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# PROCEEDINGS

#### OF THE

# ROYAL IRISH ACADEMY

## VOLUME XXIX



## DUBLIN: HODGES, FIGGIS, & CO., LTD. LONDON: WILLIAMS & NORGATE

### 1911 - 1912

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# PROCEEDINGS

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OF THE

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## SECTION A.—MATHEMATICAL, ASTRONOMICAL, AND PHYSICAL SCIENCE.



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DUBLIN: PRINTED AT THE UNIVERSITY PRESS BY PONSONBY AND GIRRS.

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For Hence we easily . . . . c being the curvature read Hence we find  $\lambda_s = -Z^{-4} (\alpha_3 \beta_s' \gamma_3'' Z''')$ .

Expanding this determinant with the aid of Fresnel's formulae and the expressions for Z, Z', etc., given in par. 52, we find  $\lambda_s = Z^{-4}c^2\sigma^3$ 

### PROCEEDINGS

OF

### THE ROYAL IRISH ACADEMY

#### PAPERS READ BEFORE THE ACADEMY

#### I.

### ON THE APPLICATION OF QUATERNIONS TO SOME RECENT DEVELOPMENTS OF ELECTRICAL THEORY.

BY ARTHUR W. CONWAY, M.A. (OXON. AND R.U.I.), D.Sc., Professor of Mathematical Physics, University College, Dublin.

Read FEBRUARY 13. Published MARCH 22, 1911.

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#### § 1. INTRODUCTION.

THE development of the mathematical theory of electrons has, in the hands of various continental mathematicians, been largely expressed in some notation of vector algebra.\* Although (necessarily from the algebra employed) no use is made of quaternion products, still the results are distinguished by a conciseness and clearness, both of which often disappear on translation to the Cartesian form. It so happens, however, that two of the most recent developments are such that if one attempts to treat them by vector methods (without the use of quaternions), it leads to expressions more complicated than the ordinary scalar methods. I refer to Poincaré'st Fredholm solutions of the electrodynamic equations, and to the transformation connected with

[1]

<sup>\*</sup> Cf. Abraham and Föppl's Theorie der Electricität. For quaternion treatments reference might be made to the Proceedings of the Royal Irish Academy, vol. xxvii., Sect. A, No. 8, and vol. xxviii., Sect. A, No. 1.

<sup>†</sup> Poincaré: Comptes Rendus Nos. 8, 13, 15, 23 (1909), and Rendiconti del' Circolo Matematico di Palermo, tomo xxix., p. 169.

R.I.A. PROC., VOL. XXIX., SECT. A.

the Relativity principle as developed by Lorentz, Larmor, and especially by Einstein."

It is the purpose of this Paper to show that a quaternion method can be employed which gives the required conciseness to the results, and which readily indicates new theorems. The notation of Hamilton is employed throughout, but for the purpose of clearness clarendon type is employed for quaternions. The Operator  $\Delta^+$  corresponds to  $\nabla$ , but is supposed to act on every part of the term in which it occurs. The algebraic imaginary  $\sqrt{-1}$ is denoted by  $h.\ddagger$ 

#### § 2. FUNDAMENTAL FORMULAE AND EXAMPLES.

If  $\varepsilon$  denotes the electric force, and  $\eta$  the magnetic force, we have the fundamental equations in free aether,

$$e^{-\varepsilon}\varepsilon = \nabla \eta, - \dot{\eta} = \nabla \varepsilon.$$

the units being electrostatic. It follows that the constant c is the speed of radiation. If we multiply the upper equation by hc, and add it to the lower, both equations are included in the single equation

$$(\nabla - h e^{-i} \hat{c}_i \hat{c} t) (\varepsilon + h e \eta) = 0.$$

If we denote the biquaternion (in Hamilton's sense) operator  $\nabla - hc^{-1}\hat{c}/\hat{c}t$ by q, and the bivector  $\varepsilon + hc\eta$  by  $\sigma$ , we have the equations expressed in the forms

$$T \sigma = 0.$$

If there is present a current  $\iota$  and a volume-density e, the fundamental equations are

$$\begin{split} e^{-2} \left( \varepsilon + 4\pi \iota \right) &= T \nabla \eta, \\ - \dot{\eta} &= T \nabla \varepsilon. \end{split}$$

together with the equation of continuity

 $\hat{e} = S \nabla_{t_{\tau}}$ 

\* Einstein : Annalem der Physik, 17 and 18 (1905), 20 and 21 (1906), 23 (1907).

† M'Aulay : The Utility of Quaternions in Physics. p. 13.

 $\mathbf{2}$ 

<sup>#</sup> Hamilton's Elements of Quaternions, vol. i., p. 290.

<sup>:</sup> The bivector is employed by Weber: Die partiellen differentialgleichungen der math. Physik; and by Silberstein: Annalen der Physik. 24 (1907). The further step of using the biquaternion was given by the author at the British Association Meeting at Dublin (1908). An equivalent formula, but expressed in the matrix notation, was given by the late **H**. Minkowski in a remarkable paper in the Nach. Göttingen (1908), p. 53. In E. B. Wilson's edition of Gibbs' Vector Analysis it is stated that Gibbs used the bivector in his lectures on Physical Optics. Many of the properties of the operator q were given by the late Prof. C. J. Joly as questions in a Fellowship Examination in the R val University (1900).

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We have also  $S\nabla \eta = 0$  from the second equation, and thus we get the quaternion equations

$$e^{-2}(\dot{\varepsilon} + 4\pi\iota) = \nabla\eta, - \dot{\eta} - 4\pi e = \nabla e,$$

so that as before we get

$$\left(\nabla - hc^{-1}\partial/\partial t\right)\left(\varepsilon + hc\eta\right) = -4\pi\left(e - hc^{-1}\iota\right)$$

or, if we introduce the biquaternion  $\mathbf{e} = e - h c^{-1} \iota$ ,

$$T\sigma = -4\pi e.$$

Several modifications of this may be noticed. Let the result of changing h into -h in a quantity like  $\sigma$  be denoted by  $\sigma_0$ . Then we have

	$\mathcal{T}_{0}\sigma_{0}=-4\pi\mathbf{e}_{0}.$
Also,	$K\sigma KD = K(\sigma\sigma) = -4\pi Ke,$
or	$\sigma D_0 = -4\pi \mathbf{e}_0.$
In like manner,	$\sigma_0 D = -4\pi e,$
where	$D = \Delta - hc^{-1}\partial/\partial t.$

If we introduce a scalar potential p and a vector potential  $\boldsymbol{\varpi}$ , we have

	$\varepsilon = -\nabla p - \dot{\varpi},$
	$\eta = V \nabla \varpi,$
where	$c^{-2}\dot{p} = S\nabla \varpi.$
We thus get	$\epsilon + hc\eta = -(\nabla + hc^{-1}\partial/\partial t)(p - hc\varpi);$
or, if we put	$p - hc \varpi = \mathbf{p}$ , we have $\sigma = - \mathcal{Q}_0 \mathbf{p}$ .

We may notice that in free aether

$$\mathcal{I}\boldsymbol{\sigma} = -\mathcal{I}\mathcal{I}_{0}\mathbf{p} = 0,$$

and that if there is volume-density of electricity,

$$\mathcal{Q}\boldsymbol{\sigma} = -\mathcal{Q}\mathcal{Q}_{0}\cdot\mathbf{p} = -4\pi\mathbf{e},$$
$$(\nabla^{2} + c^{-2}\partial^{2}/\partial t^{2})\mathbf{p} = 4\pi\mathbf{e}.$$

If we denote\* by [e'], the effect of replacing t in the value of e' at a point  $\rho'$  by  $t - c^{-1}T(\rho - \rho')$ , we have

$$p = \int dv' [e'] T(\rho - \rho')^{-1},$$

where dv' is a volume-element, and

$$\varpi = c^{-2} \int dv' [\iota'] T(\rho - \rho').$$
  
Then  $\mathbf{p} = p - hc \varpi = \int dv' [\mathbf{e}'] T(\rho - \rho')^{-1}$ 

\* This convenient notation is employed by Lorentz; cf. The Theory of Electrons, p. 19.

 $\mathbf{or}$ 

ŧ

If the electricity appears as a surface-density,

$$\mathbf{p} = \int T d\nu' [\mathbf{e}'] T(\rho - \rho')^{-1},$$

where  $d\nu'$  is a directed surface-element at the place  $\rho'$ . In this case, we have

$$\sigma = - \mathcal{Q}_0 p = - \mathcal{Q}_0 \int T d\nu' [\mathbf{e}'] T (\rho - \rho')^{-1}.$$

If we take the point  $\rho$  just outside the surface (which is supposed fixed), and if we let  $\sigma_i$  denote the value of  $\sigma$  at a neighbouring point just outside the surface, then, in calculating  $\sigma - \sigma_i$  from the formulae just written down, the only part which need be considered is that arising from the part of  $\nabla_{\tau}$ estimated normal to the surface, so that

$$\sigma - \sigma_i = -\nu^{-1} S \nu \nabla \int T d\nu' [\mathbf{e}] T(\rho - \rho')^{-1} + \nu^{-1} S \nu \nabla_i \int T d\nu' [\mathbf{e}] T(\rho_i - \rho')^{-1},$$

where, in the second integral,  $\rho$  is replaced by  $\rho_i$ ; and, by the usual theory of such integrals, suitable restrictions being placed on the function **e**, and the form of the surface near  $\rho$ , we find

$$\sigma - \sigma_i = 4\pi U \nu e.$$

If the surface is a conductor, and if there is no electric or magnetic force inside, the boundary conditions are all summed up in  $\sigma = 4\pi U_{\nu} \mathbf{e}$ , or

$$\varepsilon = 4\pi U \nu c, \qquad \eta = 4\pi c^{-2} \iota U \nu.$$

In the more complicated case of a surface moving with a velocity  $\tau$ , we can take the origin moving with the surface, and the vector  $\rho$  is a function of the time, so that  $\partial \rho / \partial t = S \tau \rho$ , and the operator  $\partial / \partial t = S t \nabla$ , when applied to functions of  $\rho$ . As before, it is only the part of  $\nabla$  normal to the surface which gives any result, so that we can replace  $S \tau \nabla$  by  $S \tau \nu^{-1} S \nu \nabla$ . Hence the effective part of  $\mathcal{Q}_0$  is  $(\nu^{-1} + hcS\tau\nu^{-1})S\nu\nabla$ , and we get for a conductor, under the same conditions as before,

$$\boldsymbol{\sigma} = (U\boldsymbol{\nu} + hcS\tau\partial\boldsymbol{\nu})\,\mathbf{e}.$$

(In the application of this formula, we must take care to include the convection current in the current relative to the surface.)

If we consider the quaternion

$$-(8\pi)^{-1}\sigma\sigma_0 = \mathbf{q} \text{ (say)},$$

we have the theorems that  $S\mathbf{q}$  is the electromagnetic energy per unit-volume, and  $V\mathbf{q}$  has the direction of the Poynting flue and of the electromagnetic momentum. Since in free space

$$\mathcal{T}_0\sigma_0=\sigma D_0=0,$$

we have in such space

or 
$$- (8\pi)^{-1} \int \sigma D_0 \sigma_0 dv = 0,$$
  
$$- (8\pi)^{-1} \int \sigma \Delta \sigma_0 dv - hc^{-1} \int \partial \mathbf{q} / \partial t_0 dv = 0,$$

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 $\mathbf{5}$ 

which becomes, on transforming by Green's theorem,

$$\int \partial \mathbf{q}/dt \, dv = (8\pi)^{-1} c \int \sigma d\nu \sigma_0.$$

The scalar part of this equation is Poynting's theorem, and the vector part expresses the theorem that the rate of change of electromagnetic momentum is balanced by the Maxwellian stresses over the surface. If the space contains electricity, we will have an additional term

 $-\frac{1}{2}hc\int (\mathbf{e}_{0}\boldsymbol{\sigma}_{0}+\boldsymbol{\sigma}\mathbf{e}_{0})\,dv,$ 

of which the scalar part is the activity of the electric forces, and the vector part is the resultant of the mechanical forces. By the aid of the theorem, which is not difficult to verify, that the expression  $V\rho V\sigma D_0 \sigma_0$  has the same value, whether  $D_0$  acts on  $\rho$  or not, we can prove a similar theorem about angular momentum.

The integral  $\iint \sigma^2 dv dt$  has some interesting properties. The first variation of it is  $\iint 2S\sigma\delta\sigma dv dt$  or  $-2\iint S\sigma \mathcal{I}_0 \delta \mathbf{p} dv dt$ , which is equal to  $-2\iint S\sigma \mathcal{D}_0 \delta \mathbf{p} dv dt$ ,

since  $\sigma D_0 = 0$  in free space. This latter integral can be replaced by a triple integral on separating  $D_0$  into its parts  $\Delta$  and  $hc^{-1}\partial/\partial t$ , and applying Green's theorem to the former, and an integration with respect to t to the latter. Hence the first variation vanishes with suitable boundary conditions. It will be found, on taking the real part of  $\int \int \sigma^2 dv dt$ , that we reproduce the Principle of Least Action as formulated by Larmor,\* and, on taking the imaginary part, we find that  $\partial \int \int S_{\epsilon\eta} dv dt = 0$ , a theorem which is perhaps new.

We give here a comparison of our results with the formulae of electrostatics. In the left-hand column we have the latter formulae, and in the right the general formulae or analogues.

$\boldsymbol{\varepsilon} = -\nabla p.$ (Definition of potential.)	$\sigma = - \mathcal{Q}_{0} \mathbf{p}.$
$\nabla \sigma = -4\pi e.$ (Poisson's equation.)	$\sigma = -4\pi \mathbf{e}.$
$p = \Sigma e' T(\rho - \rho')^{-1}.$	$\mathbf{p} = \Sigma \left[ \mathbf{e}' \right] T (\rho - \rho')^{-1}.$
$-(8\pi)^{-1}\epsilon^2$ . (Energy per unit-volume.)	$-(8\pi)^{-1}\sigma\sigma_0.$
$\varepsilon = 4\pi U \nu e.$ (At surface of conductor.)	$\sigma = 4\pi U \nu e.$
$\boldsymbol{\varepsilon} = 2\boldsymbol{\pi} U\boldsymbol{\nu}\boldsymbol{e} + \boldsymbol{\nabla} \int T d\boldsymbol{\nu} \boldsymbol{e}' \boldsymbol{T} (\boldsymbol{\rho} - \boldsymbol{\rho}')^{-1}.$	$\boldsymbol{\sigma} = 2\pi U \boldsymbol{\nu} \mathbf{e} + \boldsymbol{\mathcal{I}}_{\boldsymbol{\nu}} \int T d\boldsymbol{\nu}' [\mathbf{e}'] T (\boldsymbol{\rho} - \boldsymbol{\rho}')^{-1} \boldsymbol{\bullet}$
(Integral equation at surface	
of conductor.)	

\* Larmor; Aether and Matter, p. 82.

### Proceedings of the Royal Irish Academy.

#### § 3. On Fredholm Solutions.

If a conductor is placed in a field of force  $\sigma$ , a distribution  $\mathbf{e}$  will be on the surface which will satisfy the condition that the field produced inside the conductor is annulled by  $\sigma$ , which gives the quaternion integral equation

$$\boldsymbol{\sigma} = 2\pi U \boldsymbol{\nu} \mathbf{e} + \int T d\boldsymbol{\nu}' \boldsymbol{\mathcal{I}}_0 \left[ \mathbf{e}' \right] T (\boldsymbol{\rho} - \boldsymbol{\rho}')^{-1}.$$

Our object is to obtain equations of the Fredholm type from this. If we take the real part, we find

$$\begin{aligned} \boldsymbol{\varepsilon} &= 2\pi \boldsymbol{U}\boldsymbol{\nu}\boldsymbol{e} + \nabla \int \boldsymbol{T}\boldsymbol{d}\boldsymbol{\nu}' \begin{bmatrix} \boldsymbol{e}' \end{bmatrix} \boldsymbol{T}(\boldsymbol{\rho} - \boldsymbol{\rho}')^{\boldsymbol{1}} \\ &+ \boldsymbol{e}^{-2}\partial/\partial t \int \boldsymbol{T}\boldsymbol{d}\boldsymbol{\nu}' \begin{bmatrix} \boldsymbol{\iota}' \end{bmatrix} \boldsymbol{T}(\boldsymbol{\rho} - \boldsymbol{\rho}')^{-1}. \end{aligned}$$

If in place of  $\epsilon$  we had a force  $\epsilon \exp(kt)$ , where k may be complex, and where  $\epsilon$  is independent of t, then e is replaced by  $e \exp(kt)$ , and [e'] by

$$e \exp\left[kt - ke^{-1}T(\rho - \rho')\right].$$

Writing f for  $\exp \left[kt - ke^{-1}T(\rho - \rho')\right]$ .  $T(\rho - \rho')^{-1}$ , the equation thus becomes  $\varepsilon = 2\pi U\nu e + \nabla \int Td\nu' e'f + ke^{-2} \int Td\nu' \iota' f$ .

We thus get a scalar integral equation

 $-S_{\varepsilon}U_{\nu} = 2\pi e + \int e' T d\nu' S U_{\nu} \nabla' f - k e^{-2} \int T d\nu' S \iota U_{\nu} f.$ 

The second integral requires to be transformed into a function of e. This is effected by the aid of Stokes's theorem in the form  $\int F(Vd\nu'\Delta') = 0$ , where  $F(Vd\nu'\Delta')$  denotes a linear function of  $Vd\nu'\Delta'$ , and the surface-integral extends over any closed surface, with certain conditions as to the singularities of the function. We have the equation of continuity on the surface

 $S(Vd\nu'\nabla \cdot \iota'U\nu') = -eTd\nu'.$ 

If we now take a function g, which has no infinities except at the point  $\rho$ , and which satisfies the equation  $f = (U\nu' V U\nu' \nabla)^2 g$ , and if we take the function  $\lambda$  such that  $\lambda = V\nu' V U\nu' \nabla'$ . g, the integral

$$\int T d\nu' \iota' f = \int \iota' U\nu' V d\nu' \nabla' \cdot \lambda,$$
  
so that 
$$\int T d\nu' S\iota' U\nu \cdot f = \int S\iota' U\nu' V d\nu' \nabla' \cdot \lambda U\nu,$$

which, by Stokes's theorem,

$$= \int S U \nu \lambda V d\nu \nabla', U\nu', \iota'$$
  
=  $- \int e^2 T d\nu' S U \nu \lambda + \int S U \nu \lambda V (V d\nu \nabla', U\nu' \iota').$ 

If  $\iota'$  is such that  $V(Vd\nu'\nabla', U\nu'\iota') = 0$ , then the transformation is effected. This latter condition is

$$\iota' S d\nu' \nabla' U\nu' - U\nu' S d\nu' \nabla' \iota' = 0,$$

or  $Sd\nu'\nabla'\iota' = 0$ , which can be expressed in various ways such as that  $S\iota'd\rho'$ 

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is a perfect differential, or that i' is "irrotational" on the surface. If this condition is fulfilled, we have

$$-S_{\varepsilon}U\nu = 2\pi e + \left(e'Td\nu'SU\nu\left(\nabla'f - k^{2}c^{-2}\lambda\right)\right);$$

and this is of the required form, for we can easily see that g possesses only a logarithmic infinity, and that hence the integral is of the Fredholm type.

If we take the coefficient of h in the original equation, we have

$$c^{2}\eta = 2\pi \iota U\nu - \int V \nabla f \iota' T d\nu'.$$
  
Now  $\int V \nabla f \iota' T d\nu' = \int V \iota' \nabla' f T d\nu'$  (since  $\nabla f = -\nabla' f$ )  
 $= -\int V \iota' U\nu' V d\nu' \Delta' f - \int V \iota' U\nu' S d\nu' \nabla'. f$ ,

and  $(V_i'U_{\nu}'Vd_{\nu}'\nabla' f = (V_iVd_{\nu}'\nabla' f \cdot VU_{\nu}'i') = -(U_{\nu}'S_i'd_{\nu}'\nabla' f \cdot VU_{\nu}'i')$ 

Hence  $c^2\eta = 2\pi \iota U\nu + \int \iota' U\nu' S d\nu' \nabla' f - \int U\nu' S \iota' d\nu' \nabla' f,$ 

and  $c^2 \nabla \eta U \nu = -2\pi \iota + \int V_{\iota}' U \nu' U \nu S d\nu' \nabla' f - \int V U \nu U \nu' S_{\iota}' d\nu' \nabla' f,$ 

which is a vector integral equation of Fredholm type.

The solution of M. Poincaré is somewhat different, and can be obtained as follows :---

By Stokes's theorem,

$$\int V(\iota' U\nu' V d\nu' \nabla') f = \int f V(V d\nu' \nabla \iota' U\nu') = \int f U\nu' S\iota' d\nu' \nabla . U\nu' + \int f U\nu' S d\nu' \nabla' \iota'.$$

Applying Stokes's theorem\* again to the last integral, we find

 $\int f U \nu' S d\nu' \nabla' \iota' = -S \iota' d\nu' \nabla' . f U \nu'.$ 

Making use of this, we get

$$c^{3}V\eta U\nu = -2\pi\iota + \int V\iota' U\nu' U\nu Sd\nu'\nabla' f - \int f V U\nu' S\iota' d\nu'\nabla' U\nu' U\nu + \int S\iota' d\nu'\nabla f V U\nu' U\nu.$$

#### § 4. ON THE RELATIVITY PRINCIPLE.

Before coming to the principle of relativity let us solve this quaternion problem :—What is the most general form of the linear functions  $f_1()$ ,  $f_2()$ ,  $f_3()$ , so that for any two quaternions **p** and **q** 

$$f_1(\mathbf{p})f_2(\mathbf{q}) = f_3(\mathbf{p}\mathbf{q}),$$

and in which  $Sf_2(\rho) = 0$  where  $\rho$  is a vector ?

On putting successively  $\mathbf{p} = 1$  and  $\mathbf{q} = 1$  we get

$$f_1(\mathbf{p})f_2(1) = f_3(\mathbf{p})$$
 and  $f_1(1)f_2(\mathbf{q}) = f_3(\mathbf{q})$ .

\* The actual equation given by Poincaré, Rendiconti del Circolo Matematico, di Palermo, tomo xxix (1910), p. 186, equation (3), is (in our notation),

 $\int f U \boldsymbol{\nu}' S d\boldsymbol{\nu}' \boldsymbol{\nabla}' \boldsymbol{\iota}' = - \int S \boldsymbol{\iota}' \boldsymbol{\nabla}' \cdot f U \boldsymbol{\nu}',$ 

which appears to be erroneous.

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If we introduce a function  $g(\mathbf{p})$  such that  $f_1(1)g(\mathbf{p})f_2(1) = f_3(\mathbf{p})$ , we have  $f_1(\mathbf{p}) = f_1(1)g(\mathbf{p}), \quad f_2(\mathbf{p}) = g(\mathbf{p})f_2(1),$  and the equation becomes

$$g(\mathbf{p})g(\mathbf{q}) = g(\mathbf{pq}).$$

This involves  $g(\mathbf{p}) = 1$ , and taking scalars  $S\mathbf{p}g'g(\mathbf{q}) = S\mathbf{p}\mathbf{q}$  so that g'g = 1.

The general solution of this equation, subject to g(1) = 1, is\*

$$g() = \pm \mathbf{a}() \mathbf{a}^{-1}.$$

Hence since  $f_2(\mathbf{p}) = \mathbf{a}p\mathbf{a}^{-1}f_2(1)$ , we must have  $f_2(1) = 1$ : and we get finally

$$f_1(\mathbf{p}) = \mathbf{b}\mathbf{p}\mathbf{a}^{-1},$$
  
 $f_2(\mathbf{p}) = \mathbf{a}\mathbf{p}\mathbf{a}^{-1},$   
 $f_3(\mathbf{p}) = \mathbf{b}\mathbf{p}\mathbf{a}^{-1}.$ 

Let **q** be the quaternion  $\rho - hct$ ; then the symbol of differentiation  $d = -Sd\mathbf{q}q.$ 

If we suppose a linear transformation  $\mathbf{q}' = f(\mathbf{q})$ , we get

 $d = -Sd\mathbf{q}'\mathbf{q}' = -Sd\mathbf{q}f'(\mathbf{q}') = -Sd\mathbf{q}\mathbf{q}, \text{ so that } \mathbf{q} = f'(\mathbf{q}').$ 

If the "force"  $\sigma$  is transformed by  $\sigma = F(\sigma')$ , then the general expression  $\sigma$  becomes  $f'(\sigma')F(\sigma')$ ;

and if we require this to be a linear function of  $Q'\sigma'$ , then, as above, we must have  $f'() = \mathbf{b}()\mathbf{a}^{-1}$  and  $F() = \mathbf{a}()\mathbf{a}^{-1}$  by the last section. Hence  $Q\sigma = -4\pi\mathbf{e}$  becomes  $Q'\sigma' = -4\pi\mathbf{e}$  where  $\mathbf{e} = \mathbf{b}\mathbf{e}'^{-1}\mathbf{a}^{-1}$ .

We can now deduce the usual equations of relativity from the following principles:—1°. A charge e moving with velocity  $\lambda$  to transform into a charge e' at rest. 2°. A charge e' at rest to transform into a charge moving with velocity  $-\lambda$ . In 1° we have  $\mathbf{e} = (1 - he^{-1}\lambda)e$ . In 2° we have  $\mathbf{e} = e'$ .

We thus get 
$$c(1 - hc^{-1}\lambda) = \mathbf{b}\mathbf{a}^{+}c$$
,  
 $e' = \mathbf{b}(1 + hc^{-1}\lambda)\mathbf{a}^{-1}c$ ,  
and it easily follows that  
 $c/c' = 1/\sqrt{1 + c^{-2}\lambda^{2}}$   
 $\mathbf{b}^{-1} = \mathbf{a} = (1 - hc^{-1}\lambda)^{\frac{1}{2}}(1 + c^{-2}\lambda^{2})^{-\frac{1}{4}}$ ,

so that the relativity transformations are

$$\begin{array}{rcl}
 \mathcal{Q} &= \mathbf{a}^{-1} \mathcal{Q}' \mathbf{a}^{-1}, \\
 \sigma &= \mathbf{a} \sigma' \mathbf{a}^{-1}, \\
 e &= \mathbf{a}^{-1} \mathbf{e}' \mathbf{a}^{-1}.
\end{array}$$

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<sup>\*</sup> Joly : Manual of Quaternions, p. 283.

<sup>&</sup>lt;sup>†</sup> We can easily see that  $b^{-1}$  and **a** have the same axis, and the condition that Se must be real makes  $b^{-1} = a$ .

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As a last example of quaternion treatment we consider an interesting extension of the relativity principle by Bateman and Cunningham.\*

 $q' = q^{-1},$ 

Consider the transformation

$$d\mathbf{q}' = -\mathbf{q}^{-1}d\mathbf{q}\mathbf{q}^{-1}$$
 and  $\mathbf{q}' = \mathbf{q}\mathbf{q}(\mathbf{q})$ 

where we denote by a bracket a quantity which is not operated on by q.

$$q = \mathbf{q}' q'(\mathbf{q}').$$

If we put  $\sigma = \mathbf{q}^{\prime-1}\sigma'\mathbf{q}'m$ , where *m* is some scalar function of *q'*, we have

$$\begin{aligned} \mathcal{Q}\sigma &= \mathbf{q}'\mathcal{Q}'(\mathbf{q}')\mathbf{q}'^{-1}\sigma'\mathbf{q}'m = \mathbf{q}'\mathcal{Q}'\sigma'\mathbf{q}'m + 4\sigma'\mathbf{q}' \\ &= m\mathbf{q}'(\mathcal{Q}'\sigma')\mathbf{q}' + \mathbf{q}'(\mathcal{Q}'m)\sigma'\mathbf{q}' + m4\sigma'\mathbf{q}^{-1}, \\ &\qquad \mathcal{Q}'(\sigma')\mathbf{q}' = 0. \end{aligned}$$

since

Hence the "relativity" form is attained if  $\mathbf{q}'\mathbf{T}'m + 4m = 0$ . Hence *m* is obviously a function of  $T\mathbf{q}'$ .

$$\frac{dm}{m} = -\frac{1}{m} S d\mathbf{q}' \mathbf{q}' m = 4S d\mathbf{q}' \mathbf{q}'^{-1} = 4dT \mathbf{q}' (T\mathbf{q}')^{-1}, \text{ so that } m = (Tq')^4.$$

\* Proceedings of the London Math. Society, series 11, vol. viii, Nos. 1, 2, 3, and 4.

