriptions, glosses, substratal words in the Romance languages, and occasionally the ‘toponymical bilinguae’. Frequently the Gaulish words are reconstructed according to the proper names on the basis of similarity with structurally corresponding names or only externally similar words in the Insular Celtic languages. Naturally, if the existence proper of these hypothetical lexems is only speculative, their meanings are more than uncertain. In spite of these objections it is desirable to try to quantify the mutual relations of Gaulish with both Goidelic and Brittonic. Taking in account the synonyms, in the list of Gaulish representants of the 100-word-list postulated by Swadesh, there are 70 semantic units with 106 more or less probable Gaulish equivalents.

Gaulish – Goidelic

3b, 5a+5c, 6a, 8a, 11b, 15a, 18b, 19a, 21c, 22a, 25c, 28a+28b, 31a+31b, 32, 34a+34b, 35a, 36b, 37a, 38a, 39, 40a, 42, 43b, 45a, 46a, 49b, 51a, 52b, 53b, 55d, 57, ?58a, 59a, 61a, 62a, 63, 64a, 66a, 67b, 71b, 72a/ab, 73a, 74a/ab, 77a, 80c, 85, 86a, 87, 88, 90a+90b, 91, 93a/ac, 94a, 95a, 97c, ?98, 99a, 100a.

Totally 56 cognates, plus 2 cognates with question, plus 5 paired synonyms.

Cognates with modified semantics – 4: 41c „horn“ – OIr. *benn* „mountain, point, horn“ (#55d); 60b „night“ – OIr. *innocht* „tonight“; 33d „give“ – OIr. *dán* „gift“; 55e „mountain“ – OIr. *brí*, gen. *breg* „hill“ < **brigs*, gen. **brigos*; 77b „small“ – OIr. *laigiu*, *laugu* „smaller“ < **lagiyōs* (D 164).

Gaulish – Brittonic

3b, 5a, 6a, 8a, 11b, 15a, 18b, 19a, 22c, 23b, 28a, 31b, 32, 34a+34b, 35a, 36b, 37a, 38a, 39, 40a, 41b, 42, 45a, 46a, 49b, 51a, 52b(b), 53b, 56b+56c, 57, ?58a, 59a, 60b, 61a, 62a, 63, 64a, 66a, 67b, 71b, 74a/ab, 77a+77b, 80c, 82b, 84b, 85, 86a/ab, 87, 88, 90a+90d, 91, 93a/ac, 94b, 95a, 97c, ?98, 99a, 100c.

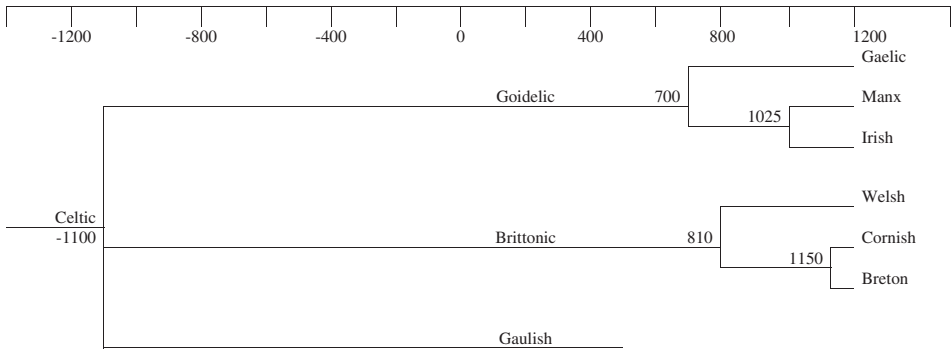
Totally 56 cognates, plus 2 cognates with question, plus 4 paired synonyms.

Cognates with modified semantics – 4: 25c „eye“ – OB. *derch* aspect; 43b „kill“ – OB. *orgiat* „killer“, *org* n. „strike“; 33d „give“ – W *dawn* „gift“; 55e „mountain“ – W., C., B. *bre* „hill“ < **brigā*; 73a „seed“ – W. *hil* „offspring, race, lineage“, OB. *hil-heiat* „seed-disseminater“ (Fleuriot 1964, 211).

Note: The underlined figures indicate the correspondences of Gaulish lexems attested in both Goidelic and Brittonic.