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#### П.

# EXTENSIONS OF FOURIER'S AND THE BESSEL-FOURIER THEOREMS.

#### EMENDATIONS AND ADDITIONS TO A PREVIOUS PAPER.

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Read FEBRUARY 13. Published MAY 13, 1911.

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#### ART. 1. Minor Corrections.

I WOULD first make certain minor corrections to my previous paper (R.I.A. Proc., xxvii., A, No. 11), as follows :---

p. 215, l. 6. Insert  $\phi(\rho)$  as a factor in the integrand.

p. 219, l. 4. After "equation" add "unless arg.  $\lambda = \pi$ , when it is finite or zero".

p. 219, l. 26. As a foot-note read :—"When arg.  $\lambda$  is very near  $\pi$ , we must use an expansion different from that which is valid when arg.  $\lambda$  is small; this may be done by introducing additional terms which involve  $e^{i\lambda\rho}$  as a factor; these contribute nothing to the double integral."

p. 220, l. 15. Insert  $r^{\frac{1}{2}}$  as a factor in the integrand.

pp. 223, 225. In equations (63), (64), if we adhere to the contour at infinity, we may add to it an infinite quadrant at each end and then halve the result. The same is true of (69) with the second or the third form of the left-hand member. We thus obtain a closed contour, though the initial and the final values of the integrand differ. Also conditions as to the zeros of the denominator are irrelevant so long as the contour is kept at infinity.

If we take the first form of the left-hand member of (69), when F(ix) is  $\sum_{p} f_{p}(x) (d/dx)^{p} K_{n}(ix)$ , F(-ix) should be  $\sum_{p} f_{p}(x) (d/dx)^{p} K_{n}(-ix)$ ; and, in the same form, if  $F(i\lambda a)$  is  $K_{m}(i\lambda a)$ ,  $F(-i\lambda a)$  should be  $(-)^{m-n} K_{m}(-i\lambda a)$ , while the derivatives referred to should be of both of these with respect to  $\lambda a$ . (The point to be secured is that (66), as corrected below, should hold when  $K_{n}$  is replaced by F.)

p. 224. The factor i should be omitted from the last term of the left-hand member of equation (66).

p. 225, l. 3 from foot. The value which is given should have a minus sign prefixed.

p. 230, l. 5. It is unnecessary that the initial disturbance should be limited externally.

p. 231. In (76) for " $\lambda \sin \lambda u - \kappa \cos \lambda u$ " read " $\lambda \cos \lambda u + \kappa \sin \lambda u$ ".

p. 242, l. 21. If  $F_1(\lambda \alpha)$  is  $J_m(\lambda \alpha)$  or a derivate,  $F_2(\lambda \alpha)$  is  $(-)^{m-n}J_{-m}(\lambda \alpha)$  or its corresponding derivate.

p. 243. When *n* is negative, (52) cannot be obtained precisely as stated. For, when *a* becomes zero,  $F_2(\lambda a)$  will always dominate  $F_1(\lambda a)$  if these are of the type given in (45), (46). The equation may be regarded as a limiting case of a somewhat more general theorem than that expressed by (49). Or it may

 $[2^*]$ 

be obtained by subtracting from the ordinary Bessel integral equation the proper multiple of the equation

$$\underset{h=x}{\text{Lt.}} \int_{-\hbar}^{\hbar} \frac{\lambda J_n(\lambda r) \sum_{p} F_p(\lambda) (d/db)^p K_n(-i\lambda b) \int_{-\pi}^{b} J_n(\lambda \rho) \rho \phi(\rho) d\rho}{\sum_{p} F_p(\lambda) (d/db)^p J_n(\lambda b)} = 0,$$

which it is not difficult to establish by the methods of the paper.

And as, in the latter method just referred to, expansions (52), (53B) of Part I. are required for + n only, a sufficient condition to be satisfied by  $\phi$ in the neighbourhood of  $\rho = 0$ , for the validity of (52), p. 243, is that

$$\int_{0} |\rho^{\frac{1}{2}} \phi(\rho)| d\rho \text{ and } \int_{0} |\rho^{1+n} \phi(\rho)| d\rho$$

should both converge: it must not be forgotten that + n itself may be negative. (The condition stated on p. 243 was intended to require that the above and

 $\int_0 |\rho^{1-n}\phi(\rho)| d\rho$ 

also should converge, but it does not fulfil the intention.)

pp. 243 et seq. In Arts. 5, 6, it is supposed that  $\alpha$  is not zero.

p. 244. From the coefficient of  $\phi$  in (58) delete "1".

#### ART. 2. Defects of the former Expansions, especially in regard to Differentiability and Uniqueness.

I proceed to consider more serious defects.

In the case of the new expansions obtained (equations (12), (69), Part I., and (25), (49), Part II.), I suggested (pp. 226, 238) that they are not unique.

It was also seen (Part I., Arts. 15, 17; Part II., Art. 5) that, as in the wellknown cases of the simple Fourier expansions, those equations expressing the expansion of an arbitrary function of x cannot usually be differentiated, term by term (once or repeatedly), with respect to x.

I did not at first give much attention to these points in the case of the most general results, and, in the previous paper, merely justified the applications to problems in vibratory motion of the expansions appropriate to the boundary condition expressed by the equation

$$\left(\frac{d}{dx}-h\right)\boldsymbol{\phi}=0,$$

where h is a constant given arbitrarily, and having in general different values at the two boundaries, if there are two. Indeed, to some extent I regarded the expansions of a more general type than these as curiosities of Pure

<sup>\*</sup> For particular cases of this equation, compare Carslaw, "Fourier Series and Integrals,"  $\S$  162-164.

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Mathematics, especially as the type of problem which suggested them can, as indicated, be solved without them by the aid of Love's general functional solutions of the differential equation.\*

Such expansions may, however, be used in problems of other types than those which suggested them. For example, Lord Rayleigh, to illustrate the effect of a yielding of the points of support of a vibrating string, has discussed<sup>†</sup> its motion on the supposition that each end is attached to a massive particle which is urged by a spring towards the position of equilibrium. He obtained, without formally establishing its validity, the expansion which is necessary in the resolution of the most general motion possible into the fundamental oscillations; this expansion is an example, slightly more difficult than that just alluded to, of the development in Trigonometrical Series which I established. So, too, if the single particle at each end be replaced by a number elastically connected, to one or more of which the string is attached, and if the motion be investigated in a similar mauner, still more complicated examples present themselves.

Moreover, in problems of this type, the boundary conditions might be such that, of the type-solutions of the differential equations, the two which contain respectively  $\ddagger e^{i\lambda et}$  and  $e^{-i\lambda et}$  involve different functions of x, and thus cannot be combined so as to contain the sine or the cosine function alone of the time: this would, for instance, be the case, if the particle or particles were subject to frictional forces proportional to the actual or to the relative velocities. Thus, in such a case, the expansions in my paper would appear not to be precisely those which are requisite.

And in proceeding to remedy this defect I noticed, much to my regret, that the expansions which I gave are so far wanting in uniqueness and generality that they make reference to only one arbitrary function, whereas they may be required to satisfy conditions which explicitly refer to two.§ In this connexion it is to be borne in mind that, in many cases in which the characteristic values of  $\lambda$  can be grouped in pairs, equal in magnitude and opposite in sign, the series of the former paper includes each term twice, whereas the usual statements of expansions of Fourier type include each term once only.

 $\ddagger c$  denotes the velocity of propagation, and t the time.

§ In the solution of problems relative to Conduction of Heat, it does not seem that such an extension is likely to be wanted.

<sup>\*</sup> Love, Phil. Trans., excvii., 1901; see also Lord Kelvin, "Baltimore Lectures," p. 193. When it is desired to follow the history of a given disturbance in any medium, a solution which is derived from the general functional solution, whenever obtainable, of the differential equation, whatever it may be, seems usually preferable to one of Fourier type. Moreover, as will be seen below, it is a matter of considerable difficulty to justify formally the solution which the quasi-Fourier treatment gives.

t "Theory of Sound," § 135.

The conditions which most naturally present themselves in physical problems are that, when each element of the sum, or integral, is multiplied by the corresponding value of  $e^{i\lambda ct}$ , the initial values of the sum and of its differential coefficient with respect to time shall each be functions of x which are arbitrarily assigned.\*

#### ART. 3. The Expansion in Trigonometrical Series modified so as to refer to Two Arbitrary Functions.

Seeking first, as being of most interest, the Trigonometrical Sum theorem which is now required, we have the following problem, modified from that of Part II., Art. 2:--

It is required to have simultaneously,  $\dagger$  when t = 0,

$$\Sigma \left(Ae^{\mu x} + Be^{-\mu x}\right)e^{\mu ct} = \psi(x),\tag{1}$$

$$d/dt \cdot \Sigma \left(Ae^{\mu x} + Be^{-\mu x}\right)e^{\mu ct} = \chi(x), \tag{2}$$

 $\psi$ ,  $\chi$  being arbitrary functions, where the characteristic values of B/A and of  $\mu$  are given by the equations

$$Ae^{\mu a}F_{1}(u, \alpha) + Be^{-\mu a}F_{2}(-\mu, \alpha) = 0, \qquad (3)$$

$$Ae^{\mu b}F_{3}(\mu, b) + Be^{-\mu b}F_{4}(-\mu, b) = 0, \qquad (4)$$

the F's denoting polynomials in  $\mu$  of which  $F_1$ ,  $F_2$  are of the same order p and  $F_3$ ,  $F_4$  of the same order q.

Unless the F's have reference to some physical problem, the solution in so far as the satisfaction of (2) is concerned appears to be in general impossible. But an expansion which satisfies (1), (2), and which, whenever it contains no term arising from a residue at  $\mu = 0,\ddagger$  is of the desired type, is given by the equation

$$- (4\pi i)^{-1} \int_{c} d\mu \left[ \left\{ e^{\mu(u-a)} F_{4}(-\mu) - e^{-\mu(u-b)} F_{3}(\mu) \right\} \right. \\ \left. \times \left\{ \int_{a} \int_{c}^{b} \left\{ e^{\mu(u-a)} F_{2}(-\mu) - e^{-\mu(u-a)} F_{1}(\mu) \right\} \left\{ \psi(u) + (c\mu)^{-1} \chi(u) \right\} du \right. \right.$$

+ Terms of index (p-1) and (p-2) in  ${}^{1}F_{2}(-\mu)$   $\{\mu^{-1}\psi(a) - \mu^{-2}\psi'(a) + e^{-1}\mu^{-2}\chi(a)\}$ 

$$+ F_{1}(\mu) \{\mu^{-1}\psi(a) + \mu^{-2}\psi'(a) + c^{-1}\mu^{-2}\chi(a)\} \} \\ - \{e^{\mu(x-a)}F_{2}(-\mu) - e^{-\mu(x-a)}F_{1}(\mu)\} \ \left\{ \text{Terms of index } (q-1) \text{ and } (q-2) \text{ in} \\ \{F_{4}(-\mu) \{\mu^{-1}\psi(b) - \mu^{-2}\psi'(b) + c^{-1}\mu^{-2}\chi(b)\} + F_{3}(\mu) \{\mu^{-1}\psi(b) + \mu^{-2}\psi'(b) + c^{-1}\mu^{-2}\chi(b)\} \right\}$$

<sup>\*</sup> The conditions might, however, assume other forms; for example, one might refer to some other time.

<sup>†</sup> We may, if we prefer it, replace (1), (2) by the simultaneous equations  $\Sigma Ae^{\mu x} = \theta(x)$  $\Sigma Be^{-\mu x} = \phi(x)$ ,  $\theta$ ,  $\phi$  being arbitrary.

<sup>‡</sup> This limitation does not affect the problem as stated in the preceding foot-note.

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$$\div \left\{ e^{\mu(b-a)} F_2(-\mu) F_3(\mu) - e^{-\mu(b-a)} F_1(\mu) F_4(-\mu) \right\} \\ = \frac{1}{2} \left( \psi \left( x - \varepsilon \right) + \psi \left( x + \varepsilon \right) \right), \quad a < x < b ;$$
or
$$= \psi (a), \quad \text{if} \quad x = a ;$$
or
$$= \psi (b), \quad \text{if} \quad x = b.$$
(5)

I shall find it convenient to refer to the left-hand member of (5) indifferently as an integral or as the equivalent sum of residues.

The equation of type (2) derivable from this is valid at the boundaries a, b; it is valid also at discontinuities in  $\psi$ , provided  $\psi'$  is continuous; but at internal discontinuities in  $\psi'$  the value of the left-hand member of (2) is not simply  $\chi$ , but

$$\chi + \frac{c}{2} \left\{ \psi'(x+\varepsilon) - \psi'(x-\varepsilon) \right\}.^*$$

The truth of (5) should be obvious.<sup>†</sup> In establishing the equation of type (2) the only point of difficulty lies in showing that the part of the left-hand member which involves  $\psi$  is zero. Perhaps the simplest manner of surmounting this, except for the boundaries, is to note that, at any time t for which  $x \pm ct$  both lie between a, b, the value of the left-hand member of (5) is

$$\frac{1}{2} \{ \psi (x + ct) + \psi (x - ct) \}.$$

The single integrals in (5) which involve the boundary values affect the initial values neither of  $\phi$  nor of  $d\phi/dt$  at points in the interior of the range; if we omit them and make  $\chi = 0$ , we obtain the expansion of the former paper for  $\psi$ ; if we omit them and make  $\psi = 0$  in the corresponding equation of type (2), we obtain the expansion of the former paper for  $\chi$ .

#### ART. 4. The Expansions still Not Unique : Terms which may be added.

These expansions are, however, not unique. We may, in fact, add to the left-hand member of (5)

$$\int d\mu \left\{ \frac{\left\{ e^{\mu(x-b)}F_{4}(-\mu) - e^{-\mu(x-b)}F_{3}(\mu) \right\} F(\mu) + \left\{ e^{\mu(x-a)}F_{2}(-\mu) - e^{-\mu(x-a)}F_{1}(\mu) \right\} f(\mu)}{e^{\mu(b-a)}F_{2}(-\mu) F_{3}(\mu) - e^{\mu(a-b)}} F_{1}(\mu) F_{4}(-\mu) \right\},$$
(6)

where  $F(\mu)$ ,  $f(\mu)$  are polynomials of orders not exceeding p - 3, q - 3 respectively, without affecting the validity of (1), (2), or altering their type.

$$\frac{e}{2}\left\{\psi'(x+\epsilon)-\psi'(x-\epsilon)\right\};$$

and it seems impossible to give any analytical expression for the displacement at time t which will not indicate this velocity as existing initially.

<sup>\*</sup> If an elastic string is released from rest with a transverse displacement  $\psi$ , any point x at which  $\psi'$  is discontinuous acquires immediately a velocity

<sup>†</sup> In a great deal of what follows it seems undesirable to give the reasoning fully, as to do so would add considerably to the length of the Paper, unduly great as it is,

These polynomials may then be chosen so as to make the expansions satisfy certain other conditions.

ARTS. 5-8. Application to Transverse Vibrations of Elastic String whose ends are attached to a System of Particles with Massless Elastic Connexions.

#### ART. 5. Equations to be satisfied : the Actual Solution.

As an example of the application of such expansions I proceed to consider a generalization of Lord Rayleigh's example referred to above. Let there be a system, which is capable of vibrating, consisting of an elastic string and at each end a number of particles. We may add to the symmetry without increasing the difficulty by supposing that every particle of the system at either end is elastically connected to every other and also to a fixed point. Let the motions of any or all the particles be resisted by viscous forces of the usual types, i.e. proportional to the actual or to the relative velocities; but let it be supposed that the string itself is not subject to viscosity. Let there be m particles at one end x = a, and n at the other x = b. It is supposed that at each end the position of one particle coincides with that of the end of the string.

The initial displacements and velocities are given, and the subsequent history of the system is required.

Supposing b > a, at the end a we have a special case of a system of m equations of the form

$$(M_{11}D^{2} + k_{11}D + \lambda_{11} - Td/dx)Y_{1} + (M_{12}D^{2} + k_{12}D + \lambda_{12})Y_{2} + (M_{13}D^{2} + k_{13}D + \lambda_{13})Y_{3} + \ldots = 0, \quad (7) (M_{21}D^{2} + k_{21}D + \lambda_{21})Y_{1} + (M_{22}D^{2} + k_{22}D + \lambda_{22})Y_{2} + (M_{23}D^{2} + k_{23}D + \lambda_{23})Y_{3} + \ldots = 0, \quad (8) (M_{31}D^{2} + k_{31}D + \lambda_{31})Y_{1} + (M_{32}D^{2} + k_{32}D + \lambda_{32})Y_{2} + (M_{33}D^{2} + k_{33}D + \lambda_{33})Y_{3} + \ldots = 0, \quad (9)$$

where D denotes d/dt and the Y's denote the displacements of the particles. Actually the system of coefficients of the Y's is symmetrical about its leading diagonal, and, when r, s are different, each constant of the type  $M_{rs}$  is zero and those of the types  $k_{rs}$ ,  $\lambda_{rs}$  are negative. We will consider the more general system above, however, as it presents no greater difficulty. It will be convenient to denote by  $\Delta_a$  and also by  $F_a(d/dt, d/dx)$  the determinant composed of the coefficients of the Y's, (and in it D may be replaced as far as we please by  $\mu c$ ), so that the displacement  $\phi$  of the string itself is subject to the terminal equations

$$F_a\left(\frac{d}{dt}, \frac{d}{dx}\right) \phi = 0, \quad \text{at} \quad x = a, \tag{10}$$

$$F_b\left(\frac{d}{dt}, \frac{d}{dx}\right) \phi = 0, \quad \text{at} \quad x = b. \tag{11}$$

And at points between a, b the string is subject to the equation

$$d^{2}\phi/dx^{2} = c^{-2}d^{2}\phi/dt^{2}; \qquad (12)$$

while each displacement involves the time factor  $e^{\mu ct}$ .

Let the minors of the above-mentioned determinant,  $\Delta_a$ , be denoted by  $A_{11}$ ,  $A_{12}$ , etc.

Let the elements of another column, to be used in forming determinants, and derived\* from  $\Delta_a$ , be

$$(M_{11}\mu c^{2} + k_{11}c) y_{1} + M_{11}cv_{1} + (M_{12}\mu c^{2} + k_{12}c) y_{2} + M_{12}cv_{2} + (M_{13}\mu c^{2} + k_{13}c) y_{3} + M_{13}cv_{3} + \dots, (13) (M_{21}\mu c^{2} + k_{21}c) y_{1} + M_{21}cv_{1} + (M_{22}\mu c^{2} + k_{22}c) y_{2} + M_{22}cv_{2} + (M_{23}\mu c^{2} + k_{23}c) y_{3} + M_{23}cv_{3} + \dots, (14) (M_{31}\mu c^{2} + k_{31}c) y_{1} + M_{31}cv_{1} + (M_{32}\mu c^{2} + k_{32}c) y_{2} + M_{32}cv_{2} + \dots (15)$$

in which the y's denote initial displacements and the v's initial velocities. And let the determinants obtained by replacing the first, second, etc., columns of  $\Delta_a$  by this column-be denoted by  ${}_a\Pi_1$ ,  ${}_a\Pi_2$ , etc., respectively.

Let a similar notation apply to the end b, the suffix b being introduced when necessary.

Also let the initial displacement and velocity at all points of the string be  $\psi$ ,  $\chi$ , respectively. I suppose that  $\psi$ ,  $\psi'$ ,  $\psi''$ ,  $\chi$ ,  $\chi'$  are Dirichlet functions, and that  $\psi$ ,  $\psi'$ ,  $\chi$  are continuous.

As  ${}_{a}Y_{1}$  is identical with  $\phi_{a}$ , it suffices to give the values of  $\phi$ ,  ${}_{a}Y_{2}$ , and  ${}_{b}Y_{2}$ , the analogue of  ${}_{a}Y_{2}$  at the end b. These are

$$\begin{split} \phi &= - \left(4\pi i\right)^{-1} \int_{c} e^{\mu ct} d\mu \left[ \left\{ e^{\mu(x-a)} F_{a}(\mu c, -\mu) - e^{-\mu(x-a)} F_{a}(\mu c, \mu) \right\} \\ &\left\{ \int_{a}^{b} \left\{ e^{\mu(u-b)} F_{b}(\mu c, -\mu) - e^{-\mu(u-b)} F_{b}(\mu c, \mu) \right\} \left\{ \psi(u) + (c\mu)^{-1} \chi(u) \right\} du - 2_{b} \Pi_{1} \right\} \\ &+ 2_{a} \Pi_{1} \left\{ e^{\mu(x-b)} F_{b}(\mu c, -\mu) - e^{-\mu(x-b)} F_{b}(\mu c, \mu) \right\} \right\} \\ &\div \left\{ e^{\mu(b-a)} F_{b}(\mu c, \mu) F_{a}(\mu c, -\mu) - e^{\mu(a-b)} F_{b}(\mu c, -\mu) F_{a}(\mu c, \mu) \right\} \right], \end{split}$$
(16)  

$$a Y_{2} &= - \left(4\pi i\right)^{-1} \int_{c} e^{\mu ct} d\mu \left[ \left\{ 2\mu T \cdot A_{12} \\ \left\{ \int_{a}^{b} \left\{ e^{\mu(u-b)} F_{b}(\mu c, -\mu) - e^{-\mu(u-b)} F_{b}(\mu c, \mu) \right\} \left\{ \psi(u) + (c\mu)^{-1} \chi(u) \right\} du - 2_{b} \Pi_{1} \right\} \\ &+ 2_{a} \Pi_{2} \left\{ e^{\mu(x-b)} F_{b}(\mu c, -\mu) - e^{-\mu(x-b)} F_{b}(\mu c, \mu) \right\}_{x=a} \right\} \div \text{Denominator of (16)} \right], \end{aligned}$$
(17)

\* See Routh, " Dynamics of a System of Rigid Bodies," Part ii., Art. 366. R.I.A. PROC., VOL. XXIX., SECT. A.

[3]

$$\sum_{a} \sum_{c} = (4\pi i)^{-1} \sum_{c} \left[ e^{\mu ct} du \left[ \int 2\mu T \cdot B_{12} \right] \right]$$

$$= (4\pi i)^{-1} \sum_{c} \left[ e^{\mu (u-a)} F_{a}(uc, -\mu) - e^{-\mu (u-a)} F_{a}(\mu c, \mu) \right] \left\{ \psi(u) + (c\mu)^{-1} \chi(u) \right\} du + 2_{a} \Pi_{1} \left\{ + 2_{b} \Pi_{2} \left\{ e^{\mu (u-a)} F_{a}(\mu c, -\mu) - e^{-\mu (u-a)} F_{a}(\mu c, \mu) \right\}_{x=b} \right\}$$

$$= Denominator of (16) \left[ - (18) \right]$$

The symbolic term  $Td^{i}dx$  does not occur in the minors<sup>\*</sup>  $A_{12}$ ,  $B_{12}$ , &c., nor in the determinants  $\Pi_{i}$ , and thus affects only the final terms of  $_{a}Y_{2}$ ,  $_{b}Y_{2}$ ,  $_{a}Y_{3}$ , etc.; it is to be interpreted in the usual sense.

It must never be overlooked that, in  $\phi$ , the form of the numerator of the integrand in the double integral may be altered by interchanging a and b,  $F_a$  and  $F_{i*}$ 

#### ART. 6. This Solution satisfies the given Initial Conditions.

Proceeding to the verification of this solution, I shall first show that it satisfies the initial conditions. The initial values of  $\phi$ ,  $d\phi/dt$  are  $\psi$ ,  $\chi$  respectively; for having regard to the difference of notation, the expansion given for  $\phi$  agrees with the left-hand member of (5) as far as is necessary; that is to say, the coefficient in (5) of

$$(4\pi i)^{-1} (e^{\mu |x-a|} F_2(-\mu) - e^{-\mu |x-a|} F_1(\mu))$$

in the integral which explicitly refers to the boundary *h*, agrees with  $2_{h}\Pi_{1}$  as far as terms of index (q-2); and similarly for the boundary *a*.

In considering the initial value of  ${}_{a}Y_{2}$  the portion whose integrand contains  $uA_{12}$  as a factor may be neglected, since this factor is one dimension lower than  $F_{a}[\mu c, \pm u]$ , which has to be set against it in the denominator, and since  ${}_{b}\Pi_{1}$  is of lower dimensions than  $F_{b}$ .

In the remaining portion, the integrand is asymptotically of the form  $-2r^{act}u^{-1}y_{1}du$ , so that the initial value of  $_{a}Y_{2}$  is  $y_{2}$ .

In obtaining the initial value of  $d dt ({}_{a}Y_{2})$ , the portion involving  $\mu A_{12\,b}\Pi_{1}$  may be neglected, since it vanishes until the time (b-a)/c.

And the remaining portion may be differentiated with respect to t under the sign of integration. For, if we do so and integrate by parts the integral involving  $\psi$  u), the terms arising from the two integrals in u and from the boundary terms at b are uniformly convergent<sup>+</sup> and have zero for their initial

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<sup>\*</sup>  $B_{11}$  denotes the analogue to  $A_{12}$  at the end  $b_{i}$ .

<sup>&</sup>lt;sup>+</sup> For then the p-dynamials in the numerator of the integrand are, for the double integrals one dimension, and, for the portions of the single integrals which do not cancel, two dimensions, less than those in the denominator.

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value; and the terms arising from the boundary terms at a due to this partial integration and from the terms involving  ${}_{a}\Pi_{2}$ , combine to give

$$- (2\pi i)^{-1} \int_{c} e^{\mu ct} d\mu \left[ (\mu c_a \Pi_2 - c T A_{12 a} y_1 d/dx) \{ e^{\mu (x-b)} F_b(\mu c, -\mu) - e^{-\mu (x-b)} F_b(\mu c, \mu) \}_{x = a} \right]$$
  
÷ Denominator of (16)

The expression

$$\mu c_a \Pi_2 - c T A_{12 a} y_1 d/dx$$

may be expressed as a determinant obtained from  ${}_{a}\Pi_{2}$  on multiplying by  $\mu c$ the expressions (13), (14), etc., which constitute the elements of its second column, and subtracting from the first the term  $cT_{a}y_{1}d/dx$ . The determinant thus obtained is unaltered, if from each element of the second column we subtract the sum of the corresponding elements of the first column multiplied by  $cy_{1}$ , the third by  $cy_{3}$ , &c. And the resulting determinant, which differs from  $\Delta_{a}$  only in the second column, may be replaced by the sum of  $\Delta_{a}$  and another determinant again differing from  $\Delta_{a}$  in the second column only. On doing so, the part of the integral arising from  $\Delta_{a}$  is zero; since, if we perform the operation  $\Delta_{a}$  on the coefficient of  ${}_{a}\Pi_{2}$  in the numerator of (17), we obtain minus the denominator of (17), so that the integrand is devoid of singularities. The part arising from the other determinant, from whose second column the symbolic term containing d/dx has disappeared, has an integrand asymptotically of the form  $-e^{\mu ct}\mu^{-1}v_{2}d\mu$ .

If this were actually the integrand, the integral would be uniformly convergent, since the contour might be replaced by a finite one, and its initial value would be  $v_2$ . And the integral whose integrand is the difference between this and the accurate expression, having the denominator asymptotically of two dimensions higher than the numerator, is also uniformly convergent, and its initial value is zero. Thus the integral actually gives d/dt ( $_aY_2$ ), and its initial value is  $v_2$ .

#### ART. 7. This Solution satisfies the Terminal Equations.

Before proceeding further it will be convenient to point out that, if in the left-hand members of (7) *et seq.* we substitute for  $Y_1$ ,  $Y_2$ , etc., the values  $A_{11}$ ,  $A_{12}$ , etc., the result in the case of (7) is simply  $\Delta_a$  and in the case of each of the other equations zero; while if we substitute  ${}_{a}\Pi_{1}$ ,  ${}_{a}\Pi_{2}$  etc., the results are respectively  $\Delta_a \times (13)$ ,  $\Delta_a \times (14)$ , etc.

I shall next show that the solution which has been written down satisfies the terminal equations (7) et seq. at a.