It seems, there are practically identical absolute numbers of cognates between Gaulish and both Goidelic and Brittonic, independently of the inclusion of problematic cognates, synonyms of cognates with rather different meanings. If the disintegration of Brittonic (AD 810) was a little later in comparison with Goidelic (AD 700), it is possible to deduce a closer relation of Gaulish and Brittonic. But the time interval of one century is so short that alternatively it is legitimate to see here three coordinate branches, Gaulish, Brittonic and Goidelic. What can be said about the absolute dating of their disintegration? The share $56/70 = 0.800$, common for both Gaulish vs. Goidelic and Gaulish vs. Brittonic, corresponds to 16 centuries of divergence. If the results calculating the age of divergence of Goidelic (13 centuries) and Brittonic (12 centuries) are correct, it remains to determine the most probable time of the Gaulish lexical data. It is naturally very difficult to estimate it, if the chronology of inscriptions, glosses, Latin & Romance borrowings and proper names is different. As an approximation the date AD 200 could be accepted. In this case, the average time interval for Gaulish & Goidelic was $(18+13)/2 = 15.5$ centuries and for Gaulish & Brittonic $(18+12)/2 = 15$ centuries BP. In sum with the time interval of divergence of Gaulish vs. Goidelic and Gaulish vs. Brittonic, namely 16 centuries, the beginning of their divergence can be dated to the 32nd or 31st cent. BP, i.e. around 1100 BC. It is exciting that this result is practically the same as the dating of divergence of the Goidelic and Brittonic languages demonstrated above.

The proposed results are summarized in the following tree-diagram:



Appendix: Classical and recalibrated glottochronology

The method called *glottochronology* represents the attempt to date the divergence of the related languages in the absolute chronology. Its author, Morris Swadesh, was inspired by another method, used for dating of the organic remnants, so called radiocarbon method. Let us repeat the main steps in the deduction of the method. In the beginning it was the discovery of the radiocarbon isotope C^{14} , existing in the atmosphere in the share $1 : 10^{12}$ with the usual isotope C^{12} . Thanks to the food-chain, the radioactive isotope occurs in the green plants and consequently in the biological tissues of animals. After the death of any living organism the disintegration of the radioactive isotopes according to the exponential function follows. The exponential disintegration means that after the constant time period T (= half-time of disintegration) the concentration of the radioactive isotope falls in a half, after $2T$ in a quarter, etc. On the basis of this phenomenon, W.F. Libby developed the radiocarbon method (1947), serving to determine the age of the organic remnants younger than 50 millennia. The method was currently defined with more precision (e.g. the change of the half-time from 5568 to 5730 years; correlation with dendrochronology, etc.), but its basic idea remains. Regarding the fact that M. Swadesh borrowed the mathematic apparatus from Libby, it is purposive to repeat it.

(1) $\Delta N(t) = -\lambda \cdot N(t) \cdot \Delta t$... decrease ΔN from N radioactive nuclei in the time interval Δt , where λ is a constant of proportion

(2) $dN(t) = -\lambda \cdot N(t) \cdot dt$... approximation of discrete quantities by connected ones, allowing the integration

$$\int \frac{dN(t)}{N(t)} = \int -\lambda \cdot dt$$

.... leading to the solution

$$\ln N(t) = -\lambda \cdot t + C. \text{ After delogarithmization we reach}$$

$$N(t) = e^{-\lambda t + C} = e^{-\lambda t} \cdot e^C, \text{ where } e^C = K. \text{ We can so write}$$

$$N(t) = K \cdot e^{-\lambda t}.$$

It remains to determine the function of the constant K . It is possible thanks to the initial conditions, i.e. in the time $t = 0$, when $N(t) = N_0$:

(3) $N(t) = N_0 \cdot e^{-\lambda t}$, where N_0 represents the number of the undisintegrated nuclei in the beginning of the process.

From the equation (3), which is a standard solution of the differential equation (2), we deduce the significance of the *half-time of disintegration* T , defined as the time interval, in which the number of the undisintegrated nuclei decrease in $1/2$:

$$(4) \begin{aligned} N(T) &= 1/2 N_0 \\ 1/2 N_0 &= N_0 \cdot e^{-\lambda T}, \text{ after a reduction} \\ 1/2 &= e^{-\lambda T}, \text{ after logarithmization} \\ \ln 1/2 &= -\lambda T, \text{ i.e. } \ln 2 = \lambda T, \text{ or} \end{aligned}$$

$$(5) T = \frac{\ln 2}{\lambda}$$

The half-time of disintegration of the radioactive isotope C^{14} was empirically established as 5730 years. It allows to determine the value of the constant of disintegration λ .

For the practical calculations it is purposive to use the formula, derived from the definition of the half-time of disintegration. If the number of the undisintegrated nuclei decreases in $1/2$ after every time period T , we get:

(6) $N(t) = N_0 \cdot (1/2)^n$, where n means, how many periods T correspond with the age of the specimen. Hence

$$\frac{N(t)}{N_0} = (1/2)^n, \text{ i.e. } \frac{N_0}{N(t)} = 2^n. \text{ Let us logarithmize it:}$$

$$\ln \frac{N_0}{N(t)} = \ln 2^n = n \cdot \ln 2 \quad \text{and we reach}$$

$$(7) n = \frac{\ln \frac{N_0}{N(t)}}{\ln 2}.$$

From here we get the age of the specimen

$$(8) t = n \cdot T.$$

1. Around 1950 Libby's radiocarbon method inspired one American anthropologist and specialist for the native American languages, Morris Swadesh, to application for a development of languages. His purpose became the absolute dating of the time of divergence of the related languages. Swadesh thought that the replacement of words in languages is determined by similar exponential rule like the disintegration of the radioactive nuclei of the isotope C^{14} . He needed to calculate the speed of this change. For this reason he established a testing word-list, consisting first of 215, later of 200 semantic units, which had to be universal and immune from borrowing. Thanks to cooperation with specialists in sinology, egyptology, classical philology, Romance and Germanic linguistics, he was able to determine the average constant of disintegration applied to one millennium, in 19,5% changes in the testing word-list, i.e. in average 80,5% units of the basic word lexicon in a development of one language should be preserved during this period (see Swadesh 1952). Naturally, if the constant is really universal. In 1955

Swadesh published a new study, reflecting the first critical reactions. He radically reduced and changed the testing word-list. The new list consisted of 100 semantic units. On the basis of the reduced 'basic lexicon', the constant of disintegration was changed to 14% per. millennium, i.e. 86% lexical units should be preserved in the development of one language after one millennium. The elementary postulates may be formulated as follows:

[1] In the lexicon of every natural language it is possible to determine the part, which is more stable than others. Let us call it *basic lexicon*.

[2] It is possible to define the set of meanings, expressed in every language by words from the *basic lexicon*. Let us designate it *basic testing list* (BTL). The symbol N_0 will signify the number of various meanings, contained in the list.

[3] The share r of the words from the basic testing list preserved after the constant period Δt , is constant; i.e. it depends only on the length of the time interval, not on a concrete language or a choice of words.

[4] All words representing the basic testing list have equal chances to be preserved during the same time interval.

[5] The probability to be preserved for any unit from the basic testing list does not depend on the probability to be preserved in the basic testing list of another language.

To calculate the time passed between the existence of two languages A and B, where B is a descendant of A, Swadesh used the mathematical apparatus from the radiocarbon method. He began from the equation (3):

(9) $N(t) = N_0 \times e^{-\lambda t}$, where λ represents the analogy to the constant of disintegration in the equation (3). Exactly it is defined as the share of the words in the basic testing list, which are replaced during one millennium. Hence:

$$(10) \frac{N(t)}{N_0} = e^{-\lambda t}, \text{ or } \ln \frac{N(t)}{N_0} = -\lambda t. \text{ From here}$$

$$(11) t = \frac{\ln \frac{N(t)}{N_0}}{-\lambda} \text{ or } \frac{\ln c}{-\lambda}, \text{ where } c = \frac{N(t)}{N_0}$$

If the share r from the postulate (3) is also related to the period of one millennium, it will represent the constant which is complementary to λ , i.e.

$$(12) r = 1 - \lambda.$$

For the decrease of the words from BTS per millennium the equation

$\Delta N = N_0 - N(t_1) = N_0 - N_0 \cdot e^{-\lambda \cdot 1} = N_0 (1 - e^{-\lambda})$ is valid. The same value must be reflected in the product $N_0 \cdot \lambda$. From confrontation $1 - e^{-\lambda} = \lambda = 1 - r$ (see 11) we reach

$$(13) r = e^{-\lambda}.$$

The same result is accessible from confrontation of the right sides of the equations expressing the shares of the preserved words in the BTL per millennium: $N = N_0 \cdot e^{-\lambda \cdot 1}$ and $N = N_0 \cdot r$.