This would be true if the left-hand members of these equations could be legitimately obtained from the values given for  $\varphi$ ,  $Y_2$ , etc., by differentiation

under the integral sign. For let us so differentiate, substitute in (7), and write x = a. Bearing in mind that  $2\mu T A_{11}(\mu)$  is the value of

$${}^{\mu(x-a)}F_a(\mu c,-\mu)-e^{-\mu(x-a)}F_a(\mu c,\,\mu)$$

at a, we see that on doing so the coefficient of the integral in u in the numerator of the integrand may be written in the form

$$2\mu T e^{\mu ct} d\mu \Delta_a(\mu) \{ e^{\mu(x-a)} F_a(\mu c, -\mu) - e^{-\mu(x-a)} F_a(\mu c, \mu) \}_{x=a}$$
(19)

which is identically zero. This, of course, applies to the coefficient of  ${}_{b}\Pi_{1}$  also. As for the coefficient of

$$e^{\mu ct} d\mu \{ e^{\mu(x-b)} F_b(\mu c, -\mu) - e^{-\mu(x-b)} F_b(\mu c, \mu) \}$$
(20)

it is  $2\Delta_a \times (13)$ ; but, when this operation is performed on (20), and x subsequently replaced by a, the result is

 $-2e^{\mu ct}d\mu \times (13) \times \text{the denominator of (16)},$ (21) so that the contour integral is zero.

Similarly for any of the other simultaneous equations.

It has now to be shown that the left-hand members of (7) *et seq. can* be legitimately obtained by differentiation under the sign of integration.

We could add to  $\phi$  terms of the type obtained from (6), allowing for the differences in notation, by multiplying each element of the integrand by  $e^{\mu ct}$ , and such as would allow the sum to be differentiated term by term twice in succession at all points, including a, b.\* To discover such terms we do differentiate separately in this fashion, twice with respect to x, the two parts of  $\phi$  which involve  $e^{\mu x}$  and  $e^{-\mu x}$ , and then in each case integrate by parts twice in succession that part of the integral in u which involves  $\psi$ , but once only that which involves  $\chi$ ; we thus obtain a double integral which, when t = 0, would constitute a quasi-Fourier expansion of  $\frac{1}{2}\psi''(x) \pm \frac{1}{2}\chi'(x)$ , and also single integrals involving values of  $\psi, \psi', \chi$ , at the boundaries. The additional terms required are then so chosen that, when they are differentiated twice, their integrands annul the integrands in the above single integrals except the terms which are requisite to make the Fourier expansions of  $\frac{1}{2}\psi''(x) \pm \frac{1}{2}\chi'(x)$  valid at the boundaries. For the double integrals, being uniformly convergent at t=0 (save near discontinuities in  $\psi''(x)$  or  $\chi'(x)$ ), remain uniformly convergent, save for isolated points, when each element is multiplied by  $e^{\mu ct}$ , and the same must therefore be true when some or all of the differentiations are with respect to t. Thus the second derivates of the sum of  $\phi$  and these added terms may be obtained by differentiation under the integral sign, except possibly at isolated instants when discontinuities in  $\psi''$  or  $\chi'$  reach a directly or after any number of reflexions. It will be assumed for the present that  $\psi''$ ,  $\chi'$  are continuous; and it will be shown later that in the event of discontinuity the exceptions are only apparent.

<sup>\*</sup> Without any such addition the operation in question would be admissible except at certain instants, one of which is t = 0.

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Now the additional terms cause, in the expression for  $\phi$ ,  ${}_{b}\Pi_{1}$  to be replaced by an expression which differs from it by terms whose order is less by at least three than that of  $F_{b}(\mu c, \pm \mu)$ , (and only the term of the highest order is either unique or important). We may, indeed, and will, choose terms which cause  $2 {}_{b}\Pi_{1}$  to be replaced by

$$F_{b}(\mu c, -\mu) \{ \mu^{-1} \psi(b) - \mu^{-2} \psi'(b) + \mu^{-3} \psi''(b) + c^{-1} \mu^{-2} \chi(b) - c^{-1} \mu^{-3} \chi'(b) \}$$

$$+ F_b(\mu c, \mu) \{ \mu^{-1} \psi(b) + \mu^{-2} \psi'(b) + \mu^{-3} \psi''(b) + c^{-1} \mu^{-2} \chi(b) + c^{-1} \mu^{-3} \chi'(b) \},\$$

and similarly, *mutatis mutandis*, for  ${}_{a}\Pi_{1}$ . The added terms are not precisely of the same type as (6), inasmuch as the numerator of their integrand includes powers of  $\mu$  with negative index. Denote by  $P_{b}$ ,  $P_{a}$  the expressions which would thus replace  ${}_{b}\Pi_{1}$ ,  ${}_{a}\Pi_{1}$  respectively.

We could add also to  ${}_{a}Y_{2}$ , etc., terms which would permit of similar differentiations. It is easily verified directly that, in the case of  ${}_{a}Y_{2}$ , it would suffice to replace  ${}_{b}\Pi_{1}$  by  $P_{b}$ , and the numerator of the integrand of the portion which involves  ${}_{a}\Pi_{2}$  by

$$2\mu T A_{12} \left[ e^{\mu(a-b)} F_b(\mu c, -\mu) \left\{ \mu^{-1} \psi(a) - \mu^{-2} \psi'(a) + \mu^{-3} \psi''(a) + c^{-1} \mu^{-2} \chi(a) - c^{-1} \mu^{-3} \chi'(a) \right\} + e^{\mu(b-a)} F_b(\mu c, \mu) \left\{ \mu^{-1} \psi(a) + \mu^{-2} \psi'(a) + \mu^{-3} \psi''(a) + c^{-1} \mu^{-2} \chi(a) + c^{-1} \mu^{-3} \chi'(a) \right\} \right].$$

And we may and will replace this last expression by

 $\div$  Denominator of (16) ,

$$2P_a A_{12}/A_{11} \cdot \{e^{\mu(a-b)}F_b(\mu c, -\mu) - e^{\mu(b-a)}F_b(\mu c, \mu)\};$$

for, bearing in mind that

$$F_a(\mu c, -\mu) - F_a(\mu c, \mu) = 2\mu T A_{11},$$

it is seen that the difference of the numerators of the integrands concerned contains the denominator of (16) as a factor, so that the difference of the integrals themselves reduces to an integral taken along a finite contour surrounding the zeros of  $A_{11}$  and the origin, and may therefore be differentiated under the sign of integration as often as is desired. These added terms, as far as the portion of  ${}_{a}Y_{2}$  which involves  ${}_{a}\Pi_{2}$  is concerned, simply change  ${}_{a}\Pi_{2}$  into  $P_{a} A_{12}/A_{11}$ .

It would therefore suffice to establish that, if, in equations (7) *et seq.*,  $Y_1$  is replaced by

$$\begin{aligned} & \mathbf{c} \int e^{\mu ct} d\mu \left[ \left\{ \left\{ e^{\mu' r - a} F_{a}(\mu c, -\mu) - e^{-\mu(r-a)} F_{a}(\mu c, \mu) \right\} (P_{b} - {}_{b} \Pi_{1}) \right. \\ & + \left\{ e^{\mu(r-b)} F_{b}(\mu c, -\mu) - e^{-\mu(r-b)} F_{b}(\mu c, \mu) \right\} ({}_{a} \Pi_{1} - P_{a}) \right\} \\ & + \left\{ e^{\mu(r-b)} F_{b}(\mu c, -\mu) - e^{-\mu(r-b)} F_{b}(\mu c, -\mu) \right\} \\ & (22) \\ & \mathbf{c} \int e^{\mu ct} d\mu \left[ \left\{ 2\mu T \mathcal{A}_{12}(P_{b} - {}_{b} \Pi_{1}) + \left( {}_{a} \Pi_{2} - P_{a} \mathcal{A}_{12}/\mathcal{A}_{11} \right) \left\{ e^{\mu(r-b)} F_{b}(\mu c, -\mu) - e^{-\mu(r-b)} F_{b}(\mu c, \mu) \right\} \right\} \\ & = \frac{1}{2} \end{aligned}$$

and  $Y_3$ , &c., by similar expressions, x being eventually replaced by a, then

(23)

the differentiations required in the left-hand members of these equations can be performed under the integral sign. And this can be shown to be true for the set of terms depending on values at the boundary b, and separately for the set depending on values at a.

It is already known that, for all values of x, t, each of the two parts of (22) can be differentiated once with respect to x or t under the integral sign; and it is to be proved that for x = a each can be so differentiated twice with respect to t and for all values of t. And this will follow if it is shown that the integrals so obtained converge uniformly for all values of t. Now, when we do so differentiate, in the set of terms which involve  $P_b - {}_b\Pi_1$ , on replacing

$$e^{\mu(x-a)} F_a(\mu c, -\mu) - e^{-\mu(x-a)} F_a(\mu c, \mu)$$

by  $2\mu T A_{11}$ , the polynomial in the numerator is two dimensions lower than those in the denominator, irrespective of exponentials in the denominator, so that this part is uniformly convergent. And in the set of terms which involve  ${}_{a}\Pi_{1} - P_{a}$  the integrand, after the double differentiation, is asymptotically a multiple of  $e^{\mu ct} \mu^{-1} d\mu$ , and therefore, as in the preceding, the integral is uniformly convergent. For (22) the desired result is therefore established.

It has next to be proved that, for  $x = \alpha$ , (23) can be differentiated twice with respect to t under the integral sign; this follows if the integral so obtained converges uniformly for all values of t. This is true for the part which involves  $P_b - {}_b\Pi_1$  as  $\mu A_{12}(P_b - {}_b\Pi_1)$  is four dimensions lower than the polynomials in the denominator.

In the remaining part replace

 $a\Pi_2 - P_a \cdot A_{12}/A_{11}$  by  $(a\Pi_2 - a\Pi_1 \cdot A_{12}/A_{11}) + (a\Pi_1 - P_a) A_{12}/A_{11}$ 

and consider first the portion involving  ${}_{a}\Pi_{2} - {}_{a}\Pi_{1} \cdot A_{12}/A_{11}$ . The expression  $A_{11 a}\Pi_{2} - A_{12 a}\Pi_{1}$  is the product of  $\Delta_{a}$  and another determinant; and the operation  $\Delta_{a}$  when performed on  $e^{\mu(x-b)} F_{b}(\mu c, -\mu) - e^{-\mu(x-b)} F_{b}(\mu c, \mu)$  makes it become identical, save for sign, with the denominator. For this portion, then, the contour may be replaced by a finite one which contains the zeros of  $A_{11}$ , and the integral is therefore uniformly convergent. As  $({}_{a}\Pi_{1} - P_{a}) A_{12}/A_{11}$  is three dimensions lower than either polynomial in the denominator, the portion of the integrand which involves this expression is asymptotically a multiple of  $e^{\mu ct}\mu^{-1}d\mu$ , and therefore, as before, this portion also of the integral is uniformly convergent. Thus the desired result has been established for (23).

In the preceding it has been supposed that  $\psi''$ ,  $\chi'$  have no internal discontinuities, and if there are such discontinuities it has not been made clear that the second derivates of  $\phi_a$ ,  $Y_2$ , etc., can be obtained by differentiation under the sign of integration at the instants when these discontinuities reach a directly or after reflexions.

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If, however, we add to  $\phi$ , in respect of each such discontinuity  $x_1$ , the terms

$$(4\pi i)^{-1} \int_{c} \left[ e^{\mu ct} d\mu \left[ \left\{ e^{\mu(x-a)} F_{a}(\mu c, -\mu) - e^{-\mu(x-a)} F_{a}(\mu c, \mu) \right\} \right] \\ \left[ F_{b}(\mu c, -\mu) e^{\mu(x_{1}-b)} \right] - \mu^{-3} \psi''(x_{1}) + e^{-1} \mu^{-3} \chi'(x_{1}) \right] \\ - F_{b}(\mu c, \mu) e^{-\mu(x_{1}-b)} \left[ \mu^{-3} \psi''(x_{1}) + e^{-1} \mu^{-3} \chi'(x_{1}) \right] \\ \vdots \left\{ \text{Denominator of (16)} \right\}, (24)$$

in which the vertical bars denote the increase which the expression between them receives as x increases through the discontinuity, and make corresponding additions to  $Y_2$ , etc., the sum of  $\phi$  and these terms can be differentiated twice everywhere with respect to t under the integral sign; and the same is true of these terms themselves at x = a, since, when

$$e^{\mu(x-a)}F_a(\mu c, -\mu) - e^{-\mu(x-a)}F_a(\mu c, \mu)$$

is replaced by  $2\mu TA_{11}$ , the polynomials in the numerator are four dimensions less than those in the numerator. Thus the instants referred to do not constitute real exceptions.

Similarly for the equations which hold at the end b. It must be borne in mind that the coefficient Td/dx, which occurs in (7), appears with the opposite sign in the analogous equation at the end b.

#### ART. 8. This Solution satisfies the Equation of Motion of the String.

Finally  $\phi$  satisfies the differential equation (12) at internal points. For the integral giving  $\phi$  can be differentiated twice under the integral sign, except at certain instants corresponding to those at which original discontinuities in  $\psi''$  or  $\chi'$  reach the point considered after any number of reflexions. (And if such discontinuities are to be considered, distinctions must be drawn between progressive and regressive derivates in the equation.)

It should be noted that at the boundaries the differential equation (12) cannot be insisted on: it holds, however, except at certain instants. The integral obtained by differentiating  $\phi$  under the integral sign twice with respect to t is, of course, the same as that obtained by differentiating twice with respect to x, but, although when x = a, it is uniformly convergent for all values of t, yet, when t is fixed, it is not uniformly convergent for all values of x, and there are instants at which the failure occurs in the neighbourhood of a; one of these is t = 0.

If we regarded discontinuity as permissible in  $\psi'$  or  $\chi$  at internal points, we could show by a similar artifice to that of the preceding sections that the differential equation (12), and also equations (7) *et scq.*, are satisfied, except at certain instants. In such a case, we add in respect of each such discontinuity terms which permit differentiation twice under the integral sign. At exceptional instants the differential equation has to be replaced by the condition which holds at a wave-front, i.e. that one of the two expressions

#### $cd\phi/dx \pm d\phi/dt$

is continuous; but, as the necessity for this condition can be established only by regarding discontinuity as a limiting case of rapid variation, too much importance might, in my judgment, be attached to its verification.

If there is only one particle at each end,  $\phi$  gives the complete solution. I have verified that, in the case considered by Lord Rayleigh, it agrees with his.

#### ART. 9. Application to a Problem in Heat-Conduction.

A problem which admits of a solution closely following that just obtained is that of the flow of heat in a system consisting of a conducting bar, and at each end a number of masses, each of one temperature throughout, and exchanging heat with one another according to the law that the rate of heat transference between any two is proportional to the difference in their temperatures, as well as radiating according to the usual law.

The modifications which have to be made in the expressions (16), (17), (18), in order to obtain the temperatures of any point of the rod and of typical particles at each end, seem so obvious that, in view of the length of the expressions, it appears unnecessary to give them.

There is, however, one point of difficulty to which I may allude. It may be held that there is here no physical reason for requiring the original temperature distribution,  $\psi$ , to be continuous; and, if we permit internal discontinuity, there is some difficulty in showing that the differential equation, which now assumes the form

$$d\phi/dt = c^2 d^2 \phi/dx^2, \tag{25}$$

and the boundary equations which now replace (7) et seq., are satisfied *initially*.<sup>\*</sup> If the time factor is now taken to be  $e^{\mu^2 c^2 t}$ , the characteristic values of  $\mu^2$ , when large, have negative real parts which increase indefinitely; and so, for all *positive* values of t, all integrals which enter into the solution are so highly convergent, that they may be differentiated under the integral sign as often as is desired; but this does not apply initially.

One method of surmounting this difficulty is as follows:—We may add to  $\phi$ , as given by the equation which now replaces (16), terms in respect of each discontinuity in  $\psi$  which will permit the sum to be differentiated under the integral sign, twice with respect to x, or once with respect to t.

<sup>\*</sup> This point appears to be frequently overlooked.
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Considering a single discontinuity  $x_1$ , such a term is, save as to a constant factor, of the form<sup>\*</sup>

$$c \int e^{\mu^{2}c^{2}t} \mu^{-1} d\mu \left[ \left\{ e^{\mu(x-a)} F_{a}(\mu^{2}c^{2}, -\mu) - e^{-\mu(x-a)} F_{a}(u^{2}c^{2}, \mu) \right\} \\ \left\{ e^{\mu(x_{1}-b)} F_{b}(\mu^{2}c^{2}, -\mu) + e^{-\mu(x_{1}-b)} F_{b}(\mu^{2}c^{2}, \mu) \right\} \\ \div \left\{ e^{\mu(b-a)} F_{b}(\mu^{2}c^{2}, \mu) F_{a}(\mu^{2}c^{2}, -\mu) - e^{\mu(a-b)} F_{b}(\mu^{2}c^{2}, -\mu) F_{a}(\mu^{2}c^{2}, \mu) \right\} \right]. \quad (26)$$

This is suitable when the value of x to be considered is less than  $x_1$ . For  $x > x_1$ , we would take the expression obtainable from this by interchanging a, b in the numerator. Now, it would evidently establish that the boundary equations at a, and the differential equation (25) are satisfied by  $\phi$ ,  $Y_2$ , &c., if we could show that initially, for  $x < x_1$ , (26), its first and second space-derivates, and its first time-derivate, are each zero. This is, in fact, true of it and all its derivates.

Initially (26) vanishes for all values for which  $x < x_1$ , and therefore so also do all its space-derivates. In order to show that the same is true of its timederivates, I proceed to examine to some extent the values of (26), and of these derivates when t is small but not zero. These derivates may, as we have seen when t is positive, be obtained by differentiation under the integral sign; and thus, in the case of any one or of (26) itself, we have, on performing the multiplications indicated in the numerator, to deal with four integrals, each of the type

$$\int \{e^{\mu^2 c^2 t - \mu y} F(\mu) d\mu / \text{Denominator of } (26)\}, \qquad (27)$$

where  $F(\mu)$  is an algebraic function, and b-a > y > a-b. Evidently the parts of the contour for which the real parts of  $\mu^2$  are infinitely great and negative contribute nothing to (27), provided the path avoids the zeros of the denominator. Evidently, also, the remaining path may, when t is less than some finite quantity depending on y, be replaced by two infinite straight lines parallel to the axis of imaginaries and passing through the points

$$\mu = (b - a + y)/2ct^{\frac{1}{2}}, \quad \mu = -(b - a - y)/2ct^{\frac{1}{2}}$$

respectively. The integral along the former may be expressed in the form

$$-i(c^{2}t)^{-\frac{1}{2}}e^{-(b-a+y)^{2}/4c^{2}t}\int_{-\infty}^{\infty}\frac{e^{-u^{2}}\theta(\mu)du}{1-e^{-2\mu(b-a)}\zeta(\mu)},$$
(28)

where  $\theta$ ,  $\zeta$  are algebraic functions involving fractions, and

$$u = i\mu ct^{\frac{1}{2}} - i(b - a + y)/2.$$

It is evident that, if we select any fixed quantity k less than unity, we can choose t so small that, for it and all smaller values of t, the modulus of the

<sup>\*</sup> Corresponding additions, whose form should be obvious, must be made to  $T_2$ ,  $T_3$ , etc. R.I.A. PROC., VOL. XXIX., SECT. A. [4]

denominator of (28) exceeds k everywhere along the line of integration, and, having regard to the actual form of  $\theta$ , that the modulus of  $\theta(\mu)$  is less than  $C\mu^h$ , where C, h are constants. From this we can readily deduce that (28) is less than

a constant × a power of 
$$t \times e^{-(b-a+y)^2/4c^2t}$$
. (29)

But this diminishes indefinitely compared with t; and similarly for the integral along the other line: hence, initially, all the time-derivates of (26) are zero.

A few words of caution seem desirable here. If U denotes the expression (26), the argument that dU/dt, for example, is initially zero, is not that it diminishes indefinitely with t, but that  $(U_t - U_v)/t$  does so; and so on.

Discontinuity in  $\psi'$  causes a similar difficulty initially, and it may be surmounted in a similar fashion.

## ART. 10. Reference to another Class of Physical Problems to which Similar Expansions apply.

I have considered also to some extent the application of the expansions to problems of the type which originally suggested them (see Art. 1, Part I. of the former paper), but for which the method is not well suited. In such cases, in the expansion which now corresponds to (5), we must continue the series of terms relating to a as far as those containing  $\psi^{(p-1)}(a)$ ,  $\chi^{(p-1)}(a)$ , and change "of index (p-1) and (p-2)" into "of index  $\neq 0$ "; similarly, mutatis mutandis, for b: usually, q = p.

## ART. 11. Reference to the corresponding Modification of the Trigonometrical Integral Expansion.

The manner in which the integral theorems of Part I., Art. 1, of the former paper should be modified like the sum theorem so as to obtain an expansion satisfying equations analogous to (1), (2) will, I think, be obvious. The exponential notation is more convenient than the trigometrical in which the integral theorems were first stated. And it seems on the whole preferable to add the contour integral (3)\* to the contour integral in (11)\* and take half the sum. When the notation is then changed to the exponential, the integral theorem is exhibited as a limiting *form* of (5) of the present paper obtained by making b infinite and a zero.

It should also be obvious that terms analogous to (6), but whose form it seems unnecessary to state explicitly, may be added.

The application to physical problems analogous to those just discussed presents no further difficulty.

<sup>\*</sup> These numbers refer to the former paper.

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ART. 12. The corresponding Modification of the Expansions in Bessel Functions, and application to a Physical Problem.

Proceeding next to similar modifications of the Bessel sum and integral theorems of the former paper, it will, I think, suffice to consider the problem in Physical Mathematics analogous to that discussed in Articles 5–8.

Let, then, the differential equation (12) be replaced by

$$d^{2}\phi/dr^{2} + r^{-1}d\phi/dr - n^{2}r^{-2}\phi = c^{-2}d^{2}\phi/dt^{2}, \qquad (30)$$

the other conditions to be satisfied being expressed as in Article 5, except that r now replaces x. This would apply to the vibrations of a circular or annular elastic lamina whose boundaries are not fixed, but connected by elastic membranes devoid of mass to a series of concentric rings which offer no resistance to being bent out of their planes.\*

The solution is comprised in the typical equations

$$\begin{split} \phi &= -(2\pi^{2})^{-1} \mathop{_{c}} \int e^{\mu ct} d\mu \left[ F_{a}(\mu c, d/da) \{ K_{n}(\mu a) K_{n}(\mu r e^{\pi i}) - K(\mu a e^{\pi i}) K_{n}(\mu r) \} \\ \begin{cases} \int_{a}^{b} F_{b}(\mu c, d/db) \{ K_{n}(\mu b) K_{n}(\mu \rho e^{\pi i}) - K_{n}(\mu b e^{\pi i}) K_{n}(\mu \rho) \} \{ \mu \psi(\rho) + c^{-1} \chi(\rho) \} \rho d\rho + i \pi_{b} \Pi_{1} \} \\ &- i \pi_{a} \Pi_{1} F_{b}(\mu c, d/db) \{ K_{n}(\mu b) K_{n}(\mu r e^{\pi i}) - K_{n}(\mu b e^{\pi i}) K_{n}(\mu r) \} \\ &\doteq \left\{ F_{a}(\mu c, d/da) K_{n}(\mu a) F_{b}(\mu c, d/db) K_{n}(\mu b e^{\pi i}) \\ &- F_{a}(\mu c, d/da) K_{n}(\mu a e^{\pi i}) F_{b}(\mu c, d/db) K_{n}(\mu b) \right\} \right], \end{split}$$
(31)  
$$a Y_{2} = (2\pi)^{-1} \mathop{_{c}} \int e^{\mu c t} d\mu \left[ \left\{ a^{-1} T A_{12} \\ \left\{ \int_{a}^{b} i F_{b}(\mu c, d/db) \{ K_{n}(\mu b) K_{n}(\mu \rho e^{\pi i}) - K_{n}(\mu b e^{\pi i}) K_{n}(\mu \rho) \} \{ \mu \psi(\rho) + c^{-1} \chi(\rho) \} \rho d\rho - \pi_{b} \Pi_{n} \right\} \\ &+ i a \Pi_{2} F_{b}(\mu c, d/db) \{ K_{n}(\mu b) K_{n}(\mu r e^{\pi i}) - K_{n}(\mu b e^{\pi i}) K_{n}(\mu r) \}_{r=a} \right\} \\ \dot{=} Denominator of (31) \right], \end{aligned}$$
(32)  
$$b Y_{2} = -(2\pi)^{-1} \mathop{_{c}} \int e^{\mu c t} d\mu \left[ \left\{ b^{-1} T B_{12} \right\} \\ \left\{ \int_{a}^{b} i F_{a}(\mu c, d/da) \{ K_{n}(\mu a) K_{n}(\mu \rho e^{\pi i}) - K_{n}(\mu a e^{\pi i}) K_{n}(\mu \rho) \} \{ \mu \psi(\rho) + c^{-1} \chi(\rho) \} \rho d\rho + \pi_{a} \Pi_{1} \right\} \\ &+ i {}_{b} \Pi_{2} F_{a}(\mu c, d/da) \{ K_{n}(\mu a) K_{n}(\mu r e^{\pi i}) - K_{n}(\mu a e^{\pi i}) K_{n}(\mu r) \}_{r=b} \right\} \\ \dot{=} Denominator of (31). \end{aligned}$$
(33)

 $[4^{*}]$ 

<sup>\*</sup> The equation which now replaces (7) would present itself more naturally in a form in which T is replaced by aT.

When n is not an integer, the integrands in these equations may be expressed in a form which, perhaps, is more familiar, by the aid of equations of the type

$$\begin{split} K_n(x)K_n(ye^{\pi i}) - K_n(xe^{\pi i})K_n(y) &= i\pi^2(2\sin n\pi)^{-1}\{I_n(x)I_{-n}(y) - I_{-n}(x)I_n(y)\}\\ &= i\pi^2(2\sin n\pi)^{-1}\{J_n(ix)J_{-n}(iy) - J_{-n}(ix)J_n(iy)\}. \end{split}$$

The solution may be verified by arguments\* following as closely as possible those used in connexion with the problem of Article 5.

In connexion with those steps in the proof which require the integral in  $\rho$  to be integrated by parts it may be convenient to introduce a repeated integral involving Bessel functions, viz., that value of

 $\iiint \dots (dx)^s x K_n(x) \text{ or } \pi(2 \sin n\pi)^{-1} \iiint \dots (dx)^s x (I_{-n}(x) - I_n(x))$ which, for arguments of x between  $-3\pi/2$  and  $+3\pi/2$  exclusive, is asymptotically of the form  $(-)^s (\pi x/2)^{\frac{1}{2}e^{-x}}$ .

## ART. 13. Expansions applicable to Vibrations of Elastic String itself subject to Viscous Forces.

The theorems which have been given in this paper and in the preceding may be extended to give expansions in terms of the functions which are appropriate to the vibrations of systems similar to those already discussed, in cases where the whole system is subject to viscous forces of the usual type, and probably other expansions of less physical interest.

Suppose that the problem of Article 5 is altered by having equation (12) replaced by

$$d^2 \mathbf{\phi}/dt^2 = c^2 d^2 \phi/dx^2 - f d\phi/dt + g d^3 \phi/dx^2 dt, \tag{34}$$

wherein the second term in the right-hand member is due to a resisting force proportional to the absolute velocity, and the third to forces in each crosssection resisting shear and proportional to the rate of shearing; also by altering the last term of the coefficient of  $Y_1$  in (7) to

$$-\sigma\left(c^{2}+gD\right)d/dx,$$

where  $\sigma$  denotes the linear density; of course  $\sigma e^2$  equals I', the tension.

The type-solution of (34) is  $e^{\mu x + \nu t}$ , where

$$\nu^2 = c^2 \mu^2 - f \nu + g \mu^2 \nu,$$

or

$$\nu = \frac{1}{2} \left\{ g\mu^2 - f \pm \left\{ (g\mu^2 - f)^2 + 4c^2\mu^2 \right\}^2 \right\},\tag{35}$$

and the characteristic values of  $\mu$ ,  $\nu$  are determined by

$$E^{\mu'b-a)}F_b(\nu,\,\mu)\,F_a(\nu,\,-\,\mu)-e^{\mu(a-b)}F_b(\nu,\,-\,\mu)\,F_a(\nu,\,\mu)$$
(36)

in conjunction with (35).

<sup>\*</sup> I have not, however, examined the case in which a is zero.

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Corresponding to every value of  $\mu$ , whether characteristic or not, (35) gives two values of  $\nu$ ; and it will usually be convenient to distinguish between them. I shall use the plus sign with the radical to denote that root whose argument is half that of  $(g\mu^2 - f)^2 + 4c^2\mu^2$ , and I shall denote the corresponding  $\nu$  by  $\nu_1$ ; the other value of  $\nu$  I shall denote by  $\nu_2$ . We shall consider large values of  $\mu$ , other than characteristic ones, and for all such we have the asymptotic equations

$$\boldsymbol{\nu}_1 \doteq g\mu^2 - f + c^2/g, \tag{37}$$

$$p_2 \doteq -c^2/g, \tag{38}$$

in which the errors are of the order  $\mu^{-2}$ .

The characteristic values of  $\mu$  may be divided into two sets associated respectively with characteristic values of  $\nu$  of the types  $\nu_1$ ,  $\nu_2$ , and for each set we evidently have asymptotic equations of the form

1

$$\mu = \pm m\pi i/(b-a), \tag{39}$$

where m is any large positive integer. The errors in these equations are of order not exceeding  $m^{-1}$ .

The successive characteristic values of  $\nu$  of type  $\nu_1$  thus tend to have negative real parts which increase indefinitely, and those of type  $\nu_2$  tend to a real negative limit.

There are four values of  $\mu$  which are branch-points for  $\nu$ , viz.: those for which  $(g\mu^2 - f)^2 + 4c^2\mu^2$  vanishes.

Taking the determinant  $\Delta_a$ , let us form from it the elements of another column by an extension of the method by which the elements (13), etc., were obtained. Expressing  $\Delta_a(D)$  in the form

in which

$$f_{11}(D) = M_{11}D^2 + k_{11}D + \lambda_{11} - \sigma (c^2 + gD)d/dx, \qquad (41)$$

let us write down

+

$$\frac{(c^2+g\nu) f_{11}(D) - (c^2+gD) f_{11}(\nu)}{D-\nu} y_1 + \frac{(c^2+g\nu) f_{12}(D) - (c^2+gD) f_{12}(\nu)}{D-\nu} y_2$$

$$+ \frac{(c^2 + g\nu) f_{13}(D) - (c^2 + gD) f_{13}(\nu)}{D - \nu} y_3 + \dots, \qquad (42)$$

$$\frac{(e^2 + g\nu) f_{21}(D) - (e^2 + gD) f_{21}(\nu)}{D - \nu} y_1 + \frac{(e^2 + g\nu) f_{22}(D) - (e^4 + gD) f_{22}(\nu)}{D - \nu} y_2$$

$$\frac{(c^2+g\nu) f_{23}(D) - (c^2+gD) f_{23}(\nu)}{D-\nu} y_3 + \dots, \qquad (43)$$

etc., and afterwards replace each Dy by the corresponding v.

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These expressions are respectively

$$(M_{11}c^{2}\nu + k_{11}c^{2} - \lambda_{11}g)y_{1} + M_{11}(g\nu + c^{2})v_{1} + (M_{12}c^{2}\nu + k_{12}c^{2} - \lambda_{12}g)y_{2} + M_{12}(g\nu + c^{2})v_{2} + \dots$$
(44)  

$$(M_{21}c^{2}\nu + k_{21}c^{2} - \lambda_{21}g)y_{1} + M_{21}(g\nu + c^{2})v_{1} + (M_{22}c^{2}\nu + k_{22}c^{2} - \lambda_{22}g)y_{2} + M_{22}(g\nu + c^{2})v_{2} + \dots,$$
(45)

etc. They are the analogues not of (13), etc., but of those expressions each multiplied by c. They are to be used instead of (13) et seq. in forming the determinants  ${}_{a}\Pi_{1, a}\Pi_{2}$ , etc.

The solution of the problem is contained in the typical equations

$$\begin{split} \phi &= (4\pi i)^{-1} \int_{c} \int e^{\nu_{1}t} d\mu \left[ \left\{ e^{\mu(x-a)} F_{a}(\nu_{1}, -\mu) - e^{-\mu(x-a)} F_{a}(\nu_{1}, \mu) \right\} \\ \left\{ \int_{a}^{b} \left\{ e^{\mu(u-b)} F_{b}(\nu_{1}, -\mu) - e^{-\mu(u-b)} F_{b}(\nu_{1}, \mu) \right\} \left\{ \nu_{2} \psi(u) - \chi(u) \right\} du + 2\mu_{b} \Pi_{1}(\nu_{1}) \right\} \\ &- 2\mu_{a} \Pi_{1}(\nu_{1}) \left\{ e^{\mu(x-b)} F_{b}(\nu_{1}, -\mu) - e^{-\mu(x-b)} F_{b}(\nu_{1}, \mu) \right\} \\ & \div (\nu_{1} - \nu_{2}) \left\{ e^{\mu(b-a)} F_{b}(\nu_{1}, \mu) F_{a}(\nu_{1}, -\mu) - e^{\mu(a-b)} F_{b}(\nu_{1}, -\mu) F_{a}(\nu_{1}, \mu) \right\} \\ &+ a \text{ term derived from this by interchanging } \nu_{1}, \nu_{2} ; \end{split}$$

$${}_{a}Y_{2} = (4\pi i)^{-1} \int_{c} e^{\nu_{1}t} d\mu \left[ \left\{ 2\mu\sigma(g\nu_{1} + e^{2})\mathcal{A}_{12}(\nu_{1}) \right\} \right. \\ \left\{ \int_{a}^{b} \left\{ e^{\mu(u-b)} F_{b}(\nu_{1}, -\mu) - e^{-\mu(u-b)} F_{b}(\nu_{1}, \mu) \right\} \left\{ \nu_{2}\psi(u) - \chi(u) \right\} du + 2\mu_{b}\Pi_{1}(\nu_{1}) \right\} \\ \left. - 2\mu_{a}\Pi_{2}(\nu_{1}) \left\{ e^{\mu(x-b)} F_{b}(\nu_{1}, -\mu) - e^{-\mu(x-b)} F_{b}(\nu_{1}, \mu) \right\}_{x=a} \right\} \doteq \text{Denominator of } (46) \\ + \text{a term derived from this by interchanging } \nu_{1}, \nu_{2}; \qquad (47)$$

$${}_{b}Y_{2} = -(4\pi i)^{-1} \int_{c} \int e^{\nu_{1}t} d\mu \left[ \left\{ 2\mu\sigma(g\nu_{1}+e^{2})B_{12}(\nu_{1}) \\ \left\{ \int_{a}^{b} \left\{ e^{\mu(u-a)}F_{a}(\nu_{1},-\mu) - e^{-\mu(u-a)}F_{a}(\nu_{1},\mu) \right\} \left\{ \nu_{2}\psi(u) - \chi(u) \right\} du - 2\mu_{a}\Pi_{1}(\nu_{1}) \right\} \\ - 2\mu_{b}\Pi_{2}(\nu_{1}) \left\{ e^{\mu(x-a)}F_{a}(\nu_{1}-\mu) - e^{-\mu(x-a)}F_{a}(\nu_{1},\mu) \right\}_{x=b} \right\} \div \text{Denominator of (46)} \\ + \text{a term derived from this by interchanging } \nu_{1}, \nu_{2}.$$
(48)

The contour is again an infinite closed one surrounding the origin and which, of course, avoids the zeros of the denominator.

In view of the length of this paper it seems unnecessary to give the verification. One point to be borne in mind in it is that  $g_{\nu_2} + c^2$  is a small quantity of order  $\mu^{-2}$ .

If we prefer it, the two terms in (46), (47), or (48), may be combined into one integral taken along a continuous path. In the integrand in the first term substitute for  $\nu_1$ ,  $\nu_2$  in terms of  $\mu$ ; then let either value of the radical

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be taken initially. Integrate this integrand alone along a path consisting of, (i) a closed contour surrounding the origin and everywhere at infinity, (ii) a contour having the same beginning and end as (i), but enclosing one and only one of the branch-points, (iii) the contour (i) again, (iv) the contour (ii) reversed. This will give the same result; for in (ii) the final value of the radical is equal in magnitude and opposite in sign to the initial, so that the contours (i) and (iii) give the previous results and the integrals along (ii) and (iv) cancel each other.

In reducing the preceding integrals to sums of residues we may first draw small contours round each of the branch-points, and then join each of these contours to some common point in the plane by curves which do not pass through any zero of the denominator. The sum of the two terms in (46), for example, reduces to the sums of the residues arising from both terms due to all zeros of the denominators other than the branch-points, taken along with the integrals of both terms along the small contours surrounding the branch-points; for along the curves joining these contours to the common point the integral from the first term and that from the second cancel each other. The integrals along the small contours are zero unless the branch-points themselves are roots of the characteristic equation.

## ART. 14. A Circular or Annular Membrane, itself subject to Viscous Forces.

We may similarly modify the problem of  $\S12$  by introducing viscous forces in the lamina itself. In that case (34) is replaced by

 $(d^2/dr^2 + r^{-1}d/dr - n^2r^{-2})(c^2\phi + gd\phi/dt) = d^2\phi/dt^2 + fd\phi/dt, \quad (49)$ and type-solutions are  $\phi = e^{\nu t}K_n(\pm \mu r),$ 

where the equation connecting  $\mu$ ,  $\nu$  is identical with (35).

The solution may be obtained by modifying that of §12 in a fashion similar to that in which the solution of §5 has been modified to give that of §13: it seems unnecessary to actually give it.

## ART. 15. The above Solutions agree with those found by aid of the characteristic Property of Normal Functions.

Returning to the problem of Arts. 5–8, the form of equation (16) suggests the following theorem :—If  $\phi$ , Y, denote the displacements in any one fundamental motion having the time-factor  $e^{\mu ct}$ , and if the same letters with dashes denote the corresponding quantities in any other fundamental mode, then

$$T(\mu + \mu') \int_{a}^{b} \phi \phi' dx + {}_{a}\Pi_{1}(\mu, Y'_{a}) \phi_{a}/A_{11}(\mu) + {}_{b}\Pi_{1}(\mu, Y'_{b}) \phi_{b}/B_{11}(\mu) = 0, \quad (50)$$

where  $\Pi_1(\mu, Y')$  denotes the value of  $\Pi_1(\mu)$  when each y, v, is replaced by the corresponding Y', dY'/dt. This equation is obtainable directly, and by its aid the normal coordinates which constitute the coefficients of the separate terms in the series of residues which is equivalent to the right-hand member of (16) may be obtained in the usual manner by integration.

The analogous equation applicable to the problem of Art. 12 differs only in having in the first term dx in the integrand replaced by rdr, and in having the second and third terms multiplied by a, b respectively.

The forms of the analogous equations in the corresponding problems of Heat-Conduction should be obvious.

Again, in the problem of Art. 13, the form of the right-hand member of (46) suggests the equation analogous to (50), which may be written in the form

$$\sigma(c^{2}f + c^{2}(\nu + \nu') + g\nu\nu') \int_{a}^{b} \phi \phi' dx + {}_{a}\Pi_{1}(\nu, Y'_{a})\phi_{a}/A_{11}(\nu) + {}_{b}\Pi_{1}(\nu, Y'_{b})\phi_{b}/B_{11}(\nu) = 0,$$
(51)

in which  $\nu$  may be either  $\nu_1$  or  $\nu_2$ , and  $\nu'$  either  $\nu'_1$  or  $\nu'_2$ . This equation, also, may be verified directly.

And, to obtain the corresponding equation for the problem of Art. 14, we again simply in (51) replace in the first term dx by rdr, and multiply the second and third terms by a, b respectively.

In the case of each of the six problems alluded to, I have verified that the solutions obtained by the two methods agree. It must be borne in mind that, in the Fourier solutions given above for the problems of Arts. 13, 14, each term occurs twice.

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#### III.

# THE LINEAR COMPLEX, AND A CERTAIN CLASS OF TWISTED CURVES.

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Read FEBRUARY 13. Published JUNE 24, 1911.

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## I.-SUMMARY.

THE class of twisted curves with which this paper deals is characterized by the property that the class of each cycle of the curve is equal to its degree. These curves are called *P*-curves in the paper.

In section III it is shown that every curve whose tangents belong to a linear complex is a *P*-curve.

Sections IV, V, VI, and VII are the result of an attempt to prove that all algebraic *P*-curves belong by their tangents to a linear complex. This I have found not to be the case.

In section IV rational *P*-curves are discussed, the homogeneous pointcoordinates (x) and plane-coordinates  $(\alpha)$  being represented by polynomials in a parameter *t*. It is shown that the class of a *P*-curve is equal to its degree, and that such a curve is characterized by one of a number of equivalent identical equations. If we write

$$\sum_{i} \frac{d^{m}}{dt^{m}} a_{i} \frac{d^{n}}{dt^{n}} x_{i} = (mn), \quad (i = 1, 2, 3, 4),$$

one of these identities is

$$(22) = 0.$$

In section  $\nabla$  these results are extended to algebraic *P*-curves. It is **B.I.A.** PROC., VOL. XXIX., SECT. A. [5]

shown that the class of the curve is equal to the degree, and that the coordinates can be represented by two sets of four "rational" functions of the analytic point t on a Riemann surface, all the functions having the same poles, and neither set of four having a common zero: these functions satisfy the identities of the preceding section.

In section VI it is shown that the necessary and sufficient condition that an algebraic P-curve should belong to a linear complex can be written in either of the equivalent forms

$$(33) = 0,$$
  
$$W_1 = \sum a_i(\theta) x_i(t) + \sum a_i(t) x_i(\theta) = 0$$

(for all positions of the points t and  $\theta$  on the curve).

Two corollaries follow. (1) An algebraic curve, which is such that the osculating plane at a point A will meet the curve again at B if the osculating plane at B passes through A, belongs to a linear complex. (2) Every *P*-curve of the fifth or lower degree belongs to a linear complex.

Section VII is chiefly metrical. Considerable use is made of two theorems on curves of a linear complex communicated to the writer by Professor M'Weeney of University College, Dublin. From one of these an expression is deduced for the curvature of a complex curve in terms of the torsion and its first two differential coefficients. By means of this the equations are found of the most general cylindrical helix belonging to a linear complex. From the second the value of the torsion of an algebraic *P*-curve is deduced in terms of the parameter *t* used in the preceding sections. By means of this expression the conditions (33) = 0,  $W_1 = 0$  for a complex curve are interpreted geometrically. It is found that a *P*-sextic will belong to a linear complex if it contains a point of one of three given species.

In section VIII the higher singularities of P-quintics are discussed. In section IX some of Pittarelli's results on the asymptotic lines of ruled surfaces of a linear complex are given, with some additions. These lead to the discussion in section x of the properties of the P-quintic with a bitangent.

It may not be out of place to point out that the letter chosen to represent this special class of curves is the initial of M. Picard's name. These curves are characterized by what we may call the generalized Picard theorem (see section III); they owe M. Picard a debt, and can claim a relationship with him.

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#### II.—GENERALITIES.

1. If the point (x) and the plane (a) are specified by the coordinates  $x_i$ ,  $a_i$ , (i = 1, 2, 3, 4), the Plücker coordinates of the line (xy) or  $(a\beta)$  are the two sets of twelve numbers

$$p_{ij} = \begin{vmatrix} x_i x_j \\ y_i y_j \end{vmatrix}, \quad \varpi_{ij} = \begin{vmatrix} a_i a_j \\ \beta_i \beta_j \end{vmatrix},$$
$$p_{ij} = -p_{ji}, \quad \varpi_{ij} = -\varpi_{ji}.$$

A linear complex is defined by

$$\Sigma a_{ij} p_{ii} = 0$$
, or  $\Sigma a_{ij} \varpi_{kl} = 0$ , (1)

the  $a_{ij}$  being constants such that  $a_{ij} + a_{ji} = 0$ .

2. The properties of curves whose tangents belong to a linear complex have been studied by Appell (Annales de l'Ecole Normale, 1876, pp. 245 sq.); Picard (*ibid.*, 1877); Koenigs (Annales de la Faculté des Sciences de Toulouse, 1887); Lie (v. "Geometrie der Berührungstransformationen," ch. 6, § 4, where other references are given).

A short account of these curves is given by Jessop ("Treatise on the Line Complex," pp. 47-50). Other references are given in the course of this paper.

3. M. Appell has shown that the osculating plane at a point on such a curve is the polar plane of the point with respect to the complex. From this it follows that the plane-coordinates of an element are proportional to linear functions of the point-coordinates. In fact, taking (x) as the point on the curve and (y) a variable point, the polar plane of (x) with respect to the complex (1) is

$$\Sigma a_{ij} \left( y_i x_j - y_j x_i \right) = 0.$$

Hence the coordinates of the osculating plane (a) at (x) satisfy the equations

$$\frac{a_{21}x_2 + a_{31}x_3 + a_{41}x_4}{a_1} = \frac{a_{12}x_1 + a_{32}x_3 + a_{42}x_4}{a_2} = \dots, \qquad (2)$$

where  $a_{ij} = -a_{ji}$ .

It follows that the class of the curve is equal to its degree; and further, that if the curve has a singularity at a point, expressed in a given form in terms of the  $x_i$ , it will have at the same point the singularity represented by similar expressions in terms of the  $a_i$ .

## III.-EXTENSION OF A THEOREM OF PICARD.

4. There are in general on a curve in space a certain number of points at which the osculating plane has stationary (four-point) contact with the curve. The tangent line at such a point may meet the curve in two or in three consecutive points. M. Picard has shown (*loc. cit.*) that if the curve belongs (by its

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tangents) to a linear complex, the tangent line at such a point has three-point contact with the curve, as in the case of an inflexion on a plane curve. Such a point we shall term an *inflexion* in the course of this paper.

5. M. Picard's theorem may be extended to higher singularities as follows :--

If at a point P on a curve belonging to a linear complex the curve has p, q, r consecutive points in common with the osculating plane, the tangent, and an arbitrary plane through P respectively, then shall

$$p = q + r. \tag{3}$$

To prove this, we take the osculating plane at P as  $x_1 = 0$ , the plane at infinity as  $x_4 = 0$ , the plane through the tangent at P, and the pole  $\Omega$  of the plane at infinity with respect to the complex as  $x_2 = 0$ , and any other plane through  $P\Omega$  as  $x_3 = 0$ .

The equation of the complex will be of the form

$$a_{14} p_{14} + a_{23} p_{23} = 0 \dots$$

For a tangent to the curve we can write

$$p_{ij} = x_i \, dx_j - x_j \, dx_i \, \ldots \, ;$$

hence the coordinates (x) of a point on the curve satisfy the equation

$$-a_{14}\,dx_1+a_{23}\,(x_2\,dx_3-x_3\,dx_2)=0,$$

when we have put  $x_4 = 1$ ,  $dx_4 = 0$ .

Now in the neighbourhood of P, in virtue of what is given, we can express the coordinates of a point on the curve in series of ascending powers of a parameter t in the form

$x_1$	=	$at^p$	+				1	
$x_2$	=	$bt^q$	+					(4)
$x_3$	=	$ct^r$			۰.		[	(4)
14	=	1				(abe = 0, p > q > r)	!	

Substituting these values in the differential equation satisfied by the curve, the terms of lowest degree on the left-hand side are

$$-a_{14}a_{p}t^{p-1} - a_{23}bc(q-r)t^{q+r-1}$$
.

We must therefore have, if the equation is to be satisfied identically,

$$p = q + r$$
.

6. This form of the proof is probably the simplest that can be given; it is substantially the same as that given by M. Picard for the restricted form of the theorem (p = 4, q = 3, r = 1).

The argument may, however, be put in another form, which has the advantage of showing that the theorem is only a particular case of the reciprocal property mentioned above (11). It also introduces considerations to which we shall have occasion to recur.

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The tetrahedron of reference being that already chosen, the osculating plane at the point (x) is

$$a_{14}(y_1 - x_1) + a_{23}(y_2 x_3 - y_3 x_2) = 0,$$

the  $y_i$  being running coordinates.

Hence the equations (2) become

$$\frac{a_1}{a_{14}} = \frac{a_2}{a_{23}x_3} = \frac{a_3}{-a_{23}x_2} = \frac{a_4}{-a_{14}x_1};$$

and hence, in the neighbourhood of P, by equations (4),

$$\begin{array}{c} a_4/a_1 = \alpha't^p + \text{higher powers,} \\ a_3/a_1 = b't^q + \dots, \\ a_2/a_1 = c't^r + \dots \end{array} \right\}$$
 (5)

Now, the equation of the osculating plane can also be written in the form

$$\begin{vmatrix} y_1 & y_2 & y_3 & y_4 \\ x_1 & x_2 & x_3 & x_4 \\ \dot{x}_1 & \dot{x}_2 & \dot{x}_3 & \dot{x}_4 \\ \ddot{x}_1 & \ddot{x}_2 & \ddot{x}_3 & \ddot{x}_4 \end{vmatrix} = \Sigma A_i y_i = 0,$$
 (5a)

the dots denoting differentiation with respect to t. If we substitute for the  $x_i$ and their derivatives the values given by (4), we see at once that  $A_1, A_2, A_3, A_4$ are of orders q+r-3, p+r-3, p+q-3, p+q+r-3 respectively in t; and hence we can write

$$\begin{array}{cccc} A_4/A_1 &= a''t^p &+ \text{ higher powers,} \\ A_3/A_1 &= b''t^{p-r} + \dots, \\ A_2/A_1 &= c''t^{p-q} + \dots, \end{array} \right\} .$$
 (6)

Now the  $A_i$  are proportional to the  $a_i$ , being the coordinates of the same plane; hence  $A_i/A_1 = a_i/a_1$ , and the equations (6) are therefore the same as the equations (5), which involves the result stated.

This second form of the proof may be thus summarized :—The *class* of a singularity P on a curve, i.e. the number of osculating planes coincident with that at P, which can be drawn through an arbitrary point in the osculating plane at P, is p - q. The *degree* of the singularity, i.e. the number of points coincident with P in which the curve is met by an arbitrary plane through P, is r. If the curve belongs to a complex, the degree and the class of the singularity are equal, and hence p - q = r.

7. The equations (4) represent a cycle with r branches, of degree r and class p-q. The theorem of this section may be stated thus:—The degree of any cycle of the curve is equal to its class.

#### IV.-RATIONAL P-CURVES.

8. We shall use the term *P*-curve to denote a curve at every point of which p - q - r vanishes: in other words, a curve of which every cycle has its degree equal to its class. Every curve belonging to a linear complex is a *P*-curve; but the converse is only true, as we shall see, when the degree of the curve is less than six.

9. A rational curve of the *n*th degree is specified by four polynomials in t,  $x_i(t)$  (i = 1, 2, 3, 4), which are proportional to the homogeneous coordinates of a point on the curve. The polynomials  $x_i$  have no common factor. The coordinates of the osculating plane will be proportional to four polynomials  $a_i(t)$ , whose degree N is equal to the class of the curve.

We shall need the determinants

$$D = | x_i x_i x_i x_i | ,$$
  
$$\Delta = | a_i a_i a_i a_i | .$$

In the neighbourhood of any point  $t_0$  we can write, by changing the tetrahedron of reference and putting t for  $t - t_0$ ,

$$\begin{cases} y_1 = at^p + a't^{p+1} + \dots \\ y_2 = bt^q + \dots \\ y_3 = ct^r + \dots \\ y_4 = d + d't + \dots \\ (p > q > r > 0, \ abcd \neq 0 \end{cases} \right\},$$
(7)

where the  $y_i$  are linear functions of the  $x_i$ . It is easily seen that the determinant D(y) has a zero of order p+q+r-6 at the point. Again, D(y)/D = const.; hence D has a zero of order p+q+r-6 at every point where this number is greater than zero (its value at an ordinary point of the curve is zero, and it is never negative).

Again, at the point  $t_0$ , let  $\beta_i$  be the transformed plane coordinates corresponding to  $y_i$ , the  $\beta_i$  being equal to linear functions of the  $a_i$ . From equations (6) we see that  $\beta_4/\beta_1$ ,  $\beta_3/\beta_1$ ,  $\beta_2/\beta_1$  are of orders p, p-r, p-q respectively in t. Again,  $\beta_1$  cannot have a zero at the point, otherwise the  $\beta_i$  would all vanish at the point, and the new tetrahedron of reference would vanish also. Hence we can write

$$\begin{cases} \beta_{1} = a_{0} + a'_{0}t + \dots \\ \beta_{2} = b_{0}t^{p-q} + \dots \\ \beta_{3} = c_{0}t^{p-r} + \dots \\ \beta_{4} = d_{0}t^{p} + \dots \\ \alpha_{0}b_{0}c_{0}d_{0} \neq 0 \end{cases} ;$$

$$\end{cases}$$

$$(8)$$

and the determinant  $\Delta(\beta)$ , and therefore  $\Delta$ , will have a zero of order

$$p + (p - r) + (p - q) - 6 = 3p - q - r - 6$$

at the point.

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For a *P*-curve the two numbers p+q+r-6 and 3p-q-r-6 are equal at every point to 2p - 6. It follows that D and  $\Delta$  have the same roots, and therefore  $\Delta/D = k$ , where k is a constant.

Conversely, if  $D = k\Delta$ , our reasoning shows that p = q + r at every point; the property is therefore peculiar to P-curves.

10. If we choose the parameter t so that the point  $t = \infty$  is an ordinary point on the curve, the degrees of D and  $\Delta$  are respectively 4n - 12 and 4N-12. Hence the class of a rational *P*-curve is equal to its degree.

Again, we have  $4n - 12 = 2\Sigma (p - 3);$ (9)and hence, to generalise the theorem (due to M. Picard) that a rational curve belonging to a linear complex has 2n - 6 inflexions, we must count a (p, q, r)point as equivalent to p-3 inflexions.

11. For a *P*-curve, every root of D (or  $\Delta$ ) is of even multiplicity (2p-6); hence D is the square of a polynomial of order 2n - 6. To find this polynomial, we write

$$\sum_{i} \frac{d^{m} a_{i}}{dt^{m}} \frac{d^{n} x_{i}}{dt^{n}} = (mn).$$

Multiplying the determinants D and  $\Delta$  by the ordinary rule, and remembering that, since (a) is the osculating plane at (x),

$$(00) = (01) = (10) = (02) = (11) = (20) = 0, \dots$$
(10)  
$$kD^2 = DA = (03)(12)(21)(30).$$

we find

$$D^2 = D\Delta = (03)(12)(21)(30).$$

If we differentiate the last three of the equations (10), we find

$$03) = -(12) = (21) = -(30). \dots (11)$$

Hence

Hence

$$kD^2 = (03)^4$$
... (12)

The required polynomial is therefore (03), aside from a constant factor. The identity (12) is obviously equivalent to  $kD = \Delta$ , and is therefore peculiar to P-curves.