Consequently it is possible to rewrite the equation (10) by means of (13) in the form

$$(14) c = r^t, \text{ where } t \text{ indicates the time in millennia.}$$

Regarding the postulate (5) the share c_2 of the preserved lexicon from the BTL in two related languages, i.e. the languages, developed from a common protolanguage, equal to the square of the share of the words preserved in the individual development:

$$(15) c_2 = (r^t)^2 = r^{2t}. \text{ Logarithmizing it, we express } t:$$

$$\ln c_2 = \ln r^{2t} = 2t \ln r. \text{ From here}$$

$$(16) t = \frac{\ln c_2}{2 \ln r} \text{ or with respect to the equation (13)}$$

$$(17) t = \frac{\ln c_2}{-2\lambda}$$

where c_2 means the share of commonly inherited pairs of the words in BTL in both analyzed languages.

In application of glottochronology the formulae (16) or (17) are used most frequently. For illustration of the practical procedure let us to estimate the time of divergence of German and French. In the BTL of both languages there are 33 pairs of commonly inherited words. Both lists are complete, it means that $c_2 = 0,33$. Applying it for the equations (16) or (17), we reach the time of divergence in millennia:

$$(16') t = \frac{\ln 0,33}{2 \ln 0,86} = \frac{-1,10866}{-0,30164} = 3,675$$

It is more advantageous to calculate a rich set of data with corresponding share of preservation of BTL for one language (c_1) or for two related languages (c_2) – see table 1:

c_1	0,99	0,97	0,95	0,90	0,85	0,80	0,75	0,70	0,65	0,60	0,55	0,50	0,45	0,40	0,35	0,30	0,25	0,20	0,15	0,10
c_2	0,97	0,94	0,90	0,81	0,72	0,64	0,56	0,49	0,42	0,36	0,30	0,25	0,20	0,16	0,12	0,09	0,06	0,04	0,02	0,01
t	0,03	0,20	0,35	0,70	1,10	1,50	1,90	2,40	2,90	3,40	4,00	4,60	5,30	6,10	7,00	8,00	9,30	10,7	13,0	15,3

The time of divergence for German and French occurs in the line for t, corresponding with $c_2 = 0,33$. This value may be approximated between the times 3,40 and 4,00 millennia in the table 1. Concretely it is possible to estimate the age of the common ancestor for German and French as 3700 BP or 1700 BC according to the methodology developed by Swadesh.

The preceding steps operated only with the pair of synchronical languages. It is also necessary to solve the situation, if every of the compared languages was recorded in the different time. Let us designate t_1 and t_2 the times from the disintegration of the common ancestor of the compared languages to their record in various times. In this case the equation (16) can be modified as $2t = \frac{\ln c_2}{\ln r}$, and further

$$(18) t_1 + t_2 = \frac{\ln c}{\ln r}.$$

Since t_1 and t_2 are usually unknown, only their subtraction $\Delta\Delta t_{12}$ is at our disposal, it is possible to substitute the sum $t_1 + t_2$ by $t_1 + t_1 + \Delta\Delta t_{12} = 2t_1 + \Delta\Delta t_{12}$, where t_1 is shorter from both intervals t_1, t_2 . From here for two asynchronously attested languages the final formula looks:

$$(19) t_1 = \frac{\ln c}{2 \ln r} - \frac{\Delta\Delta t_{12}}{2}, \text{ where } t_1 = \min(t_1, t_2).$$

Swadesh' glottochronology was welcome by specialists studying the languages without any longer literary history. In contrary, the sharpest negative reaction was from the specialist in the Indo-European languages. It was understandable: the confrontation of the glottochronological estimations with the safely known facts from the known history of some of the Indo-European languages indicated frequently a big disagreement. More interesting than the aprioristic rejection was the criticism of the concrete premises, postulates, conclusions, especially, if the critics offered their alternative solutions. The most remarkable modifications eliminating some of the weak points of the method were formulated by Canadian Sheila Embleton (1986) and Russian Sergei Starostin (1989, English 1999). Both scholars agree, the 'classical glottochronology' of Swadesh was mistaken that the replacement of the words was not differenced from borrowing. E.g. such innovation was Russian *glaz* „eye“, which replaced common Slavic **oko*. On the other hand, the borrowing probably of Iranian origin is possible to identify in Russian *sobaka* „dog“, besides less frequent *pěs*, which reflects common Slavic **pěsь* „dog“. Starostin offered a simple solution: before any calculation to eliminate all borrowings. Applying this procedure to the testing languages, used for the estimation of the constant of disintegration λ , we reach lower value of the constant and its significantly smaller dispersion (table 3).

Starostin compared the shares of the inherited lexicon in histories of the same languages during various time of divergence, related to one millennium times, concretely in some Romance languages versus Vulgar Latin from the middle of the first mill. AD and versus early classical Latin from the time of Plautus, c. 200 BC. The values of c in the table 2 are calculated already without loans, time is expressed in millennia:

TABLE 2 language	$c = \frac{N(t)}{N_0}, t = 1,5$	$\lambda = \frac{\ln c}{-t}, t = 1,5$	$c = \frac{N(t)}{-t}, t = 2,2$	$\lambda = \frac{\ln c}{-t}, t = 2,2$
French	88/99 = 0,89	0,07	75/97 = 0,77	0,12
Spanish	90/98 = 0,92	0,06	79/97 = 0,80	0,10
Rumunian	87/96 = 0,91	0,06	76/95 = 0,80	0,10

For the differences between the results in the third and fifth columns Starostin finds the only explanation, the formula (11), implying $\lambda = \frac{\ln c}{-t}$, is not valid.

The empirical figures from the table 2 confirm that the optimal approximation is the function

$$\lambda^* = \frac{\lambda}{t} = \frac{\ln c}{-t^2} \quad (20).$$

The preceding thoughts are based on the data in the table 3:

language	age t [millennia]	λ after Swadesh	$\hat{\lambda}\lambda$ without loans	$\lambda\lambda^* = \lambda\lambda / t$
English	1,3	0,14	0,10	0,08
German	1,2	0,08	0,05	0,04
Norwegianish (riksmal)	1,0	0,20	0,05	0,05
Icelandic	1,0	0,06	0,06	0,06
French	1,5	0,09	0,07	0,05
Spanish	1,5	0,07	0,06	0,04
Rumunian	1,5	0,09	0,06	0,04
Japanese	1,2	0,11	0,06	0,05
Chinese	2,6	0,10	0,10	0,04

It is apparent, the dispersion of the ‘constant of disintegration’ λ according to Swadesh is very high, from 6 do 20%. After the elimination of borrowings, the dispersion of this value for the analyzed nine languages varies between 5 ÷ 10%. Still narrower will be the interval in the case, if λ is the function of the time. Abstracting from rather specific English, the value oscilates from 4 to 6%. These results lead Starostin to the new value of the ‘constant of decrease’: $\lambda = 0.05$ per millennium. The situation of English is more complex. It seems its development is faster than it is usual in other languages. This phenomenon is undoubtedly connected with the massive influence of Old Norse in the period 800–1100 and Old French in the following five centuries, causing according to Starostin certain pidgin-like features in English. But even the new value of $\lambda = 5\%$ does not defend against tendency to reach younger data of divergence, especially in the case of longer time periods. Starostin seeks a solution in the following idea. It is empirically proven that individual words in a lexicon of every language, including BTL, are replaced unevenly. If the words in any language would be ordered from least stable to most stable, the words with the lowest stability were replaced most quickly, while the more stable words had a longer life. It means, the speed of changes decreases in time. Summing up, „ c “ is no constant, but the function of time, $c = c(t)$ and the formula (9) should be modified in:

$$(21) N(t) = N_0 \cdot e^{-\lambda \times c(t) \times t^2} \text{ for a development of one language, where } c(t) = \frac{N(t)}{N_0},$$

and

$$(22) N(t) = N_0 \cdot e^{-2\lambda \sqrt{c(t)} \cdot t^2} \text{ for the divergence of two languages, developed from the common protolanguage.}$$

From here it is possible to deduce for the time of development of one language (23), or for the time of divergence of two languages (24):

$$(23) t = \frac{\sqrt{(\ln c)}}{\sqrt{-\lambda \cdot c}}$$

$$(24) t = \frac{\sqrt{(\ln c)}}{\sqrt{(-2\lambda \cdot \sqrt{c})}}$$

The result is the transcendental function, because $c = c(t)$. The easiest way of determination of the time of divergence for the empirically investigated values is offered in the table 4, calculated by Sergei Starostin:

c_1	0,99	0,97	0,95	0,90	0,85	0,80	0,75	0,70	0,65	0,60	0,55	0,50	0,45	0,40	0,35	0,30	0,25	0,20	0,15	0,10
c_2	0,97	0,94	0,90	0,81	0,72	0,64	0,56	0,49	0,42	0,36	0,30	0,25	0,20	0,16	0,12	0,09	0,06	0,04	0,02	0,01
t	0,3	0,8	1,0	1,5	2,0	2,4	2,8	3,2	3,7	4,1	4,7	5,3	6,0	6,8	7,8	9,0	10,7	12,7	16,6	21,5