12. Again, we have

(

$$\frac{a_1}{\partial D/\partial x_1} = \frac{a_2}{\partial D/\partial x_2} = \dots = \frac{\sum a_i x_i}{D} = \frac{(03)}{D}$$
$$= \frac{(04)}{|x_i \dot{x}_i \dot{x}_i \dot{x}_i|} = \frac{(04)}{\dot{D}} \cdot$$
Hence
$$\frac{\dot{D}}{D} = \frac{(04)}{(03)} \cdot$$
In like manner
$$\frac{\dot{\Delta}}{\Delta} = \frac{(40)}{(30)} = \frac{-(40)}{(03)} \cdot$$

Hence the condition

$$\Delta = kD$$
, or  $\Delta/\Delta = D/D$ ,

is equivalent to the condition

$$(04) + (40) = 0...$$

If we differentiate the equations (11), we see that this is equivalent to

$$(13) + (31) = 0, (22) = 0;$$

and any one of these three equations involves the other two. Differentiating the three, we infer that

$$(05) + (50) = (14) + (41) = (23) + (32) = 0.$$

13. There is another form in which the condition for a P-curve may be put. Let

$$X_{ij} = x_i \dot{x}_j - x_j \dot{x}_i, \quad A_{ij} = a_i \dot{a}_j - a_j \dot{a}_i$$

be the point and plane coordinates of the tangent at (x). Then all the fractions  $A_{kl}/X_{ij}$  are equal, if we suppose that i, j, k, l are 1, 2, 3, 4, taken in order, so that j > i, and l > k or < k, according as k + l is even or odd. Let these fractions be equal to  $\mu$ , so that

then

$$A_{kl} = \mu X_{ij},$$

$$A_{kl} = \mu X_{ij} + \mu X_{ij}.$$

Now, if the curve is a *P*-curve, the equations

$$(00) = (22) = 0$$

show that the line joining the two points (x) and  $(\ddot{x})$  lies in the two planes (a) and  $(\ddot{a})$ . Hence the fractions

$$\frac{a_k \ddot{a}_l - a_l \ddot{a}_k}{x_i \ddot{x}_j - x_j \ddot{x}_i} = \frac{\dot{A}_{kl}}{\dot{X}_{ij}}$$

are all equal, say to  $\lambda$ . Hence

$$\dot{A}_{kl} = \lambda \dot{X}_{ij}$$

Hence

$$\lambda \dot{X}_{ij} = \mu \dot{X}_{ij} + \dot{\mu} X_{ij}, \quad \dot{X}_{ij} / X_{ij} = \dot{\mu} / (\mu - \lambda).$$

It follows either that all the fractions  $X_{ij}/X_{ij}$  are equal, and therefore that the ratios of the  $X_{ij}$  are constant, or else that

$$\mu = \lambda, \quad \mu = 0.$$

The first supposition is inadmissible, and therefore, for a *P*-curve,  $\mu$  is constant. Conversely, if  $\mu$  is constant, we have

$$A_{kl} = \mu X_{ij},$$

which shows that the line whose plane-coordinates are  $\dot{A}_{ij}$  is identical with the line whose point-coordinates are  $\dot{X}_{ij}$ ; this shows that the plane  $(\ddot{a})$  and the point  $(\ddot{x})$  are incident, and hence (22) = 0.

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14. To summarize the properties we have shown to belong to a rational P-curve :--

- (1) The class is equal to the degree.
- (2)  $\Sigma(p-3) = 2n 6.$

(3) The curve is characterized by the following identities, any one of which involves the others :---

(a) 
$$p - q - r = 0;$$
  
(b)  $\Delta = kD;$   
(c)  $k^{\frac{1}{2}}D = (03)^{2};$   
(d)  $(22) = 0, \text{ from which follows}$   
(e)  $(mn) + (nm) = 0, (m + n < 6);$   
(f)  $\mu = A_{kl}/X_{ij} = \text{const.}$   
(13)

Note.-We shall see in the next section that, for an algebraic P-curve, we can represent the coordinates  $x_i$  and  $\alpha_i$  by functions of order *n*, rational on a Riemann surface, and having their poles in common; and for these the equations (13) will hold.

Note on the General Rational Curve.

15. For any rational curve we can write

$$\mu = \sum a_{ij} A_{kl} / \sum a_{ij} X_{ij} = A / X,$$

where the  $a_{ij}$  are arbitrary constants. It is easily verified from equations (7) and (8) that, at a point with the characteristic numbers p, q, r, A and X have zeros of order r-1 and p-q-1 respectively. The other zeros of X are the points where the tangent belongs to the complex  $\sum a_{ij} p_{ij} = 0$ , and these are also zeros of A. Removing these, we find

$$\mu = k_1 \prod_{t_s} (t - t_s)^{r-1} / \prod_{t_s} (t - t_s)^{p-q-1} = k_1 \prod (t - t_s)^{q+r-p}, \ldots \qquad (a)$$

where the continued product applies to all points  $t_s$  at which either r or p-qis greater than unity.

Again,

$$D/\Delta = k_2 \prod (t - t_s)^{p + q + r - 6 - (3p - q - r - 6)} = k_2 \prod (t - t_s)^{2(q + r - p)} = k_3 \mu^2 \dots (\beta)$$

Ħ

Hence 
$$k_3 \mu^2 = D^2 / D\Delta = D^2 / (03)^4, \ \mu = k_4 D / (03)^2. \ \dots \ (\gamma)$$

A and X are respectively of degrees 2N-2 and 2n-2 in t, N and n being the class and degree of the curve. The order of  $\mu$  for  $t \rightarrow \infty$  is therefore 2(N-n). Hence

$$\Sigma(q+r-p) = 2(N-n)...$$
 (\delta)

Again, hence

$$(03)^4 = D\Delta = k_5 \Pi (t - t_s)^{4p-12},$$
  
(03) =  $k_6 \Pi (t - t_s)^{p-3}, \dots$  ( $\epsilon$ )

[6]

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It follows that D and  $\Delta$  each contain (03) as a factor, since the exponents of  $(t - t_s)$  in D and  $\Delta$ , namely p + q + r - 6 and 3p - q - r - 6, are each at least equal to p - 3.

The degree of (03) is seen to be N+n-6 by writing  $\theta = t + (\theta - t)$  in  $\Sigma a_i(t) x_i(\theta)$  and expanding in powers of  $(\theta - t)$ . We find that  $(\theta - t)^3$  divides  $\Sigma a_i(t) x_i(\theta)$ , and that

 $\sum \alpha_i(t) x_i(\theta) / (\theta - t)^3 = (03)/3! + (\theta - t) G,$ 

where G is finite or zero for  $\theta = t$ . The left-hand side is of degrees N-3, n-3 in t and  $\theta$  respectively. Hence, putting  $\theta = t$ , we find that (03) is of degree N+n-6.

Hence 
$$\Sigma (p-3) = N + n - 6.$$
  
If we write  $\varpi = p - 3$ ,  $k = q - 2$ ,  $\rho = r - 1$ , we have  
 $\Sigma \varpi = N + n - 6,$   
 $\Sigma (k + \rho - \varpi) = 2N - 2n;$   
hence  $\Sigma (k + \rho) = 3N - n - 6.$ 

$$(\zeta)$$

For a *P*-curve these results coincide with those already found.\*

The n-3, n-3 Relation on a Curve of a Linear Complex.

16. If the osculating plane at a point A on a curve of a linear complex passes through another point B on the curve, that at B will pass through A. AB will be a line of the complex. If the curve is a rational n - ic, the parameters of A and B are connected by a symmetric n - 3, n - 3 relation, say,

$$V(t,\boldsymbol{\theta}) = 0.$$

V(t, t) will vanish at the points where p > 3. It is of degree 2n - 6, and is easily seen to be equal to (03), apart from a numerical factor. In fact,

Hence  

$$V(t, \theta) = \sum a_i(t) x_i(\theta) / (\theta - t)^3.$$

$$V(t, t) = \operatorname{Lt}_{\theta > t} V(t, \theta) = (03)/3!$$

It follows that V(t, t) has a zero of order p - 3 at a point  $t_0$  where p > 3. Again, it is easily seen that  $V(t, t_0)$  has a zero of the same order at  $t_0$ . For if we write  $t = t_0 + (t - t_0)$  and expand  $x_i(t)$  in powers of  $(t - t_0)$ , we find

$$V(t, t_0) = (03)_0/3! + (t - t_0)(04)_0/4! + \dots$$

Now at the point  $t_0$  we have

 $(00) = (01) = (02) = \dots (0m) = 0, (m = p - 1), (0p) \neq 0,$ which proves the proposition.

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<sup>&</sup>lt;sup>\*</sup> A number of questions connected with non-linear cycles on twisted curves are treated by W. A. Versluys in three papers:—Proceedings of the Royal Academy of Sciences, Amsterdam, vol. viii. (1905), p. 498; and vol. ix. (1906), p. 364 (English series). Archives du Musée de Teyler, Haarlem, sér. 2, vol. x. (1907), pp. 253-365. (On curves of the type  $x = at^n$ ,  $y = bt^{n+r}$ ,  $z = ct^{n+r+m}$ .)

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17. It is natural to ask whether to every symmetric polynomial  $V(t, \theta)$ , of degree n-3 in  $\theta$  and in t, there corresponds a rational complex curve such that V = 0 is the condition that the line  $t\theta$  should belong to the complex.

From what we have just proved, this is not so unless V satisfies the following condition:—Let t and  $\theta$  denote the Cartesian coordinates of a point in a plane. Then at any point  $(t_0, t_0)$  where the curve V = 0 meets its axis of symmetry  $t = \theta$ , the three lines  $t = t_0$ ,  $t = \theta$ ,  $\theta = t_0$  must have contact of the same order with the curve V.

18. This condition is necessary but not sufficient. Consider, for instance, the 2, 2 relation

$$\boldsymbol{V} = t^2 + \boldsymbol{\theta}^2 + at\boldsymbol{\theta} = 0, \quad (a+2\neq 0),$$

and suppose that there is a corresponding rational quintic Q. The stationary points\* on Q are given by the roots of the *quartic*,

$$V(t, t) = (a + 2) t^2 = 0,$$

which has t = 0 and  $t = \infty$  as double roots. Hence, at the points 0 and  $\infty$  on Q, p = 5. Each of these points is therefore either an *undulation* (p = 5, q = 4, r = 1) or a cusp (5, 3, 2). Since any plane through the tangent at an undulation meets the curve at only one other point, there cannot be a cusp and an undulation on the same quintic. Hence the coordinates of a point on Q may be written either  $t^5, t^4, t, 1$  (two undulations) or  $t^5, t^3, t^2, 1$  (two cusps). The 2, 2 relations are easily found to be respectively

 $3t^2 + 4t\theta + 3\theta^2 = 0, \qquad t^2 + 3t\theta + \theta^2 = 0.$ 

Hence, unless  $\alpha = 3$  or 4/3, there is no curve Q corresponding to V. I have not been able to determine the other conditions which V must satisfy.

In the case of a *P*-curve not belonging to a complex, there is an n-3, n-3 relation given by  $\mathcal{V}=0$ , where

$$(\theta - t)^3 V(t, \theta) = V_1(t, \theta) = \Sigma a_i(\theta) x_i(t) - \Sigma a_i(t) x_i(\theta).$$

This relation is discussed in section VII, 48, 49, along with the n-6, n-6 relation W = 0, where

$$(\boldsymbol{\theta} - t)^{6} W(t, \boldsymbol{\theta}) = W_{1} = \boldsymbol{\Sigma} \boldsymbol{a}_{i}(\boldsymbol{\theta}) \boldsymbol{x}_{i}(t) + \boldsymbol{\Sigma} \boldsymbol{a}_{i}(t) \boldsymbol{x}_{i}(\boldsymbol{\theta}).$$

#### V.—Algebraic P-Curves.

19. Taking Cartesian coordinates, the equations of an algebraic curve of the nth degree can be written in the form

$$x = F_1(t, t'), \quad y = F_2(t, t'), \quad z = F_3(t, t'),$$

where t and t' are connected by the algebraic equation  $\phi(t, t') = 0$ , and  $F_1, F_2, F_3$  are rational functions of the point t on the Riemann surface

\* We use this expression to denote cycles of the curve for which p > 3.

defined by  $\phi = 0$ . (The specification of the point *t* involves of course the choice of one of the values of *t'* corresponding to the given value of *t*, i.e. the choice of the sheet of the surface on which the point lies.)

The functions x, y, z will each have n zeros, and will therefore be functions of order n. If the points at infinity are distinct, and none of them is situated in any of the coordinate planes, the three functions have the same poles, all simple. We can suppose any plane to be the plane at infinity: in other words, we can suppose, if necessary, that x, y, z, 1 are proportional to the homogeneous coordinates of a point on the curve with respect to a finite tetrahedron; hence we can suppose the poles to be common to x, y, z and simple.

The plane coordinates will be given by three functions  $\lambda, \mu, \nu$ , rational on the Riemann surface, and satisfying  $\lambda x + \mu y + \nu z = 1$ .

The order of  $\lambda$ ,  $\mu$ , and  $\nu$  will be N, the class of the curve. Their poles will give the osculating planes which pass through the origin. These we can also suppose simple, and common to  $\lambda$ ,  $\mu$ ,  $\nu$ .

20. Consider the function  $U = x_t/\lambda_t$ , where  $x_t$  and  $\lambda_t$  are the determinants  $(\dot{x}\ddot{y}\ddot{z})$  and  $(\lambda\ddot{\mu}\ddot{\nu})$  (corresponding to D and  $\Delta$  of the last section). U is a rational function on the Riemann surface  $\phi$ .

(a) Near an ordinary point  $M(t = t_0)$  on the surface, which is not a pole of (x) or of  $(\lambda)$ , we have, writing t for  $t - t_0$ ,

$$x, y, z, \lambda, \mu, \nu = \alpha + bt + ct^2 + \dots$$

Hence  $x_t$  and  $\lambda_t$  are finite or zero. The point will be a zero of  $x_t$  of order p + q + r - 6 = 2p - 6, provided that we can write by a change of coordinates

$$X = at^{p} + a't^{p+1} + \dots, \quad Y = bt^{q} + \dots, \quad Z = ct^{r} + \dots, \quad (p > q > r, \quad p > 3),$$

X, Y, Z being linear (integral) functions of x, y, z, 1.

When this is so, the osculating plane of the curve will be

$$AX + BY + CZ + D = 0,$$

where we may take A, B, C, D equal (and not merely proportional) to linear functions of  $\lambda, \mu, \nu, 1$ . Then, as shown in section III, the orders in t of D/A, C/A, B/A are respectively p, q, r (since we are dealing with a *P*-curve). Again, A is not infinite at M, since the point is not one of the poles of  $\lambda, \mu, \nu, 1$ ; nor is it zero, since in that case A, B, C, D would be simultaneously zero, and the determinant of transformation from  $(\lambda \mu \nu 1)$  to (A B C D) would vanish. We can therefore write

$$A = a_1 + \dots, \quad B = b_1 t^r + \dots, \quad C = c_1 t^q + \dots, \quad D = d_1 t^p + \dots$$

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Hence the determinant  $A_t$  of which one row is |A A A A| has a zero of order 2p - 6. Now  $A_t/\lambda_t = \text{const.}$ ; hence in the neighbourhood of such a point  $U = x_t/\lambda_t$  is finite and regular.

(b) At a pole of  $x, y, z, x_t$  has a pole of order 4;  $\lambda_t$  is finite, since the point is an ordinary point on the curve and 2p - 6 = 0; hence U has a pole of order 4. At a pole of  $\lambda, \mu, \nu, U$  will have a zero of order 4.

(c) Near a branch-point on the surface, we can write

$$t - t_0 = \zeta^{\mu}, \quad t' - t'_0 = h\zeta^{\lambda} + k\zeta^{\lambda+1} + \dots$$

and hence by a change of coordinates,

$$X = \alpha \zeta^p + \dots \qquad Y = b \zeta^q + \dots \qquad Z = c \zeta^r + \dots$$

It follows that as in (a),  $x_{\zeta}/\lambda_{\zeta}$  is finite, where the determinants  $x_{\zeta}$ ,  $\lambda_{\zeta}$  are formed by analogy with  $x_t$ ,  $\lambda_t$ .

$$x_{\zeta} = x_t \left(\frac{dt}{d\zeta}\right)^6, \quad \lambda_{\zeta} = \lambda_t \left(\frac{dt}{d\zeta}\right)^6,$$

hence U is finite.

Now

(d) We can deal with  $t = \infty$  by writing  $\tau = t^{-1}$ . Hence (whether the surface has or has not a branch-point at infinity) we find that, for the points for which  $t = \infty$ , the function  $x_r/\lambda_\tau = x_t/\lambda_t = U$  is finite. We assume that none of these points is a pole of x, y, z or of  $\lambda, \mu, \nu$ . This involves no loss of generality, since we can transform t homographically.

It follows from the preceding discussion that U is rational on the surface, has the *n* poles of *x*, *y*, *z* as poles of order 4, the *N* poles of  $\lambda$ ,  $\mu$ ,  $\nu$  as zeros of order 4, and has no other poles or zeros.

21. Since U must have the same number of poles as of zeros, n = N. The degree of an algebraic P-curve is equal to its class.

Again U is the fourth power of a rational function of the *n*th order. For let the four determinations of  $U^{\ddagger}$  corresponding to a point M on the surface be  $w, iw, -w, -iw, = w, w_1, w_2, w_3$ . It is easily verified that if M describes any closed path on the surface, each of the four functions  $w, w_1, w_2, w_3$ returns to its original value. Any one of them, say w, is therefore uniform, and has no singularities on the surface except n poles. Hence it is a rational function of order n.

22. Now if we write

$$x_1 = x, \quad x_2 = y, \quad x_3 = z, \quad x_4 = 1,$$
  
 $a_1 = \lambda w, \quad a_2 = \mu w, \quad a_3 = \nu w, \quad a_4 = w,$ 

the functions  $x_i$  and  $a_i$  will have the same poles (except  $x_4$ , which is constant) and neither set will have a common zero.

Again, if D and  $\Delta$  have the same meaning as in the last section,

 $D = -x_t$ ,  $\Delta = -w^4 \lambda_t = -U\lambda_t$ , and  $D/\Delta = x_t/U\lambda_t = 1$ . (14)

From this identity we can deduce as in the last section the rest of the identities (13).

23. Hence an algebraic P-curve of the nth degree is of the nth class, and can be represented by two sets of functions  $x_i$  and  $\mathbf{a}_i$ , rational of order n on a Riemann surface, and such that (a) neither set has a common zero, (b) the poles of  $\sum a_i x_i$ are the same as those of  $\sum b_i a_i$ , where the  $a_i$  and  $b_i$  are arbitrary constants.

These functions satisfy all the identities (13) of the last section.

In proving that  $D/\Delta$  is constant, we imposed a more stringent condition on the functions (x) and (a) than the condition (b): but the extension is easy, and it is not necessary for our purpose to justify it.

24. To show the necessity of the restriction (a), that neither set of functions must have a common zero, consider for example the rational quartic for which the  $x_i$  are  $t^4$ ,  $t^2$ , t, 1, and the  $a_i$  are  $1, -6t^2$ ,  $8t^3$ ,  $-3t^4$ . It is not a *P*-curve, as we can see by examining the point t = 0, or the point  $t = \infty$ . The same curve can be represented by the  $x_i t^9$ ,  $t^5$ ,  $t^3$ , t and the  $a_i$   $1, -6t^4$ ,  $8t^6$ ,  $-3t^8$ . For the latter forms we find  $D/\Delta$  constant, (22) = 0, &c.; but this tells us nothing about the curve, since *D* contains a factor *t* (due to the common zero t = 0 of the  $x_i$ ) which has no geometric meaning.

#### Metrical Significance of the Function w.

25. If x, y, z are Cartesian coordinates in par. 19, w will have the value  $kZ \sigma^{\frac{1}{2}}$ , where Z is the perpendicular from the origin on the osculating plane at  $t, \sigma$  is the torsion at t, and k is a constant. This can be inferred from the expression for the torsion of a *P*-curve given in section VII, par. 46, or it may be directly proved thus:—

If x, y, z are not rectangular, replace them by rectangular axes. This is equivalent to multiplying  $w^4 = x_t \lambda_t$  by a constant. We then have  $x_t/\lambda_t = x_s/\lambda_s$ . Also  $x_s = c^2 \sigma$ , where c is the curvature. Again, the direction-cosines  $a_3$ ,  $\beta_3$ ,  $\gamma_3$ of the binormal are equal to  $Z\lambda, Z\mu, Z\nu$ . Hence we easily find  $\lambda_s = Z^{-4}(a_3)_s$ , where  $(a_3)_s$  is the determinant formed by replacing  $\lambda, \mu, \nu$  by  $a_3, \beta_3, \gamma_3$  in  $\lambda_s$ .

Evaluating this determinant with the help of Frenet's formulae (VII, par. 36), we find  $Z^4\lambda_s = c^2\sigma^3$ , c being the curvature.

Also  $x_s = c^2 \sigma$ ; hence, remembering that w has been multiplied by a constant,

$$h^4 w^4 = x_t \lambda_t = x_{s/} \lambda_s = Z^4/\sigma^2, \quad hw = Z/\sigma^2.$$

#### Value of w on a Curve of a Linear Complex.

26. In this case, let  $\boldsymbol{\xi} = 0$  be the polar plane of the origin with respect to the complex.  $\boldsymbol{\xi}(t)$  is a function of t of order n, having the poles of x, y, z as poles, and having as zeros the poles of  $\lambda \mu v$ : in effect, the points whose osculating planes pass through the origin lie in the plane  $\boldsymbol{\xi} = 0$ . Hence

$$\boldsymbol{\xi} = k\boldsymbol{w} = k_1 \boldsymbol{Z} / \boldsymbol{\sigma}^{\frac{1}{2}},$$

where k and  $k_1$  are constants.

It will be noticed that, for a general *P*-curve, we have only been able to see that w is a function having the same poles as x, y, z, and having given zeros: for a complex curve it is a linear function of x, y, z. The equation

$$\boldsymbol{\xi} = k_1 \boldsymbol{Z} / \boldsymbol{\sigma}^{\frac{1}{2}}$$

is a particular case of a theorem due to Professor McWeeney, which holds for any curve of a linear complex, algebraic or not [VII, equation (19)].

## VI.—SUFFICIENT CONDITIONS THAT AN ALGEBRAIC CURVE SHOULD BELONG TO A LINEAR COMPLEX.

27. Every curve belonging to a linear complex is a P-curve, as we have seen (section III), and is characterized by the identity (22) = 0. In this section we investigate the further condition required, in order that an algebraic P-curve should belong to a linear complex. (A geometrical interpretation of this condition will be given in section VII.)

The following lemma is required :----

Let A, B, C, D be four points in space forming a tetrahedron of non-zero volume, and let R = 0 be the equation of a quadric. If R passes through A, B, and C, and if the tetrahedron ABCD is self-conjugate with respect to it, R must reduce to the square of the plane ABC.

This is easily proved, either analytically or geometrically.

28. Consider an algebraic *P*-curve represented in homogeneous coordinates by two sets of functions  $x_i$  and  $a_i$ . We have, in the notation of section IV,

$$(mn) + (nm) = 0$$
, if  $m + n < 6$ .

We define sixteen functions  $a_{ij}$  of t by the sixteen equations

$$\begin{array}{l} d^{m}a_{i} = a_{i1}d^{m}x_{1} + a_{i2}d^{m}x_{2} + a_{i3}d^{m}x_{3} + a_{i4}d^{m}x_{4} \\ (d = d/dt, \ i = 1, \ 2, \ 3, \ 4, \ m = 0, \ 1, \ 2, \ 3). \end{array}$$

$$(15)$$

If the functions (x) and (a) are rational either in the *t*-plane or on a Riemann surface, so likewise will be the  $a_{ij}$ .

29. Let y and z be any points in space. Let

$$\sum_{i} y_i \sum_{j} a_{ij} z_j + \sum_{i} z_i \sum_{j} a_{ij} y_j = R(yz).$$

The equation R(yy) = 0 represents in general a quadric. The coefficients  $(a_{ii}, \text{ etc.})$  being functions of t, there will be one quadric R attached to each point on the curve.

It is clear that if R(yz) vanishes, the points y and (z) are conjugate with respect to R. Also if we write  $R(\dot{x}\ddot{x}) = R(12)$ ,  $R(x\dot{x}) = R(01)$ , etc., equations (15) show that for m, n < 4,

$$R(mn) = (mn) + (nm) = 0, \quad (m \neq n) \quad R(mm) = 2(mm) = 0 \quad \text{for} \quad m = 0, 1, 2.$$

Hence the tetrahedron  $(x_i(\dot{x})(\ddot{x})(\ddot{x})$  is self-conjugate, and the first three vertices lie on R. Also if the point (x) is an ordinary point on the curve, this tetrahedron is of finite volume, since the determinant of the coordinates of its vertices, which is  $(x_i\dot{x}_i\ddot{x}_i=D)$ , does not vanish. Hence by the lemma, R reduces to the square of the plane  $(x)(\dot{x})(\dot{x})$ , i.e. of the osculating plane  $\alpha$ .

Hence

$$\begin{split} R(yy) &= \lambda(\Sigma a_i y_i)^2, & \text{and therefore} \\ (33) &= R(33) = \lambda(\Sigma a_i \tilde{x}_i)^2 = \lambda(03)^2. \end{split}$$

Therefore  $R'(yy) = (33) (\Sigma a_i y_i)^2/(03)^2$ . Hence R'(yy) vanishes identically if, and only if, (33) = 0. (16) 30. If (33) vanishes identically, so does R'(yy), and hence

$$\alpha_{ii} = \alpha_{ji} + \alpha_{ij} = 0. \tag{17}$$

Supposing this, one of the equations (15) becomes  $a_1 = a_{12}x_2 + a_{13}x_3 + a_{14}x_4$ . Differentiating this, and taking account of the value of  $\dot{a}_1$  given by another of the equations (15), we get  $\dot{a}_{12}x_2 + \dot{a}_{13}x_3 + \dot{a}_{14}x_4 = 0$ .

Treating  $\dot{a}_1$ ,  $\ddot{a}_1$  in the same way, we get

$$\dot{a}_{12}\dot{x}_2 + \dot{a}_{13}\dot{x}_3 + \dot{a}_{14}\dot{x}_4 = 0, \quad a_{12}\ddot{x}_2 + \dot{a}_{13}\ddot{x}_3 + \dot{a}_{14}\ddot{x}_4 = 0.$$

Now the determinant  $(x_2 \dot{x}_3 \ddot{x}_4)$  is not identically zero; hence

$$\dot{a}_{12} = a_{13} = \dot{a}_{14} = 0,$$

and  $a_{12}$ ,  $a_{13}$ ,  $a_{14}$  are constants. Similarly the other  $a_{ij}$  are constants. The equation (01) = 0 can then be written  $\sum a_{ij} \langle x_i \dot{x}_j - x_j \dot{x}_i \rangle = \sum a_{ij} X_{ij} = 0$ , and this is the equation of the complex to which the tangents belong.

Conversely, if the curve belongs to a linear complex we must have

$$\frac{a_1}{b_{12}x_2 + b_{13}x_3 + b_{14}x_4} = \frac{a_2}{b_{21}x_1 + b_{23}x_3 + b_{24}x_4} = \cdots$$

$$(b_{ij} \text{ const.}, \quad b_{ij} + b_{ji} = 0).$$

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Let each of these fractions be equal to  $1/\lambda$ . Then

 $\lambda a_1 = b_{12} x_2 + b_{13} x_3 + b_{14} x_4, \qquad \dot{\lambda} a_1 + \lambda \dot{a}_1 = b_{12} \dot{x}_2 + b_{13} \dot{x}_3 + b_{14} \dot{x}_4,$ 

with similar expressions for  $a_2$ ,  $\dot{a}_2$ . Hence

$$\begin{split} \lambda^2 \mathcal{A}_{12} &= \begin{vmatrix} b_{12} x_2 + b_{13} x_3 + b_{14} x_4 & b_{21} x_1 + b_{23} x_3 + b_{24} x_4 \\ b_{12} \dot{x}_2 + b_{13} \dot{x}_3 + b_{14} \dot{x}_4 & b_{21} \dot{x}_1 + b_{23} \dot{x}_3 + b_{24} \dot{x}_4 \end{vmatrix} \\ &= \begin{vmatrix} 0 & b_{12} & b_{13} & b_{14} \\ b_{21} & 0 & b_{23} & b_{24} \end{vmatrix} \times \begin{vmatrix} x_1 & x_2 & x_3 & x_4 \\ \dot{x}_1 & \dot{x}_2 & \dot{x}_3 & \dot{x}_4 \end{vmatrix} \\ &= b_{12} \Sigma b_{ij} X_{ij} - X_{34} (b_{12} b_{34} + b_{31} b_{24} + b_{23} b_{14}) \\ &= -X_{34} (b_{12} b_{34} + b_{31} b_{24} + b_{23} b_{14}). \end{split}$$

But  $A_{12}/X_{34} = \mu = \text{const.}$ ; hence  $\lambda$  is a constant. We may clearly take this constant as unity. The functions  $a_{ij}$  of equations (15) will then be equal to the  $b_{ij}$ : hence the equations (17) are satisfied, R(yy) = 0; and hence (33) = 0.

Hence the necessary and sufficient condition that an algebraic *P*-curve should belong to a linear complex is  $(33) \equiv 0$ , the functions (x) and (a) being chosen as in sections IV and V. We may note that when the functions are so chosen in the case of a complex curve, the  $a_i$  will be equal and not merely proportional to linear functions of the  $x_i$ , and conversely.