Now it is possible to return to the question of the time of divergence between German and French. In both languages there are 3 various loans in the BTL and 33 common cognates Hence

$$c_2 = \frac{33}{100-3-3} = \frac{33}{94} = 0.351 = 35,1\%.$$

The corresponding time of divergence is c. 4 220 years. Naturally, it is exaggerated to conclude that two languages were separated in one concrete decade. Better is to use the formulation that their common protolanguage disintegrates in the 23rd cent. BC.

2.1. The situation of two asynchronously attested languages is solved by Starostin differently from Swadesh. Starostin's strategy consists in projection of the historical data in the present level and only after this synchronization the same approach as for living languages is applied for them. It is purposive to demonstrate this procedure on the concrete idioms, e.g. classical Latin e.g. of Caesar (1st cent. BC) and Gothic of Wulfila's translation of the New Testament (4th cent. AD). The Latin corpus (i.e. the 100-word-list) is complete, in the Gothic list 18 units are missing (if Crimean Gothic *ada* „egg“ is included). It means, there are 82 common semantic pairs from the BTL and from them 39 cognates, i.e. etymologically related forms inherited from a common protolanguage. The share 39/82 means 47,6%. The language recorded the time interval Δt ago would preserve till the present c -times less words from BTL. For Latin recorded 20.5 cent. ago it is c. 0.845. If Gothic would exist till the present time, in its hypothetical descendant the share of the preserved BTL was 0.892 (see table 4). The common protolanguage of Latin and Gothic projected in the present would preserve $c_{LG} \cdot c_L \cdot c_G = 0.476 \cdot 0.842 \cdot 0.892 = 0.357$, i.e. 35,7% common words. Let us mention, the result of the comparison of German and French gave the share 0.351. It means, the dating of the divergence of the representants of modern Germanic and Romance languages is practically the same as the dating of the divergence of Latin and Gothic, 23rd cent. BC. It seems to be natural, but for the 'classical glottochronology' it was an unattainable purpose.

Conclusion

The independent calculations of Sergei Starostin and the present authors correlate in dating of the beginning of divergence of Goidelic and Brittonic to 1100BC. Practically the same result was reached for chronology of the disintegration of Gaulish vs. Goidelic and Gaulish vs. Brittonic. The most natural conclusion, which postulates three coordinate branches, neutralizes the long controversy between *p/q* and Insular/Continental models of the classification of the Celtic languages. It is pity the lexical corpus of Celtiberian does not allow a similar test. It is necessary to stress, this dating gives no information about the place of the Celtic dispersion. For the Goidelic languages Starostin supposes a common separation around AD 900. It could be understood as an average of two separations, between Gaelic and Irish-Manx (AD 700), and between Irish and Manx (AD 1025). A closer relationship between Manx and Irish than Manx and Gaelic was proposed by Elsie too (1986, 244). The relative late dating could be explained by the influence of literary Irish for both Manx and Gaelic. The analogous explanation is necessary to apply for the Brittonic languages, where our dating of their disintegration (AD 810) coincides with the beginning of the literary era of Welsh and Breton. But these first fragments are for both idioms so homogenous that frequently it is possible to differentiate them only on the basis of paleography. The dating of the separation of Breton and Cornish to the 12th. cent. (Starostin: 11th cent.) indicates a well-known fact of their permanent contact of this time. The contemporary witness confirms a mutual intelligibility of the Brittonic languages not only in the 9th cent. (Book of Llandâv), but even in the 12th cent. (Giraldus Cambrensis: *Cornubia uero et Armorica Britannia lingua utuntur fere persimili, Cambris tamen, propter originalem conuenientiam, in multis adhuc et fere cunctis intelligibili* – see Kalygin & Korolev 1989, 221–22).

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O APLIKACI GLOTTOCHRONOLOGIE NA KELTSKÉ JAZYKY

Výsledkem naší glottochronologické analýzy keltského materiálu je zjištění, že goidelské a britonské jazyky i galština se od sebe oddělují prakticky ve stejnou dobu, kolem r. 1100 př. Kr. Tento překvapivý záměr smiřuje dva názorové tábory ohledně klasifikace keltských jazyků, předpokládajících p- a q- větve, resp. větev ostrovní versus kontinentální.

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