31. Corollary 1.—In order that any algebraic *P*-curve should belong to a linear complex, it is necessary and sufficient that the function

$$W_1(t, \theta) = \Sigma a_i(\theta) x_i(t) + \Sigma a_i(t) x_i(\theta)$$
(18)

should vanish for all values of t and  $\theta$ .

First, it is sufficient; for if we differentiate  $W_1 = 0$  three times with respect to  $\theta$  and three times with respect to t, and then put  $\theta = t$ , we get

$$(33) = 0.$$

Secondly, it is necessary. For if the curve belongs to a linear complex, we have seen that

Now, put  $\begin{aligned} a_i &= \sum \alpha_{ij} x_{ji}, \qquad a_{ij} = \text{const.}, \qquad \alpha_{ij} + \alpha_{ji} = 0 \qquad \alpha_{ii} = 0.\\ a_i(\theta) &= \beta_{ii}, \qquad x_i(\theta) = y_{ii}, \qquad a_i(t) = a_{ii}, \qquad x_i(t) = v_{ii}. \end{aligned}$ 

Then if we substitute for  $a_i$  and  $\beta_i$  in terms of the  $x_i$  and  $y_i$  in  $W_i$ , we find a series of terms of the form

$$(a_{ij}+a_{ji})(x_iy_j+x_jy_i)$$

which all vanish.  $W_1$  therefore vanishes identically for any curve of a linear complex.

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32. Corollary 2.—If an algebraic curve is such that whenever a point A of the curve lies on the osculating plane at a point B, B also lies on the osculating plane at A, the curve must belong to a linear complex.

This is the partial converse (since we only assert it of algebraic curves) of a well-known property of curves of a linear complex.

Consider an algebraic curve with this property. Its class is clearly equal to its degree; for the points at which the osculating plane at  $\mathcal{A}$  meets the curve are those whose osculating planes pass through  $\mathcal{A}$ .

Again, it is a *P*-curve. For consider a singularity A with the characteristic numbers p, q, r, and let B be a point where the osculating plane at Ameets the curve again. If B is not on the tangent at A, the number of points coincident with A in which the curve is met by the osculating plane at B is r(the number of branches at A). Suppose a point  $\beta$  near B on the curve. The osculating plane at  $\beta$  meets the r branches of the curve in r points near A, and the osculating plane at each of these passes through  $\beta$ , by the hypothesis. Let  $\beta$  move towards B: we see in the limiting case that the number of osculating planes coincident with that at A which can be drawn through B is r. But the number of these planes is precisely the class p - qof the singularity A. Hence p - q = r.

If B lies on the tangent at A, a similar argument shows that p - r = q. That being so, consider the function

$$S = \sum a_i(\theta) x_i(t) / \sum a_i(t) x_i(\theta).$$

Considered as functions of  $\theta$ , the numerator and the denominator have the same zeros, namely  $\theta = t$  (thrice) and the n-3 other points which lie on the osculating plane at t, and whose osculating planes pass therefore through t. They have likewise the same poles; namely the poles of the  $x_i$  (which are also those of the  $a_i$ ).

Hence S is independent of  $\theta$ . A similar argument shows that it is independent of t. It is therefore a constant. To determine its value, let  $\theta$  tend towards t. Then

$$\begin{split} & \Sigma a_i(\theta) \, x_i(t) \longrightarrow (\theta - t)^3 \, (30)/3 \, ! \\ & \Sigma a_i(t) \, x_i(\theta) \longrightarrow (\theta - t)^3 \, (03)/3 \, ! \end{split}$$

Hence the value of S is (30)/(03) = -1, and therefore  $W_1 = 0$ . The rest follows by corollary 1.

33. Corollary 3.—For an algebraic *P*-curve, putting  $\theta = t + (\theta - t)$ , and expanding  $x_i(\theta)$  and  $a_i(\theta)$  in terms of  $\theta - t$ , we find that, if  $\theta$  is sufficiently near t,

$$W_1 = \sum_{0}^{5} A_r (\boldsymbol{\theta} - t)^r / r! + (\boldsymbol{\theta} - t)^6 G,$$

where G is finite or zero for  $\theta = t$ .

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In this expansion  $A_r = (0r) + (r0)$ , and hence, by section IV, equation (13), (e),  $A_r = 0$  (r = 0, 1, 2, 3, 4, 5).

Hence  $W_1$  has a zero of order six for  $\theta = t$ . It follows that every algebraic *P*-curve whose degree is less than six belongs to a linear complex.

For consider  $W_1$  as a function of  $\theta$ . Its order is the degree of the curve, and therefore less than six. Since it has a zero of order six for  $\theta = t$ , it must vanish identically.

#### Independence of the Condition .(33) = 0.

34. So far we have not proved that the identity (33) = 0 is not involved in the identity (22) = 0 which characterizes a *P*-curve; in other words, we have not shown that a *P*-curve may exist whose tangents do not belong to a linear complex.

The locus of the point  $t^6 + 6at^5$ ,  $t^4 + 2bt^3$ ,  $t^3 + 3bt^2$ , t + a is such a curve. In effect, the plane coordinates are easily found to be

and

$$t + b$$
,  $-5t^3 - 15at^2$ ,  $5t^4 + 10at^3$ ,  $-t^6 - 6bt^5$ ,  
(22) = 0, (33) = 360 (a - b).

The curve will not belong to a linear complex unless a = b. [There are cusps at 0 and  $\infty$ , accounting for four of the six stationary points. There are two inflexions given by  $(03)/t^2 = t^2 + 2t (a + b) + 6ab = 0$ , which will coalesce if  $(a + b)^2 = 6ab$ . In the latter case the third stationary point will be a cusp and not an undulation, since a *P*-sextic with an undulation must belong to a linear complex (VII, par. 50).]

It follows that the condition (22) = 0 does not involve the condition (33) = 0.

#### VII.—METRICAL RESULTS.

35. The signs to be attached to the curvature and the torsion at a point on a twisted curve are variously determined by different writers. The system we shall adopt is Darboux's.

We take a fixed system of rectangular axes, O(XYZ). If a rigid body has the point O fixed and is rotated round OX, we consider the rotation positive if the directed line, initially coincident with the positive sense of OY, coincides with the positive sense of OZ after a rotation of amount  $\pi/2$ , we denote this positive sense of rotation by (YZ). The positive rotations will therefore be (YZ), (ZX), (XY) round the three axes.

Supposing the curve to be described by a moving point, the direction of motion determines the positive direction of the tangent. If M be the point, and MT, MN, MB be the tangent, principal normal, and binormal, we choose

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arbitrarily either sense of MN as the positive sense at the point of the curve which we take as initial point. We then determine the positive sense of MB by the condition that the trihedron (trirectangular system of axes) M(TNB) is superposable on OXYZ by a movement of M(TNB) regarded as a rigid body.

As M moves along the curve, the trihedron M(TNB) moves in space. The elementary movement is specified by a translation ds along MT, and by rotations round MT and MB proportional respectively to the torsion and the curvature. We take the torsion and curvature to have the same sign as these rotations. The torsion, for instance, is positive if the trihedron rotates round T in the sense (NB) as M advances along the curve.

If the curve is discontinuous, or if we have to deal with separate curves, we must make a new convention for each curve (or branch) as to the positive sense of ds and the initial position of MN.

36. We denote the direction cosines of the tangent, principal normal, and binormal at a point (xyz) by  $a_1\beta_1\gamma_1$ ;  $a_2\beta_2\gamma_2$ ;  $a_3\beta_3\gamma_3$ . The torsion we put equal to  $\sigma$  or  $1/\tau$ ; the curvature to c or  $1/\rho$ .

With these conventions, Frenet's formulæ are

$$\frac{d\mathbf{a}_1}{ds} = c\mathbf{a}_2, \quad \frac{d\mathbf{a}_2}{ds} = \sigma\mathbf{a}_3 - c\mathbf{a}_1, \quad \frac{d\mathbf{a}_3}{ds} = -\sigma\mathbf{a}_2,$$

with similar equations in  $\beta$  and  $\gamma$ .

#### Torsion of a Curve of a Linear Complex. Prof. McWeeney's results.

37. The two following theorems were communicated to the writer by Prof. H. C. McWeeney, of University College, Dublin :---

(A) The torsion is proportional to the square of the cosine of the angle between the binormal and the axis of the complex.

(B) If  $\pi_{\lambda\mu}$  denotes the perpendicular from the point  $\lambda$  of the curve on the osculating plane at the point  $\mu$ , then for any two points  $\lambda$  and  $\mu$  on a curve of a linear complex, we shall have

$$\sigma_{\lambda}\pi^{2}_{\lambda\mu} = \sigma_{\mu}\pi^{2}_{\mu\lambda}, \qquad (19)$$

where  $\sigma_{\lambda}$  and  $\sigma_{\mu}$  are the torsions at  $\lambda$  and  $\mu$ .

Since all the curves belonging to the same complex which pass through a point, say  $\lambda$ , have the same osculating plane and the same torsion at the point, we may suppose  $\lambda$  and  $\mu$  to lie on two different curves of the same complex, and theorem (B) will still hold. Theorem (B) is given, for the particular case of a twisted cubic, by M. C. Servais (Mémoires couronnés par l'Académie Royale de Bruxelles, 1898).

To prove these theorems, we take the axis of the complex as z-axis. The

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differential equation of the complex is then  $xdy - ydx = \kappa dz$ , and hence, for a curve of the complex,

$$x\beta_1 - y\alpha_1 - \kappa\gamma_1 = 0. \dots$$
 (20)

Differentiating with respect to the arc, using Frenet's formulae and dividing by c, we get

$$x\beta_2 - ya_2 - \kappa\gamma_2 = 0. \tag{20a}$$

Differentiating again, we get

$$x(\sigma\beta_3-c\beta_1)-y(\sigma\alpha_3-c\alpha_1)-\kappa(\sigma\gamma_3-c\gamma_1)=\alpha_2\frac{dy}{ds}-\beta_2\frac{dx}{ds}=-\gamma_3.$$

Hence

$$x\beta_3 \quad ya_3 - \kappa\gamma_3 = -\gamma_3/\sigma. \tag{20b}$$

Equations (20) and (20a) give

$$\frac{x}{-\beta_3} = \frac{y}{\alpha_3} = \frac{\kappa}{\gamma_3} = \sqrt{x^2 + y^2 + \kappa^2}.$$
$$\gamma_3 = \kappa/\sqrt{x^2 + y^2 + \kappa^2}.$$

 $\gamma_3/\sigma = -x\beta_3 + y\alpha_3 + \kappa\gamma_3$ 

Hence

Also,

$$= \sqrt{x^{2} + y^{2} + \kappa^{2}} (\beta_{3}^{2} + a_{3}^{2} + \gamma_{3}^{2}) = \sqrt{x^{2} + y^{2} + \kappa^{2}}.$$
  
$$\sigma = \kappa / (x^{2} + y^{2} + \kappa^{2}), \qquad \gamma_{3}^{2} = \sigma \kappa.$$
 (21)

Hence

The second of the equations (21) is Professor McWeeney's theorem (A). The first is Lie's expression for the torsion.

Again, the osculating plane at (xyz) is  $Xy - Yx + \kappa (Z - z) = 0$ ; hence, if  $\lambda$  is  $(x_1y_1z_1)$ , and  $\mu$  is  $(x_2y_2z_2)$ , we find

$$\tau^{2}_{\lambda\mu}/\pi^{2}_{\mu\lambda} = (x^{2}_{1} + y^{2}_{1} + \kappa^{2}_{J}/\sqrt{z^{2}_{2}} + y^{2}_{2} + \kappa^{2})$$
(21a)  
=  $\sigma_{\mu}/\sigma_{\lambda}$ ,

38. Corollary.—If  $\lambda$  and  $\mu$  are two ordinary points on any twisted curve, the equation (19) is the necessary and sufficient condition for the existence of a linear complex containing three consecutive tangents at each of the two points.

For, choose as z-axis the axis of the complex determined by three consecutive tangents at  $\lambda$  and two at  $\mu$ , and let  $x\beta_1 - y\alpha_1 - \kappa\gamma_1 = f(s)$ . Then at  $\lambda$  and  $\mu$  we have f(s) = f'(s) = 0, and at  $\lambda$  we also have f''(s) = 0.

If f''(s) vanishes also at  $\mu$ , then the proof just given establishes equation (19). The condition is therefore necessary.

Suppose, on the other hand, that we are given equation (19). Equation (21a) follows from the fact that f(s) = f'(s) = 0 at  $\lambda$  and  $\mu$ . Since f''(s) = 0 at  $\lambda$ , we have  $\sigma_{\lambda} = \kappa/(x_1^2 + y_1^2 + \kappa^2)$ . From this, (19) and (21a), we find that

$$\sigma_{\mu} = \kappa / (x_{2}^{2} + y_{2}^{2} + \kappa^{2})$$
:

and it is easy to verify that this involves the vanishing of f''(s) at  $\mu$ ; the complex, therefore, contains a third consecutive tangent at  $\mu$ .

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Curvature of a Complex Curve.

39. If we write  $\sigma = \delta^2$ ,  $\kappa^{-1} = a^2$ , equation (21) becomes  $\delta = a\gamma_3$ . Now  $d\gamma_1/cds = \gamma_2 = -d\gamma_3/\sigma ds$ ,

hence

$$\frac{c}{\sigma} = -\frac{d\gamma_1}{d\gamma_3} = -\alpha \frac{d}{d\delta} \sqrt{1 - \gamma_2^2 - \gamma_3^2}.$$

Again  $a\gamma_2 = -d\delta/\sigma ds = -d\delta/d\epsilon$ , where  $d\epsilon = \sigma ds = \delta^2 ds$  = the elementary angle of torsion. Hence

$$\frac{c}{\sigma} = -\frac{d}{d\delta}\sqrt{a^2 - \left(\frac{d\delta}{d\epsilon}\right)^2 - \delta^2},$$
(22)

where  $\delta^2 = \sigma$ ,  $d\varepsilon = \sigma ds$ .

Hence the curvature is a given function of the torsion and of its first two differential coefficients with respect to the arc.

#### Applications. 1. Curves of Constant Torsion.

40. The right-hand member of the equation (22) is a function of  $\delta$ ,  $d\delta/ds$ , and  $d^2\delta/ds^2$ . Hence if  $\delta$  is constant, so is c. The only curves of constant torsion which belong to a linear complex are circular helices.

2. Helices on a Cylinder of any form.

41. For these  $c/\sigma = \text{const.} = b$ . Integrating (22), we get

$$b\delta + b_1 = -\sqrt{a^2 - \delta^2 - \left(\frac{d\delta}{d\epsilon}\right)^2},$$
$$\left(\frac{d\delta}{d\epsilon}\right)^2 = a^2 - \delta^2 - (b\delta + b_1)^2 = h^2 (A_1 - \delta) (\delta - B_1),$$

where  $h^2 = 1 + b^2 = (c^2 + \sigma^2)/\sigma^2$ , and  $A_1$  and  $B_1$  are constants.

Let us now take the z-axis parallel to the generators of the cylinder. If  $d\psi$  is the angle of contingence of the section of the cylinder by z = const., we get

$$d\psi = \sqrt{c^2 + \sigma^2} \, ds = h\sigma ds = hd\varepsilon.$$

The differential equation becomes therefore

$$d\delta = \sqrt{(\overline{A_1} - \delta)(\delta - B_1)} d\psi$$

Let  $2\delta = A_1 + B_1 - (A_1 - B_1)\cos\theta$ ; we get  $d\theta = d\psi$ ; and we can ake  $\theta - \psi$ .

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Hence  $4\sigma = 4\delta^2 = (A - B\cos\psi)^2$ ,  $ds = d\epsilon/\sigma = d\psi/h\sigma = 4d\psi/h(A - B\cos\psi)^2$ . Again  $z/s = \text{const.} = \sigma/\sqrt{(c^2 + \sigma^2)} = 1/h$ .

Hence

$$z = \frac{4}{h^2} \int \frac{d\psi}{(A - B\cos\psi)^2}$$

Again, if S is the arc of the normal section of the cylinder,

 $dS = cdz/\sigma = bdz = 4bd\psi/h^2 (A - B\cos\psi)^2.$ 

Also

$$x = \int \cos \psi dS, \quad y = \int \sin \psi dS,$$

hence the most general cylindrical helix whose tangents belong to a linear complex is given by the equations

$$x = M \int \frac{\cos \psi d\psi}{(A - B\cos \psi)^{2}}, \quad y = M \int \frac{\sin \psi d\psi}{(A - B\cos \psi)^{2}},$$
$$z = N \int \frac{d\psi}{(A - B\cos \psi)^{2}}, \quad (M, N \text{ const.})$$

Here  $M/N = c/\sigma$ .

It is easily verified that these curves are algebraic only when  $A = \pm B$ . If A = B, we put  $\psi' = \psi + \pi$ , which gives A' = -B.

Hence the algebraic curves of this type are given by

$$x = 2m \int \frac{\cos \psi \, d\psi}{(1 + \cos \psi)^2}, \quad y = 2m \int \frac{\sin \psi \, d\psi}{(1 + \cos \psi)^2}, \quad z = 2n \int \frac{d\psi}{(1 + \cos \psi)^2}.$$

Putting  $t = \tan \frac{1}{2}\psi$ , we obtain

$$x = m \int (1 - t^2) dt = m \left( a + t - \frac{t^3}{3} \right),$$
  

$$y = m \int 2t \, dt = m \left( b + t^2 \right),$$
  

$$z = n \int (1 + t^2) \, dt = n \left( c + t + \frac{t^3}{3} \right).$$

Hence the only algebraic helices whose tangents belong to a linear complex are certain twisted cubics.\*

#### 3. Bertrand Curves.

42. These curves are characterized by a linear relation between c and  $\sigma$ . In this case equation (22) can be integrated by elliptic functions. In particular, we note that the circular helix is not the only curve of constant curvature belonging to a linear complex.

<sup>[\*</sup>Note ADDED IN THE PRESS.—Another form of the equations of the complex helices is given by Keraval in Nouvelles Annales, 1909, pp. 42 sq.]

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#### Curvature and Torsion at Singularities on a P-Curve.

43. Taking a point M on the *P*-curve as origin, the equations of the curve in the neighbourhood of M can be written

 $x = \alpha t^r + \alpha' t^{r+1} + \dots, \quad y = bt^q + \dots, \quad z = ct^p + \dots \quad (p = q + r, q > r).$ 

If the axes are not rectangular, we may make them so by a transformation

$$x = \lambda x' + \mu y', \quad y = \lambda' y' + \mu' z', \quad z = z'$$

without altering the first terms in the series for x, y, z. Suppose this done: then the axes form the trihedron MTNB already described.

Curvature.—At a point M, (xyz) on the curve we have

$$c\beta_2 = \frac{d\beta_1}{ds} = \frac{1}{s} \frac{d}{dt} \frac{\dot{y}}{\dot{s}}.$$

Let us estimate the order of the terms in this equation when  $t \to 0$ . Clearly  $\beta_2 \to 1$  and  $\dot{s} \to \dot{x} = art^{r-1} + \ldots$  Also  $\dot{y}/\dot{s}$  is of order (q-1) - (r-1) = q - r. The right-hand side is therefore of order  $\dot{q} - r - 1) - (r - 1) = q - 2r$ . This is the order of c. The value of p has not come into the discussion, except that of course it was implicitly supposed greater than q. Hence for any curve, at a point with the characteristic numbers p, q, r the infinitesimal order of the curvature is q - 2r in terms of t, or q/r - 2 in terms of the arc.

Torsion.-We have

$$\sigma \gamma_3 = \frac{d\gamma_2}{ds} + c\gamma_1$$
, and  $\gamma_3 \longrightarrow 1$ .

The term  $c\gamma_1$  on the right is of order (q - 2r) + (p - r) = 2(q - r), since p - r = q. Again,  $\gamma_2 = c^{-1} d\gamma_1/ds = c^{-1} d^2z/ds^2$ , and is therefore of order 2r - q + p - 2r = p - q = r. Hence  $d\gamma_2/ds$  is of order r - r, and is therefore finite, while  $c\gamma_1$  is zero (q - r > 0). Hence at every point of a *P*-curve in the finite portion of space the torsion has a finite non-zero value.

This applies of course only to real points on a real portion of the curve. It is an extension of a well-known property of curves of a linear complex deducible from Lie's expression for the torsion.

The method by which we have deduced these results seems at first sight open to objection. We have assumed in fact that if a function F(t) is of order v, F'(t) will be of order v-1 in t. This is only true when  $v \neq 0$ . Our investigation, however, only requires that this shall be so for the functions  $x, \dot{y}, \ddot{z}$ , for each of which v > 0; and therefore  $\dot{x}, \ddot{y}, \ddot{z}$  will each have a leading term of the proper order with a non-zero coefficient even in the most unfavourable case where p = 3, q = 2, r = 1.

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#### Metrical Properties of Algebraic P-Curves.

44. Lemma 1.—If  $\lambda$  and  $\mu$  are any two points, one on each of two twisted curves (or both on the same curve), then, with a proper convention of signs,

$$\frac{\partial^2}{\partial s_1 \partial s_2} \log \pi_{\lambda \mu} = \sigma_{\mu} \, \delta_{\lambda \mu} / \pi^2_{\lambda \mu},$$

where  $s_1$  and  $s_2$  are the arcs of the curves, measured from fixed points to  $\lambda$ and  $\mu$ ,  $\delta_{\lambda\mu}$  is the mutual moment of the tangents at  $\lambda$  and  $\mu$ ,  $\sigma_{\mu}$  is the torsion at  $\mu$ , and  $\pi_{\lambda\mu}$  is the perpendicular from  $\lambda$  on the osculating plane at  $\mu$ .

Take the trihedron of tangent, principal normal, and binormal at  $\lambda$  as axes, and let  $\mu$  be (*xyz*).

Then 
$$-\pi_{\lambda\mu} = a_3 x + \beta_3 y + \gamma_3 z$$
,  $\frac{\partial \pi_{\lambda\mu}}{\partial s_2} = \sigma_\mu \left(a_2 x + \beta_2 y + \gamma_2 z\right)$ 

(since  $\sum a_3 \frac{\partial x}{\partial s_2} = \sum a_3 a_1 = 0$ ).

Hence  $\frac{\partial}{\partial s_2} \log \pi_{\lambda\mu} = -\sigma_{\mu} (a_2 x + \beta_2 y + \gamma_2 z)/(a_3 x + \beta_3 y + \gamma_3 z).$ 

Now transfer the axes to the trihedron at  $\mu$ , and let  $\lambda$  be (XYZ). Then

$$a_{z}x + \beta_{2}y + \gamma_{2}z = -Y, \quad a_{3}x + \beta_{3}y + \gamma_{3}z = -Z, \quad \frac{\partial}{\partial s_{2}}\log \pi_{\lambda\mu} = -\sigma_{\mu}Y/Z.$$

Differentiating with respect to  $s_1$ , and remembering that  $\sigma_{\mu}$  is constant for this differentiation, we get

$$\frac{\partial^2}{\partial s_1 \partial s_2} \log \pi_{\lambda \mu} = \sigma_{\mu} \frac{Y \frac{\partial Z}{\partial s_1} - Z \frac{\partial Y}{\partial s_1}}{Z^2} = \sigma_{\mu} \delta_{\lambda \mu} / \pi^2_{\lambda \mu}.$$

Corollary.—Since  $\delta_{\lambda\mu} = \delta_{\mu\lambda}$ , we have

$$\frac{\partial^2}{\partial s_1 \partial s_2} \log \frac{\pi_{\lambda \mu}}{\pi_{\mu \lambda}} = \delta_{\lambda \mu} \left( \frac{\sigma_{\mu}}{\pi_{\lambda \mu}^2} - \frac{\sigma_{\lambda}}{\pi_{\mu \lambda}^2} \right) \cdot$$

45. Lemma 2.—On an algebraic curve, where the homogeneous coordinates (x) and (a) are represented by functions of t, rational on the t-plane or on a Riemann surface, we have clearly

$$\pi_{i\theta} = \sum_{i=1}^{4} a_i(\theta) x_i(t) / L(t) \int \phi(\theta),$$

where L(t) and  $\phi(t)$  are the results of substituting the functions  $w_i(t)$  and  $a_i(t)$  respectively in the left-hand members of the point equation of the plane at infinity and of the plane equation of the circle at infinity. In the case of an algebraic *P*-curve where the functions (x) and (a) have been chosen as in sections IV. and V., L and  $\phi$  are rational, of orders n and 2n respectively, and have the same poles as  $(x_i, a_i)$ . The order of these poles is doubled in the case of  $\phi$ .

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### Torsion of Algebraic P-curves.

46. We shall write  $a_i(\theta) = \beta_i$ ,  $x_i(\theta) = y_i$ ,  $a_i(t) = a_i$ ,  $x_i(t) = x_i$ , so that  $(\beta), (y), s_2$  are functions of  $\theta$ , and  $(a), (x), s_1$  functions of t.

Since  $\Sigma_{\beta_i} x_i$  is of the form  $\pi_{t\theta} F_1(s_1) F_2(s_2)$  (lemma 2), it follows that

$$\frac{\partial^2}{\partial s_1 \partial s_2} \log \Sigma \beta_i x_i = \frac{\partial^2}{\partial s_1 \partial s_2} \log \pi_{t\theta} = \delta_{t\theta} \sigma_{\theta} / \pi^2_{t\theta}.$$

If we denote differentiations with respect to t and  $\theta$  by dots and accents respectively, we have

$$\frac{\partial_2}{\partial s_1 \partial s_2} \log \Sigma \beta_i x_i = \frac{1}{\dot{s}_1 s_2'} \frac{\partial^2}{\partial t \partial \theta} \log \Sigma \beta_i x_i = \frac{1}{\dot{s}_1 s_2'} \frac{\Sigma \beta_i x_i \Sigma \beta'_i \dot{x}_i - \Sigma \beta_i \dot{x}_i \Sigma \beta'_i x_i}{(\Sigma \beta_i x_i)^2} \cdot \frac{\partial^2 \beta_i x_i \Sigma \beta'_i x_i}{(\Sigma \beta_i x_i)^2} + \frac{\partial^2 \beta_i x_i \Sigma \beta'_i x_i}{(\Sigma \beta_i x_i)^2} \cdot \frac{\partial^2 \beta_i x_i \Sigma \beta'_i x_i}{(\Sigma \beta_i x_i)^2} + \frac{\partial^2 \beta_i x_i \Sigma \beta'_i x_i}{(\Sigma \beta_i x_i)^2} \cdot \frac{\partial^2 \beta_i x_i}{(\Sigma \beta_i x_i)^2} + \frac{\partial^2 \beta_i x_i}{(\Sigma \beta_i x_i)^2} \cdot \frac{\partial^2 \beta_i x_i}{(\Sigma \beta_i x_i)^2} + \frac{\partial^2 \beta_i x_i}{(\Sigma \beta_i x_i)^2} \cdot \frac{\partial^2 \beta_i x_i}{(\Sigma \beta_i x_i)^2} + \frac{\partial^2 \beta_i x_i}{(\Sigma \beta_i x_i)^2} \cdot \frac{\partial^2 \beta_i x_i}{(\Sigma \beta_i x_i)^2} + \frac{\partial^2 \beta_i x_i}{(\Sigma \beta_i x_i)^2} \cdot \frac{\partial^2 \beta_i x_i}{(\Sigma \beta_i x_i)^2} + \frac{\partial^2 \beta_i x_i}{(\Sigma \beta_i x_i)^2} \cdot \frac{\partial^2 \beta_i x_i}{(\Sigma \beta_i x_i)^2} + \frac{\partial^2 \beta_i x_i}{(\Sigma \beta_i x_i)^2} \cdot \frac{\partial^2 \beta_i x_i}{(\Sigma \beta_i x_i)^2} + \frac{\partial^2 \beta_i x_i}{(\Sigma \beta_i x_i)^2} \cdot \frac{\partial^2 \beta_i x_i}{(\Sigma \beta_i x_i)^2} + \frac{\partial^2 \beta_i x_i}{(\Sigma \beta_i x_i)^2} \cdot \frac{\partial^2 \beta_i x_i}{(\Sigma \beta_i x_i)^2} + \frac{\partial^2 \beta_i x_i}{(\Sigma \beta_i x_i)^2} \cdot \frac{\partial^2 \beta_i x_i}{(\Sigma \beta_i x_i)^2} + \frac{\partial^2 \beta_i x_i}{(\Sigma \beta_i x_i)^2} \cdot \frac{\partial^2 \beta_i x_i}{(\Sigma \beta_i x_i)^2} + \frac{\partial^2 \beta_i x_i}{(\Sigma \beta_i x_i)^2} \cdot \frac{\partial^2 \beta_i x_i}{(\Sigma \beta_i x_i)^2} + \frac{\partial^2 \beta_i x_i}{(\Sigma \beta_i x_i)^2} \cdot \frac{\partial^2 \beta_i x_i}{(\Sigma \beta_i x_i)^2} + \frac{\partial^2$$

The numerator of this fraction is equal to

$$\begin{vmatrix} \beta_1 & \beta_2 & \beta_3 & \beta_4 \\ \beta_1' & \beta_2' & \beta_3' & \beta_4' \end{vmatrix} \times \begin{vmatrix} x_1 & x_2 & x_3 & x_4 \\ \dot{x}_1 & \dot{x}_2 & \dot{x}_3 & \dot{x}_4 \end{vmatrix} = \Sigma B_{ij} X_{ij}, \quad (j > i),$$

where  $B_{ij}$ , for instance, is  $\beta_i \beta'_j - \beta_j \beta'_i$ .

Now the fractions  $B_{ij}/Y_{\kappa l}$  are all equal, and in the case of a *P*-curve their common value  $\mu$  is a constant (section IV., equations (13), and note).

We have therefore  $\delta_{t\theta}\sigma_{\theta}/\pi^2_{t\theta} = \mu \Sigma X_{ij} Y_{kl}/\dot{s}_1 s'_2 (\Sigma \beta_i x_i)^2$ , or, substituting the value of  $\Sigma \beta_i x_i/\pi_{t\theta}$  from lemma 2,

$$\delta_{t\theta}\dot{s}_{1}s'_{2}L^{2}(t)\phi(\theta)\sigma_{\theta} = \mu\Sigma X_{ij}Y_{kl}.$$

Interchanging t and  $\theta$  we get

$$\delta_{t\theta} \dot{s}_1 s'_2 L^2(\theta) \phi(t) \sigma_t = \mu \Sigma X_{kl} Y_{ij} = \mu \Sigma X_{ij} Y_{kl}.$$

(We suppose j > i, and l - k positive or negative according as k + l is odd or even.)

Hence 
$$\frac{\sigma_t \phi(t)}{L^2(t)} = \frac{\sigma_\theta \phi(\theta)}{L^2(\theta)},$$
 (23)

= const., since t and  $\theta$  are two arbitrary points on the curve.

Hence the torsion at a point t on an algebraic P-curve is equal to  $\mathcal{A}L^{2}(t)/\phi(t)$ , where L and  $\phi$  are the rational functions described in lemma 2 and A is a constant.

 $L^2$  and  $\phi$  have the same poles and with the same order of infinity (lemma 2): hence the torsion is zero at points on the plane at infinity, infinite at the points of contact of isotropic osculating planes, and finite at all other points, real or imaginary.

47. Every curve belonging to a linear complex, whether algebraic or not, has this property. For, since  $a_3: \beta_3: \gamma_3 = y: -x: \kappa$  (par. 37), the equation  $a_3^2 + \beta_3^2 + \gamma_3^2 = 0$ , which gives the isotropic osculating planes, is equivalent to  $x^2 + y^2 + \kappa^2 = \kappa/\sigma = 0$ ; and  $\kappa/\sigma$  is infinite only at the points of the curve in the plane at infinity. I have not been able to ascertain whether non-algebraic *P*-curves have the property.

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48. Value of the functions

$$\begin{aligned} \Sigma a_i(\theta) x_i(t) + \Sigma a_i(t) x_i(\theta) &= (\theta - t)^6 W, \\ \Sigma a_i(\theta) x_i(t) - \Sigma a_i(t) x_i(\theta) &= (\theta - t)^3 V \end{aligned}$$

for an algebraic P-curve.

We have seen that  $\sum a_i(\theta) x_i(t)$  or  $\sum \beta_i x_i$  is equal to  $\pi_{t\theta} L(t) \sqrt{\phi(\theta)}$ . Now  $\sigma_{\theta}$  is  $AL^2(\theta)/\phi(\theta)$ ; hence

 $\Sigma \beta_i x_i = \alpha L(t) L(\theta) \pi_{i\theta} \sigma_{\theta} \tilde{z}, \text{ where } \alpha = A^{\frac{1}{2}} = \text{const.}$ 

Hence

$$\begin{array}{l} (\theta - t)^{6} W = \alpha L(t) L(\theta) \left( \pi_{t\theta} \sigma_{\theta}^{-\frac{1}{2}} + \pi_{t\theta} \sigma_{t}^{-\frac{1}{2}} \right), \\ (\theta - t)^{3} V = \alpha L(t) L(\theta) \left( \pi_{t\theta} \sigma_{\theta}^{-\frac{1}{2}} - \pi_{\theta t} \sigma_{t}^{-\frac{1}{2}} \right). \end{array}$$

$$(24)$$

It follows, by the theorem of par. 38, that the necessary and sufficient condition that the same linear complex should contain three consecutive tangents at each of the two ordinary points t and  $\boldsymbol{\theta}$  on an algebraic *P*-curve is that the points should be connected by the relation VW = 0.

49. The equations V = 0, W = 0 define symmetric correspondences on the curve, of orders (n-3, n-3) and (n-6, n-6) respectively. A pair of conjugate points of either correspondence has the property just stated; but there is certainly some geometric difference between the two correspondences which I have been unable to discover.

If the curve itself belongs to a linear complex, W vanishes identically, as we saw; while V only vanishes when the chord  $t\theta$  is a line of the complex.

The Self-Conjugate Points of V = 0 and of W = 0.

50. If we allow  $\theta$  to approach t, we find

Lt 
$$V = -(03)/3$$
,  
 $\theta \rightarrow t$   
Lt  $W = \frac{(06) + (60)}{6!} = -\frac{2(33)}{6!}$ .

Hence the self-conjugate points of V are given by (03) = 0; in other words, they are the singularities of the curve, each occurring with the order of multiplicity p-3 (sections IV and V). The self-conjugate points of W are given by (33) = 0.

Hence every ordinary (3, 2, 1) point at which six consecutive tangents belong to a linear complex satisfies the equation (33) = 0.

This explains why we found that the *identity* (33) = 0 characterizes curves of a complex among *P*-curves.

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Besides the ordinary (3, 2, 1) points which annul it, (33) may vanish at some of the singularities. In effect, if we use the equations (5a) and (6) of section III to determine the initial coefficients of the functions  $a_i$  in the neighbourhood of such a point, we can write

 $\begin{array}{ll} x_1 = at^p + \dots, & a_1 = bcd\,qr\,(r-q) + \dots, \\ x_2 = bt^q + \dots, & a_2 = cad\,rp\,(p-r)\,t^r + \dots, \\ x_3 = ct^r + \dots, & a_3 = abd\,pq\,(q-p)\,t^q + \dots, \\ x_4 = d + \dots, & a_4 = abc\,(p-q)\,(q-r)\,(r-p)\,t^p + \dots, \\ & (p = q + r). \end{array}$ 

Suppose p > 5: then the term of lowest degree in  $\sum \vec{a}_i \vec{x}_i = (33)$  will be of degree p - 5. If r < 3, this is evident; if not, the coefficient of  $t^{p-6}$  is derived from  $\vec{a}_2 \vec{x}_2 + \vec{a}_3 \vec{x}_3$  and is

$$abcdq! r! [rp(p-r) + pq(q-p)]/(q-2)! (r-2)! 2! 2!$$

Since p-r=q and q-p=-r, this vanishes. Hence a singularity for which p>5 is a root of (33) of order p-5 (or in particular cases of higher order).

In the case of an undulation (5, 4, 1), it is easily verified from the expressions just given for the coordinates that (33) has a root at the undulation.

51. From what precedes we can infer that if a sextic P-curve (rational or not) has a point for which p = 6, or an undulation, or an ordinary (3, 2, 1) point at which six consecutive tangents belong to a linear complex, all the tangents to the curve belong to a linear complex.

In effect, if we write

$$W_1(t, \theta) = \sum a_i(\theta) x_i(t) + \sum a_i(t) x_i(\theta) = (\theta - t)^{\epsilon} W(t, \theta),$$

and if  $t_0$  be the special point just referred to, then the function  $W_1(t_0, \theta)$  of  $\theta$  has  $t_0$  as a zero of order seven, since

Lt 
$$W_1(t_0, \theta)/(\theta - t_0)^6 = -2 (33)_0/6! = 0.$$

But  $W_1(t_0, \theta)$  is of the sixth order in  $\theta$ , and therefore can only have a zero of order seven by vanishing identically.

Now consider the function  $W_1(t, \theta)$  where  $t \neq t_0$ . It has the zero  $\theta = t$  of order six and also the zero  $\theta = t_0$ : hence it vanishes for all values of  $\theta$  and t: and this requires that the curve should belong to a linear complex.

In the case of a rational *P*-curve the function (33) is of order 2n - 12in *t*, since it gives the coincidences of an n - 6, n - 6 correspondence. On an algebraic *P*-curve its order is  $2n - 12 + 2\gamma d$ , where  $\gamma$  is an integer and *d* is the deficiency.

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Note 1.

52. Since  $W_1(t_1,\theta)$  has a zero of order six for  $\theta = t$ , it is to be expected, in virtue of equation (24), that the expression  $\pi_{t\theta}/\sigma_{\theta}^{\frac{1}{2}} + \pi_{\theta t}/\sigma_{t}^{\frac{1}{2}}$  should have a zero of order six in terms of the arc for  $\theta = t$  at an ordinary point of any twisted curve. This is seen to be true if we take the trihedron at t as the coordinate axes, and suppose  $\theta$  to be (xyz).

We have, then (writing  $\Sigma$  for  $\sigma_{\theta}$  and  $\sigma$  for  $\sigma_{t}$ ),

$$\boldsymbol{\pi}_{\theta t} = z, \qquad -\boldsymbol{\pi}_{t\theta} = \boldsymbol{a}_3 x + \boldsymbol{\beta}_3 y + \boldsymbol{\gamma}_3 z;$$

and we have to find the order of

$$\left(\frac{\Sigma}{\sigma}\right)^{\frac{1}{2}}z - (a_3x + \beta_3y + \gamma_3z),$$

when the arc diminishes indefinitely.

We calculate z by the formulae

$$\begin{aligned} \frac{dz}{ds} &= \gamma_1, \quad \frac{d\gamma_1}{ds} = c\gamma_2, \quad \frac{d\gamma_2}{ds} = \sigma\gamma_3 - c\gamma_1, \quad \frac{d\gamma_3}{ds} = -\sigma\gamma_2. \\ (\text{Lt } \gamma_1, \gamma_2 = 0, \quad \text{Lt } \gamma_3 = 1) \end{aligned}$$

Again, if

$$\begin{aligned} & Z = a_3 x + \beta_3 \ y + \gamma_3 z, \\ & \frac{dZ}{ds} = -\sigma \left(a_2 x + \beta_2 y + \gamma_2 z\right) = -\sigma Y, \\ & \frac{dY}{ds} = \sigma Z - c \left(a_1 x + \beta_1 y + \gamma_1 z\right) = \sigma Z - c X, \\ & \frac{dX}{ds} = c \sum a_2 x + \sum a_1 \frac{dx}{ds} = c Y + 1. \end{aligned}$$

We shall write  $\sigma_1, \sigma_2; c_1, c_2 \dots$  to denote the values of

$$\frac{d\sigma}{ds}, \quad \frac{d^2\sigma}{ds^2} \dots \frac{dc}{ds} \dots \text{ at the origin } t.$$

$$\nu = (\Sigma/\sigma)^{\frac{1}{2}} = 1 + \nu_1 s + \nu_2 s^2/2 ! + \nu_3 s^3/3 ! + \dots,$$

$$\nu_1 = \sigma_1/2\sigma, \quad \nu_2 = \sigma_2/2\sigma - \sigma_1^2/4\sigma^2,$$

where

$$\boldsymbol{\nu}_3 = \boldsymbol{\sigma}_3/2\boldsymbol{\sigma} - 3\boldsymbol{\sigma}_1\boldsymbol{\sigma}_2/4\boldsymbol{\sigma}^2 + 3\boldsymbol{\sigma}_1^3/8\boldsymbol{\sigma}^3.$$

We find that the first five powers of s disappear from the expansion of  $\nu z - Z$ . The coefficient of  $s^6/6!$  is

$$C_6 = c\sigma_3 - \sigma_2 c_1 + 3\sigma^2 c\sigma_1 - 2\sigma^3 c_1 + c^3\sigma_1 + \frac{3c_1\sigma_1^2}{2\sigma} - \frac{9c\sigma_1\sigma_2}{2\sigma} + \frac{15c\sigma_1^3}{4\sigma^2} \cdot$$
(25)

The vanishing of  $C_6$  is therefore equivalent to the equation (33) = 0. We can see from the form of  $C_6$  that it vanishes if c and  $c_1$  are both zero; in other words, if q/r > 3 (par. 43). This shows that an undulation (p = 5, q = 4, r = 1) on an algebraic *P*-curve annuls (33); an inflexion does not, unless the coefficient of  $c_1$  vanishes, i.e. unless  $2\sigma\sigma_4 = 3\sigma_1^2 - 4\sigma^4$ .

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If the curve belongs to a linear complex,  $C_6$  vanishes identically. The differential equation so obtained can be written  $Ac_1 = Bc - Cc^3$ , where A, B, C are functions of  $\sigma$ ,  $\sigma_1$ ,  $\sigma_2$ ,  $\sigma_5$ . This equation for c is easily integrated, and gives the expression for c in terms of  $\sigma$ ,  $\sigma_1$ ,  $\sigma_2$ , already given in equation 22]. It was thus, in fact, that that equation was obtained in the first instance.

Note 2.

53. Mr. J. H. Grace (*Proc. Camb. Phil. Soc.*, vol. XI., pp. 132 sq.) states that a rational curve of the *n*th degree with 2n - 6 stationary tangents (inflexions) belongs to a linear complex. He gives special proofs for n = 3, 4, 5. For the general case his argument is as follows:—

The determinant of the sixth order

$$| X_{ij} \quad dX_{ij}/dt \quad d^2 X_{ij} | dt^2 \dots d^5 X_{ij}/dt^5 | = J,$$

$$(X_{ij} = \mathcal{X} \dot{\mathcal{X}}_j - \mathcal{X} \dot{\mathcal{X}}_i, \quad j > i)$$

is of degree 6(m-5) in t, where m = 2n-2 is the degree of the polynomials  $X_{ij}$ . This is best seen if we make the  $X_{ij}$  homogeneous by introducing a second variable t', which can subsequently be put equal to unity.

The equation J = 0 gives, clearly, the points at which six consecutive tangents belong to a linear complex.

Now, according to the argument, a stationary tangent accounts for six of these points, and hence J has 6 (2n - 6) roots; but its degree is 6 (2n - 7); hence it must vanish identically; and it is easy to deduce that the curve must belong to a complex.

This argument is at fault in one particular. If we consider, for example, the quartic

 $t^4, t^3, t^2 + \alpha, t + 3,$ 

which has a stationary tangent at t = 0, we find that J is  $mt^5(t-a)$ where m is a constant. Hence the inflexion only counts for five and not six roots of J. Accepting the argument that the number of roots of Jrepresented by an inflexion is independent of the degree of the curve, since it depends only on the infinitesimal properties of the curve at the inflexion (tom. cit., p. 28), the 2n - 6 inflexions account for 10n - 30 roots. This leaves 2n - 12 ordinary points satisfying J, if n > 6. J vanishes identically only if n < 6.

There are no undulations and no points where p > 5 on the curve, by hypothesis; hence the 2n - 12 roots of (33) = 0 are ordinary points: these are the roots of J not accounted for by the inflexions.

In this case the factors of J are  $(03)^5(33)$ , since the zeros of (03) are the stationary points each of order p-3, which in this case means unity

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Factors of J for the General Rational P-curve.

54. Consider the determinant of the sixth order

$$\left|\begin{array}{ccc} X_{ij} & \frac{dX_{ij}}{dt} & \frac{d^2X_{ij}}{dt^2} & Y_{ij} & \frac{dY_{ij}}{d\theta} & \frac{d^2Y_{ij}}{d\theta^2} \end{array}\right| = j(t,\theta),$$

where  $Y_{ij}$  as before is the result of substituting  $\theta$  for t in  $X_{ij}$ . The function j is of degree 3(m-2) = 6n - 12 in  $\theta$  and also in t. Again j contains the factors D(t) and  $D(\theta)$  where  $D(t) = |x_i \dot{x}_i \ddot{x}_i \ddot{x}_i|$ .

To prove this point, we suppose that  $t_s$  is a singularity with the characteristic numbers p, q, r. Then changing the tetrahedron of reference and writing t for  $t - t_s$ , we find that the orders in t of the initial terms of the  $X_{ij}$  are

$$p+q-1$$
,  $p+r-1$ ,  $p-1$ ,  $q+r-1 = p-1$ ,  $q-1$ ,  $r-1$ .

Let us write  $X_1, X_2, \ldots X_6$  for the  $X_{ij}$ , arranged according to their infinitesimal order in  $t, X_1$  being of the highest order. If we substitute  $X'_3 = \lambda X_3 + \mu X_4$  for  $X_3$ ,  $\lambda$  and  $\mu$  being constants properly chosen,  $X'_3$  will be of order p (or higher). That being so, it is clear that the term of lowest degree in t belonging to j will occur in the product of

by its minor in j.

Now  $X_4 = At^{p-1} + A't^p + \dots$ ,  $X_5 = Bt^{q-1} + \dots$ ,  $X_6 = Ct^{r-1} + \dots$ 

Hence the term of lowest degree in the determinant last written is

$$ABC(p-q)(q-r)(r-p)t^{p+q+r-6}$$
.

The coefficient, it is to be noticed, does not vanish, even when, for instance, r = 1. It follows that j considered as a function of t has a zero of order

$$p + q + r - 6 = 2(p - 3),$$

no more and no less, at a point  $t_s$  at which p > 3.

Hence *j* contains the factor  $\Pi(t-t_s)^{2p-6}$ , which, as we saw in section IV, is equal to D(t), disregarding constant factors. In like manner, *j* contains  $D(\theta)$ .

Again, j is easily seen to contain  $(\theta - t)^{\circ}$ . Hence

$$j(t, \theta) = D(t) D(\theta) (\theta - t)^{9} F(t, \theta).$$

The degree in t of F is

$$(6n + 12) - (4n - 12) - 9 = 2n - 9.$$

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Hence  $F(t, \theta)$  defines a 2n-9, 2n-9 correspondence between t and  $\theta$ . Now the equation  $j(t, \theta) = 0$  obviously means that a linear complex contains three consecutive tangents at t and three at  $\theta$ . It follows (pars. 48, 49) that F = VW. Hence (ac)

Again,

$$j(t,\theta) = (\theta - t)^{s} D(t) D(\theta) V W.$$

$$J = \underset{\theta \leftrightarrow t}{\operatorname{Lt}} j(t,\theta) / (\theta - t)^{s} = D^{2}(t) (VW)_{\theta = t}.$$
(26)

Now when  $\theta = t$ , V and W, as we saw in par. 50, become (03) and (33). Hence

$$J = (03)(33) D^2 = (03)^5(33), \tag{27}$$

omitting a numerical factor.

#### VIII.—P-QUINTICS.

55. Snyder has shown (American Journal of Mathematics, 1907, pp. 279 sq.) that a quintic belonging to a linear complex is rational. As every P-quintic belongs to a complex, it likewise is rational.

56. A rational *P*-quintic (which we shall denote by the symbol  $R_5$ ) cannot have a double point with two distinct tangents. For if it has, take the two parameters of the point as t=0,  $t=\infty$ . Let  $x_1x_2x_3$  be the point : the equations of the curve can be written in the form

$$x_1/(at^4 + bt^3) = x_2/(ct^3 + dt^2) = x_3/(et^2 + ft) = x_4/T,$$

where T is a quintic in t. The osculating planes of the two branches are therefore  $x_1 = 0$  and  $x_3 = 0$ ; these are distinct, and cannot both be the polar plane of the point with respect to a linear complex. Hence the curve does not belong to a linear complex, and therefore (since it is of the fifth degree) it cannot be a *P*-curve.

57. The only possible singularities are therefore the cusp (5, 3, 2), the undulation (5, 4, 1), and the inflexion (4, 3, 1). Since  $\Sigma(p-3) = 2n - 6 = 4$ (section IV, par. 14), we may have

- (A) two cusps,
- (B) two undulations,
- (C) one cusp and two inflexions,
- (D) one undulation and two inflexions,
- (E) four inflexions.\*

No quintic can have an undulation and a cusp (see IV, par. 18).

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<sup>&</sup>quot;When this paper was read to the Royal Irish Academy, I had not seen Professor Snyder's paper above referred to, in which this classification is reached by a different method.

58. The equations of the types (A) and (B) can be written

$$x_1/t^5 = x_2/t^3 = x_3/t^2 = x_4$$
; (A)  
 $x_1/t^5 = x_2/t^4 = x_3/t = x_4$ ; (B)

(C) can be written

$$x_1/t^5 = x_2/(t^3 + at^4) = x_3/t^2 = x_4/(1 + ct),$$

 $x_1$  being the osculating plane at the cusp  $(t = 0, x_1 = x_2 = x_3 = 0)$ , and  $x_4$  that at an inflexion  $(t = \infty, x_2 = x_3 = x_4 = 0)$ .

If we express the fact that the tangents belong to a linear complex, we find that the complex must be  $p_{14} = 5p_{23}$ , and that this requires that  $c = 5\alpha$ . Hence we can write (putting t/a for t),

$$x_1/t^5 = x_2/(t^3 + 2t^4) = x_3/t^2 = x_4/(1 + 5t).$$
 (C)

In the same way we find that the curves of type (D) can be written

$$x_1/t^5 = x_2/t^4 = x_5/(t + 6t^2) = x_4/(1 + 5t).$$
 (D)

It will be noticed that if we identify all the homographic transformations of a curve, each of the four types we have discussed reduces to a single curve.

The type (E) does not so reduce. We shall consider one curve of this type in detail in section X.

# IX.—Asymptotic Lines of Ruled Surfaces belonging to a Linear Congruence.

59. Picard has shown (loc. cit., section I) that on a ruled surface whose generators belong to a linear complex there lies in general one curve of the complex, cutting each generator twice. The osculating plane at any point will be the tangent plane of the surface: the curve will therefore be an asymptotic line.

60. If the surface has two linear directrices, the generators belong to a linear congruence, and each asymptotic line will belong to a complex of the congruence. These lines have been studied by Pittarelli (*Rendiconti della R. Accademia dei Lincei, Sem.* 2, 1894). I propose to supplement his work by examining the relation of these lines to the pinch-points and the cuspidal generators of the surface.

61. Let the directrices be ( $\delta$ )  $x_3 = x_4 = 0$ , and ( $\delta'$ )  $x_1 = x_2 = 0$ . The congruence is  $p_{12} = p_{34} = 0$ . A generator of the surface will be

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[9]

Writing  $x_1 = \lambda x_4$ , we obtain the equations of the surface

$$x_1/\lambda = x_2/\lambda f = x_3/\phi = x_4 \tag{29}$$

in terms of the parameters  $\lambda$  and  $\theta$ .

The equation of the tangent plane reduces to

$$(\lambda f x_1 - \lambda x_2) \phi' + (x_3 - \phi x_4) f' \lambda^2 = 0,$$

which is the polar plane of the point  $\lambda$ ,  $\lambda f$ ,  $\phi$ , 1, with respect to the complex

$$\phi' p_{12} + \lambda^2 f' p_{34} = 0.$$

Hence the curve given by

$$\lambda^2 f' / \phi' = c \tag{30}$$

belongs to the complex

$$p_{12} + cp_{34} = 0, (31)$$

and is an asymptotic line of the surface. In effect, the polar plane of a point on the curve is the tangent plane to the surface. This contains the tangent to the curve, which is therefore a line of the complex.

The asymptotic line c is changed into the line c' by the transformation

$$x'_1 = x_1, \quad x'_2 = x_2, \quad x'_3 \sqrt{c'} = x_3 \sqrt{c}, \quad x'_4 \sqrt{c'} = x_4 \sqrt{c}$$

in virtue of (29) and (30). The asymptotic lines are therefore all of the same degree and class, with the same singularities lying on the same generators, exceptions being made for the two directrices c = 0,  $c = \infty$ .

The foregoing analysis is in substance Pittarelli's.

Pinch . points.

62. If  $\phi'(\theta_0) = 0$ ,  $f'(\theta_0) \pm 0$ , two of the generators which can be drawn through the point where the generator  $\theta_0$  meets  $\delta'$  coincide. This point is a pinch-point. For every finite value of c we find  $\lambda = 0$  for  $\theta = \theta_0$ , and therefore  $x_1 = x_2 = 0$ . Hence all the asymptotic lines pass through the pinch-point.

Supposing  $\phi$  regular when  $\theta$  is near  $\theta_0$ , we can write

$$\phi(\boldsymbol{\theta}) = \boldsymbol{\phi}_0 + (\boldsymbol{\theta} - \boldsymbol{\theta}_0)^2 \boldsymbol{G},$$

where G is finite for  $\theta = \theta_0$ , unless  $\phi''(\theta_0) = 0$ . Hence  $\phi' = (\theta - \theta_0)G_1$ ; and therefore, by (30), for the asymptotic line c, we have

$$\lambda = \alpha \left(\theta - \theta_{o}\right)^{2} + b \left(\theta - \theta_{o}\right)^{2} + \dots$$

Writing  $\theta - \theta_0 = t^2$ , we have  $\lambda = at + bt^3 + \dots$ ,  $\phi = \phi_0 + dt^4 + ht^6 + \dots$ 

$$f = f_0 + et^2 + gt^4 + \dots$$
; hence  $x_1/x_4 = at + bt^3 + \dots$ ,

$$(x_2 - f_0 x_1)/x_4 = \lambda (f - f_0) = b't^3 + \dots, \qquad (x_3 - \phi_0 x_4)/x_4 = \phi - \phi_0 = dt^4 + \dots$$

Hence all the asymptotic lines pass through every pinch-point on a directrix, and have there an inflexion. They have all the same osculating plane at the point, that, namely, through the pinch-point and the other directrix; and the same tangent line, namely, the generator corresponding to the pinch-point.

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EGAN-Linear Complex, and a certain class of Twisted Curves. 67

Cuspidal Generators.

63. If we have, when  $\theta$  is near  $\theta_0$ ,

 $f = f_0 + (\boldsymbol{\theta} - \boldsymbol{\theta}_0)^2 G(\boldsymbol{\theta}), \qquad \boldsymbol{\phi} = \boldsymbol{\phi}_0 + (\boldsymbol{\theta} - \boldsymbol{\theta}_0)^2 H(\boldsymbol{\theta}),$ 

where G and H are regular near  $\theta_0$  and do not vanish for  $\theta = \theta_0$ , the generator  $\theta = \theta_0$  is a cuspidal line of the surface. In effect, if we put  $\theta - \theta_0 = t$ , then, for points on the surface near the line  $\theta_0$ ,

$$x_2 - f_0 x_1 = x_1 (At^2 + Bt^3 + \ldots), \quad x_3 - \phi_0 x_4 = x_4 (A't^2 + \ldots);$$

and the section of the surface by the plane  $x_1 = kx_4$  has a cusp where t = 0, i.e. where the plane meets the generator  $\theta_0$ . It is easy to see that the hyperboloid  $\mathcal{A}'x_4(x_2 - f_0x_1) = \mathcal{A}x_1(x_3 - \phi_0x_4)$  touches the surface along the cuspidal line.

Again, for the asymptotic line c,

$$\lambda^2 = c\phi'/f' = c(M_0 + M_1t + \ldots) \qquad (t = \theta - \theta_0).$$

Hence

$$\begin{split} \lambda &= \pm c^{\frac{1}{2}}(a + bt + ct^{2} + \dots), \quad \phi - \phi_{0} = A't^{2} + B't^{3} + \dots, \quad f - f_{0} = At^{2} + Bt^{3} + \dots \\ \text{Hence} & X &= x_{1}/x_{4} = \pm c^{\frac{1}{2}}(a + bt + \dots), \\ Y &= (x_{2} - f_{0}x_{1})/x_{4} = \pm c^{\frac{1}{2}}(A''t^{2} + \dots), \\ Z &= (x_{3} - \phi_{0}x_{4})/x_{4} = A't^{2} + \dots \end{split}$$

The tangent line is Y = Z = 0 (the cuspidal generator); there are two points of contact  $(X = \pm ac^{\frac{1}{2}})$ . Hence each asymptotic line is bitangent to the cuspidal generator: the pairs of points of contact and the pairs of osculating planes form involutions whose foci are the points and the planes common to the cuspidal line and the directrices.\*

The results in the more general case where

$$f = f_0 + (\theta - \theta_0)^m G, \quad \phi = \phi_0 + (\theta - \theta_0)^n H$$

are easily worked out, but need not detain us here.

#### Other Stationary Points.

64. These will lie by twos on certain generators. Expressing that the tangent plane to the surface has four-point contact with the curve, and eliminating  $\lambda$ ,  $\lambda'$ ,  $\lambda''$  by equation (30), we find

$$f'''/f' - 3f''^{2}/2f'^{2} = \phi'''/\phi' - 3\phi''^{2}/\phi'^{2}, \qquad (32)$$

which gives these generators.

[9\*]

<sup>\*</sup> Pittarelli (*loc. cit.*) appears to confuse the case of pinch-points with that of cuspidal generators. He says (if I have understood him correctly) that the 'singular generators' are bitangent to the asymptotic lines, the points of contact lying on the directrices.

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## The Ruled Cubic with two Directrices.

65. The equations of this surface can be written (cf. Salmon, ch. 15, § 520) in the form  $x_1/\lambda = x_2/\lambda\theta = x_3/\theta^2 = x_4$ .

The asymptotic lines are therefore given by  $\lambda^2 = 2c\theta$ ; or if we write  $\theta = 2ct^2$ , then  $\lambda = 2ct$ , and the lines *c* are

$$x_1/2ct = x_2/4c^2t^3 = x_3/4c^2t^4 = r_4.$$
(33)

The inflexions are t = 0,  $t = \infty$ . These are pinch-points on the directrix  $x_1 = x_2 = 0$ . The other directrix is not a double line on the surface: there are therefore no pinch-points on it.

A Certain Quartic Scroll.

66. The scroll S determined by

$$x_2 = x_1 (\mu - 2)^2$$
,  $x_3 = x_4 (\mu + 2)^2$ 

is a quartic. It is generated by a line meeting the lines  $x_1x_2$  and  $x_3x_4$  and a conic (the section of the surface by any plane through  $x_1x_4$  except  $x_1 = 0$  or  $x_4 = 0$ ). The line p joining the points where the directrices meet the plane of the conic is a double generator of the surface (Salmon, ch. 16, § 553). In the present case p (which is  $x_1x_4$ ) touches the conic and is a cuspidal generator.

Any point on S is  $\lambda$ ,  $\lambda(\mu - 2)^2$ ,  $(\mu + 2)^2$ , 1, in terms of  $\lambda$  and  $\mu$ .

The asymptotic lines are given (writing  $k^2$  for c) by

$$\lambda^{2} = k^{2}(\mu + 2)/(\mu - 2).$$

Putting  $\lambda = k(t+1)/(t-1)$ , we get  $\mu = t + t^{-1}$ . Hence the asymptotic lines are

$$\frac{x_1}{kt^2(t+1)} = \frac{x_2}{k(t+1)(t-1)^4} = \frac{x_3}{(t-1)(t+1)^4} = \frac{x_4}{t^2(t-1)} \cdot (34)$$

These are rational quintics whose tangents belong to the complex

$$p_{12} + k^2 p_{34} = 0.$$

The line  $p(x_1 = x_4 = 0)$  is a bitangent at t = 0 and  $t = \infty$ . The points  $t = \pm 1$  are inflexions: t = 1 is the pinch-point  $x_2x_3x_4$  on the directrix  $x_3x_4$ : t = -1 is the pinch-point  $x_1x_2x_3$  on the other directrix. All the curves have three-point contact at these two points. The 2, 2 relation expressing that the line  $t\theta$  belongs to the complex is  $t^2\theta^2 = 1$ , hence the four inflexions are the roots of  $t^4 - 1 = 0$ , i.e.  $\pm 1, \pm i$ . Two of these  $(\pm 1)$  are the pinch-points on the directrices. The other two lie on the generator  $\mu = 0$ , i.e.  $x_2 = 4x_1, x_3 = 4x_4$ . Each pair  $(\pm 1 \text{ and } \pm i)$  satisfies the 2, 2 relation.

# X.—The P-Quintic with a Bitangent.

67. Any one of the curves k (equation 34) has the following properties, none of which, as we shall see, belongs to any other  $R_s :=$ 

(a) It has a bitangent.

(b) The 2,2 relation breaks up into two symmetrical factors  $(t\theta = \pm 1)$ ; i.e., the secants of the curve which are lines of the complex determine two involutions on the curve.

(c) There are inscribed in the curve an infinity of quadrilaterals, such that the osculating plane at each vertex contains the two adjacent sides. (The points  $t, t^{-1}, -t, -t^{-1}$  are the vertices of such a quadrilateral.)

68. We begin with the property (c), and show that in no other rational quintic can one such quadrilateral be inscribed. Let A, B, C, D be four non-coplanar points; consider a rational quintic passing through them and having DAB, ABC, BCD, CDA as osculating planes at A, B, C, D. Take as t = 0,  $t = \infty$ , the foci of the involution on the curve in which A, C and B, D are corresponding pairs. Then if a and b are the parameters of A and B, those of C and D will be -a and -b. Taking ABCD as tetrahedron of reference, it is easy to see by considering the points where the coordinate planes meet the curve that the equations of the curve can be written

$$\frac{x_1}{(t+a)^3(t^2-b^2)} = \frac{x_2}{(t+b)^3(t^2-a^2)} = \frac{x_3}{(t-a)^3(t^2-b^2)} = \frac{x_4}{(t-b)^3(t^2-a^2)} \cdot$$

Forming  $p_{13}$  and  $p_{24}$  for the tangent, we find  $bp_{13} = ap_{24}$ , hence the curve belongs to a linear complex.

The 2, 2 relation works out  $t^2\theta^2 = a^2b^2$ , and if we take ab equal to unity, as we may by multiplying t by  $1/\sqrt{(ab)}$ , we get  $t^2\theta^2 = 1$ .

The line  $0 \infty$  is a bitangent. For 0 and  $\infty$  are two ordinary points on the curve, the osculating plane at each of which touches the curve at the other, in virtue of the 2, 2 relation. Property (b) follows from the 2, 2 relation. Hence (a) and (b) are involved in (c). The inflexions are  $\pm 1, \pm i$ .

If we now take as coordinate planes the osculating planes at 1, 0,  $\infty$ , -1, and consider as before the parameters of the points where these planes meet the curve, we see that the new equations of the curve can be written

$$\frac{x_1}{(t-1)^4 (t+1)} \qquad \frac{x_2}{t^3} = \frac{x_3}{t^2} = \frac{x_4}{(t+1)^4 (t-1)} .$$
(35)

In effect,  $x_1$  meets the curve in four points coincident with the inflexion t = 1. It also passes through t = -1, since  $(t = 1, \theta = -1)$  satisfies the 2, 2 relation; and so on.

It is easy to see that (35) represents the same curve as (34). Now the equations (35) were deduced from the relation  $t^2\theta^2 = 1$ , which was deduced from the hypothesis that a quadrilateral of the kind in question could be inscribed in a rational quintic. It follows that (35) is the only rational quintic with this property.

69. Again, if an  $R_{\circ}$  has a bitangent, we take the points of contact as 0 and  $\infty$ . The 2, 2 relation,

$$\mathcal{T} = at^2\theta^2 + bt\theta(t+\theta) + c(t^2+\theta^2) + dt\theta - e(t+\theta) + f = 0,$$

has double roots  $t = 0, \infty$ , corresponding to the values  $\theta = \infty, 0$ . Hence c = c = b = 0, and V can be written in the form  $V = (at\theta + b)(ct\theta + d)$ . Hence property (a) involves (b), and it is easy to see that the converse holds.

Supposing (a)—or (b)—to hold, then by putting t' = kt, we can write the 2, 2 relation  $(t\theta - 1)(t\theta - a) = 0$ .

The equations of the corresponding curve, after the analogy of equations (35), are

$$\frac{x_1}{(t-1)^4(t-a)} = \frac{x_2}{t^3} = \frac{x_3}{t^2} = \frac{x_4}{(t+1)^4(t+a)}.$$

The condition that the tangents should belong to a linear complex is easily found to be  $(a + 1)^2 = 0$ , so that the curve is identical with (35) or (34); hence no other  $R_s$  possesses properties (a) or (b).

70. The three pairs  $(\pm 1)$ ,  $(\pm i)$ ,  $(0, \infty)$  are harmonically conjugate with respect to one another, and the vertices of any one of the quadrilaterals  $(t, t^{-1}, -t, -t^{-1})$  are harmonically conjugate by twos with respect to these three pairs.

71. We may sum up these results as follows :--

If in a rational quintic curve one quadrilateral can be inscribed such that the plane of any two adjacent sides is the osculating plane at their vertex, then (1) an infinity of such quadrilaterals can be inscribed; (2) the tangents to the curve belong to a linear complex which contains the sides of the quadrilaterals; (3) the curve has a bitangent; (4) the secants of the curve which belong to the complex (i.e. the sides of the quadrilaterals) determine two involutions on the curve, whose foci are the two pairs into which the four inflexions fall, and whose common pair of conjugate points are the points of contact of the bitangent; (5) if the vertices of one of the quadrilaterals are determined by the quartic f(t) = 0, the sextic covariant of f gives the four inflexions and the points of contact of the bitangent, and all the other quadrilaterals are determined by equations of the form  $f + \lambda h = 0$ , where h is the Hessian of f; (6) the curve will be a homographic transformation of that given by the equations (35); (7) no other R, possesses either of the properties (3) or (4).

System of Curves and Surfaces derived from one of these Curves.

72. We saw in section IX, par. 66, that a curve k is an asymptotic line on a quartic scroll S whose parametric equations are

 $x_2 = (\mu - 2)^2 x_1, \quad x_3 = (\mu + 2)^2 x_4.$ 

The equation of S is therefore

 $\sqrt{(x_2/x_1)} + \sqrt{(x_3/x_4)} = 4,$ 

or, rationalizing and arranging according to descending powers of  $x_1$  and  $x_4$ ,

$$256 x_1^2 x_4^2 - 16 x_1 x_4 (x_1 x_3 + x_2 x_4) + (x_1 x_3 - x_2 x_4)^2 = 0,$$

which shows that the two sheets of the surface which touch along the cuspidal line p touch the hyperboloid  $H = x_1x_3 - x_2x_4 = 0$  along the line p. It is easy to see that H contains, besides p, the two lines  $(\pm 1)$ ,  $(\pm i)$ . These we shall call J and I respectively.

73. S is the locus of the secant  $(t, t^{-1})$  of a curve k; in other words, it is the locus of the join of two conjugate points in one of the two involutions into which the 2, 2 relation breaks up. The corresponding line  $(t, -t^{-1})$ connected with the other involution generates a surface S'.

To investigate S', we put t' = it on the curve k: we have then to find the locus of the line (t', 1/t'). Now the 2, 2 relation is of the same form as before. Hence, by taking as coordinate planes the osculating planes at  $t' = 1, 0, \infty, -1$ , we find the equations of the curve in the form (35), with t' for t, and of course with a different tetrahedron of reference. The equation of S' will therefore be the same as would be the equation of S if derived from equations (35).

74. Both S' and S have the bitangent of the curve as a cuspidal line. Further, they touch along this line. In effect, the tangent plane to S is determined by the hyperboloid H, which is determined by its three generators of the same species p, I, J. Consider the corresponding lines p, I', J'. I' passes through the points  $t' = \pm i$ , i.e.  $t = \pm 1$ ; it therefore coincides with J, and J' in like manner is I. Hence H and H' are identical, and the two surfaces S, S' touch along the common cuspidal line.

Again, they touch along the curve k, since it is an asymptotic line on each. Hence the intersection of S and S', which is of the sixteenth degree, is made up of the curve counted twice and the bitangent counted six times.

75. Starting with a curve k, we obtain two surfaces, S and S', having k as a common asymptotic line. These surfaces contain an infinity of curves k (their asymptotic lines); all of these have the same bitangent p, and their inflexions lie by twos on the lines I and J. Taking any such curve (say on S), we obtain a new surface  $S'_1$  and a new set of curves k. Proceeding thus we

obtain an infinity of surfaces and curves. All the surfaces have the same cuspidal line p, and touch the same hyperboloid H along p. All the directrices are generators of H of one system (a), since they meet the generators p, I, J of the other system ( $\beta$ ). Hence all the linear congruences to which the generators of the surfaces belong contain the regulus ( $\beta$ ). The surfaces S fall into two systems, I being a generator of those of one system, and J of those of the other.

System of Quadrilaterals and Tetrahedra in Space connected with a Curve k.

76. Take the equations of the curve in the form

$$x_1/(t^5 - 3t) = x_2/t^3 = x_3/t^2 = x_4/(3t^4 - 1),$$
(36)

which is easily derived from (34) or (35).

The complex is  $C = p_{13} + p_{24} = 0$ .

The congruence  $(t, t^{-1})$  is constituted by C, and  $C' = p_{12} + p_{34} = 0$ .

The congruence  $(t, -t^{-1})$  is constituted by C, and  $C'' = p_{12} - p_{34} = 0$ .

The lines  $(\pm t)$  belong to the congruence C' = C'' = 0.

The three complexes C, C', C'' are in involution, and therefore determine a system of tetrahedra in space such that any vertex is the pole of each of the adjacent faces with respect to one of the three complexes. Each edge will of course belong to the congruence formed by two of the complexes.

If (x),  $(\xi)$ ,  $(\eta)$ ,  $(\zeta)$  are the points  $t, t^{-1}, -t, -t^{-1}$  respectively on the curve, we have easily, from (36),

 $x_1: x_2: x_3: x_4 = -\xi_4: \xi_3: \xi_2: -\xi_1 = -\eta_1: -\eta_2: \eta_3: \eta_4 = -\zeta_4: \zeta_3: -\zeta_2: \zeta_1.$ 

It follows that, if five points  $t_i$  (i = 1, 2, ..., 5) lie in a plane  $\Pi_1$ , the sets of five points  $t_i^{-1}$ ,  $-t_i$ ,  $-t_i^{-1}$  will lie in planes  $\Pi_2$ ,  $\Pi_3$ ,  $\Pi_4$ .

If (y) is the pole  $P_1$  of  $\Pi_1$  with respect to C, the equation of  $\Pi_1$  is

$$X_1 y_3 - X_3 y_1 + X_2 y_4 - X_4 y_2 = 0.$$

# Hence $\Pi_2$ is $-X_4y_3 - X_2y_4 + X_3y_4 + X_1y_2 = 0.$

Hence  $\Pi_2$  contains  $P_1$ , and is its polar plane in C'.

Similarly  $\Pi_3$  contains  $P_1$ , and is its polar plane in C''.

If  $P_i$  is the pole of  $\Pi_i$  in C, we see in this way that the tetrahedra (P) and  $(\Pi)$  coincide, and form a tetrahedron of the kind described above.

Starting, therefore, from any point  $P_1$  in space, we get a quadrilateral  $P_1 P_2 P_3 P_4$  such that the pairs of opposite sides belong to the congruences  $(t, t^{-1})$  and  $(t, -t^{-1})$ , and the diagonals to the congruence (t, -t). Further, if the plane  $\Pi_i(P_4 P_1 P_2)$  meets the curve in five points  $A_i$ , the plane  $\Pi_2$  will meet the curve in the five vertices  $B_i$  of the quadrilaterals  $A_i B_i C_i D_i$  on the curve (par. 67) (c); and so with  $\Pi_3$  and  $\Pi_4$ .

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# [ 73 ]

# IV.

# THE DIFFERENTIATION OF QUATERNION FUNCTIONS.

## BY K. T. WANG.

[Read MAY 8. Published JULY 13, 1911.]

DIFFERENTIALS of quaternion functions of algebraical and transcendental forms containing no quaternion constants are precisely analogous to those of ordinary or scalar functions, if dq///q. But in the general case, without the coplanarity dq///q, the differentiation becomes far more complex. I have never yet seen any author deal with much of it.

But recently I found that there is a general expression for the differentiation of such functions.

In the general case dq can always be resolved into two components: the one is a quaternion ///q, and the other a vector  $\perp Axq$ ; the perpendicular vector component can be expressed in the form

$$-Vq \cdot V(Vdq:Vq),$$

and the coplanar quaternion component,

$$dq + Vq$$
.  $V(Vdq:Vq)$ .

For every set of values of q and dq there is only one set of components which satisfies the above definition.

Let F(q, dq) denote the differential of fq; hence it is a linear function of dq: it is distributive, or

$$F(q, dq) = F \{q, dq + Vq, V(Vdq : Vq)\} + F \{q, -Vq, V(Vdq : Vq)\}$$

Because  $dq + Vq \cdot V(Vdq : Vq)///q$  and its functions, containing no quaternion constants; so, similar to the special case dq///q,

$$F\{q, dq + Vq \cdot V(Vdq : Vq)\} = f'q \cdot \{dq + Vq \cdot V(Vdq : Vq)\}$$

(f' signifies the ordinary form of derivative of f), and it is also ///q or fq.

The other term  $F\{q, -Vq \cdot V(Vdq : Vq)\}$ , though it is not so simple as the first one, is always a sum of products of coplanar quaternions and the vector, that  $\perp$  their axis,  $-Vq \cdot V(Vdq : Vq)$ . All such products are vectors  $\perp$  the axis of the quaternions; therefore the sum, i.e.

$$F\left\{q, -Vq \cdot V(Vdq:Vq)\right\},$$

is also a vector  $\perp Axq$  or Axfq.

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[10]

But, similar to dq, dfq can only be resolved into one set of components, a quaternion ///fq, i.e.

and a vector  $\perp Axfq$ ,  $dfq + Vfq \cdot V(Vdfq : Vfq),$  $- Vfq \cdot V(Vdfq : Vfq).$ 

Therefore we can equate the coplanar quaternion part

$$\begin{aligned} f'q \cdot \{dq + Vq \cdot V(Vdq : Vq)\} &= dfq + Vfq \cdot V(Vdfq : Vfq) \\ &= dfq + Vfq \cdot V(Vdq : Vq) \end{aligned}$$

$$(Axfq = \pm Axq, \quad dAxfq = \pm dAxq,$$

and V(Vdfq:Vfq) = dAxfq:Axfq = dAxq:Axq = V(Vdq:Vq)).This gives dfq = f'q.dq + (f'q.Vq - Vfq)V(Vdq:Vq).

In addition to the foregoing proof, the differentials of some particular functions of q can be found in other ways. The results are the same as those deduced from the above equation; therefore they can be used as the verifications of it.

(1.) Differentiate  $q^{\overline{m}}$ , where m and n are positive integral scalars.

Let  $r = q^{\frac{n}{m}}$ , then  $r^m = q^n$ . Differentiate,

 $r^{m-1}$ .  $dr + r^{m-2}$ .  $dr \cdot r + \ldots + dr \cdot r^{m-1} = q^{n-1} \cdot dq + q^{n-2} \cdot dq \cdot q + \ldots + dq \cdot q^{n-1}$ . Multiply each member of equation

$$r^{-m+\frac{m}{n}} = q^{-n+1}$$

by the corresponding member of last equation,

$$r^{\frac{m}{n}-1} \cdot dr + r^{\frac{m}{n}-2} \cdot dr \cdot r + \dots + r^{\frac{m}{n}-m} \cdot dr \cdot r^{m-1}$$
$$= dq + q^{-1} \cdot dq \cdot q + \dots + q^{-n+1} \cdot dq \cdot q^{n-1}.$$

Denote

$$Q + r^{-1} Qr + r^{-2} Qr^{2} + \ldots + r^{-m+1} Qr^{m-1} \quad \text{by} \quad F_{1} Q$$
$$Q + q^{-1} Qq + q^{-2} Qq^{2} + \ldots + q^{-n+1} Qq^{n-1} \quad \text{by} \quad F_{2} Q,$$

and

then

 $F_1\left(\frac{m-1}{r^n}, dr\right) = F_2 dq.$ 

Hence every term of  $F_1$  and  $F_2$  is a conical rotation of the operands therefore

and 
$$SF_1 = F_1S = mS, \quad VF_1 = F_1V,$$
  
 $SF_2 = F_2S = nS, \quad VF_2 = F_2V$ 

thus 
$$mS \langle r^{\frac{m}{n}-1}, dr \rangle = nS dq,$$

and 
$$F_1 V \left( \frac{m}{r^n} - 1 \right) = F_2 V dq$$

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Divide by 
$$Vq$$
, and hence all powers of  $r$  and  $q///q$  and  $Vq$ ; therefore  
 $FQ: Vq = F(Q:Vq);$   
thus  $F_1\left\{V(r^{\frac{m}{n}-1}.dr): Vq\right\} = F_2(Vdq:Vq);$   
and  $mS\left\{V(r^{\frac{m}{n}-1}.dr): Vq\right\} = nS(Vdq:Vq),$   
and  $F_1V\left\{V(r^{\frac{m}{n}-1}.dr): Vq\right\} = nS(Vdq:Vq).$   
The two operands of the last equation  $\bot Axr$  and  $Axq$ , therefore  
 $r^{-x}vr^x = Ur^{-2x}.v$  and  $q^{-x}vq^x = Uq^{-2x}.v,$   
thus the equation becomes  
 $(1 + Ur^{-2} + Ur^{-4} + ... + Ur^{-2m+2})V\left\{V(r^{\frac{m}{n}-1}.dr): Vq\right\}$   
 $= (1 + Uq^{-2} + Uq^{-4} + ... + Ur^{-2m+2})V\left\{V(r^{\frac{m}{n}-1}.dr): Vq\right\}$   
 $= (1 + Uq^{-2} + Uq^{-4} + ... + Uq^{-2n+2})V(Vdq:Vq),$   
or  $\frac{1 - Ur^{-2m}}{1 - Ur^{-2}}V\left\{V(r^{\frac{m}{n}-1}.dr): Vq\right\} = \frac{1 - Uq^{-2n}}{1 - Uq^{-2}}V(Vdq:Vq),$   
or  $V\left\{V(r^{\frac{m}{n}-1}.dr): Vq\right\} = \frac{1 - Uq^{-2n}}{1 - Uq^{-2}}V(Vdq:Vq),$   
But  $1 - Uq^{-2x} = Uq^{-x}(Uq^x - Uq^x) = 2Uq^{-x}.V.Uq^x = 2q^{-x}V,q^x;$ 

$$V \left\{ V \left( r^{n} - dr \right) : Vq \right\} = \frac{1 - Uq}{1 - Uq^{-2}} V \left( Vdq : Vq \right).$$

$$1 - Uq^{-2x} = Uq^{-x} \left( Uq^{x} - Uq^{-x} \right) = 2Uq^{-x} \cdot V \cdot Uq^{x} = 2q^{-x} \cdot V \cdot q^{x};$$
fore
$$V \left\{ V \left( r^{\frac{m}{n} - 1} \cdot dr \right) : Vq \right\} = q^{-\frac{n}{m} + 1} \frac{V \cdot q^{\frac{m}{m}}}{Vq} V \left( Vdq : Vq \right).$$

therefore Then

Then  

$$V(r^{\frac{m}{n}-1}, dr): Vq = (S+V) \left\{ V(r^{\frac{m}{n}-1}, dr): Vq \right\}$$

$$= \frac{n}{m} S(Vdq:Vq) + q^{-\frac{n}{m}+1} \frac{V \cdot q^{\frac{m}{m}}}{Vq} V(Vdq:Vq),$$

$$= \frac{n}{m} Vdq: Vq + \left(-\frac{n}{m} + q^{-\frac{n}{m}+1} \frac{V \cdot q^{\frac{n}{m}}}{Vq}\right) V(Vdq:Vq);$$

$$V\left(r^{\frac{m}{n}-1}, dr\right) = \frac{n}{m} Vdq + \left(-\frac{n}{m} + q^{-\frac{n}{m}+1} \frac{V \cdot q^{\frac{m}{m}}}{Vq}\right) V(Vdq:Vq) \cdot Vq,$$

$$= \frac{n}{m} Vdq + \left(\frac{n}{m} Vq - q^{-\frac{n}{m}+1} V \cdot q^{\frac{n}{m}}\right) V(Vdq:Vq) \cdot Vq,$$

$$(\because Vq \perp V(Vdq:Vq), \text{ so } V(Vdq:Vq) \cdot Vq = -Vq \cdot V(Vdq:Vq));$$

$$[10^*]$$

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$$\begin{split} r^{\frac{m}{n}-1} \cdot dr &= (S+V)\left(r^{\frac{m}{n}-1} \cdot dr\right) = \frac{n}{m} Sdq + \frac{n}{m} Vdq \\ &+ \left(\frac{n}{m} Vq - q^{-\frac{n}{m}+1} V \cdot q^{\frac{n}{m}}\right) V \left(Vdq : Vq\right) \\ &= \frac{n}{m} dq + \left(\frac{n}{m} Vq - q^{-\frac{n}{m}+1} V \cdot q^{\frac{n}{m}}\right) V \left(Vdq : Vq\right); \end{split}$$

and finally

$$d \cdot q^{\frac{n}{m}} = dr = r^{-\frac{m}{n}+1} \left( \frac{m}{r^{n}} - 1, dr \right) = q^{\frac{n}{m}-1} \left( \frac{m}{r^{n}} - 1, dr \right)$$
$$= \frac{n}{m} q^{\frac{n}{m}-1} dq + \left( \frac{n}{m} q^{\frac{n}{m}-1} Vq - V, q^{\frac{n}{m}} \right) V(Vdq : Vq).$$

(2.) Differentiate  $q^{-\frac{1}{m}}$ .

Let  $r = q^{-\frac{n}{m}}$ , then  $r^m = q^{-n}$ . Differentiate,

 $r^{m-1}$ .  $dr + r^{m-2}$ . dr.  $r + \ldots - dr$ .  $r^{m-1} = -q^{-n}$ .  $dq \cdot q^{-1} - q^{-n+1}$ .  $dq \cdot q^{-2} - \ldots - q^{-1} \cdot dq \cdot q^{-n}$ . Multiply each member of equation

$$p^{-m-\frac{m}{n}} = q^{n+1}$$

by the corresponding member of the last equation and treat in a similar way as in (1), the result is

$$d \cdot q^{-\frac{n}{m}} = -\frac{n}{m} q^{-\frac{n}{m}-1} dq + \left(-\frac{n}{m} q^{-\frac{n}{m}-1} \boldsymbol{V} q - \boldsymbol{V} \cdot \boldsymbol{q}^{-\frac{n}{m}}\right) \boldsymbol{V}(\boldsymbol{V} dq : \boldsymbol{V} q).$$

Therefore if  $\alpha$  is any scalar either integer or fraction (or irrational, the limit of fraction), positive or negative,

$$d \cdot q^a = aq^{a-1} dq + (aq^{a-1} Vq - V \cdot q^a) V(Vdq : Vq).$$

(3.) Differentiate  $\log_e q$ .

$$\log_e q = \lim_{n \to 0} \frac{q^n - 1}{n};$$

therefore

$$d \log_e q = \lim_{n \to 0} \frac{dq^n}{n} = \lim_{n \to 0} \left[ q^{n-1} dq + \left( q^{n-1} Vq - \frac{V \cdot q^n}{n} \right) V(Vdq: Vq) \right]$$
$$= q^{-1} dq + \left( q^{-1} Vq - V \log_e q \right) V(Vdq: Vq).$$

(4.) Differentiate  $e^q$ .

$$e^{q} = \lim_{n \to 0} \left(1 + nq\right)^{\frac{1}{n}};$$

therefore

$$d.e^{q} = \lim_{n \to 0} d(1 + nq)^{\frac{1}{n}} = \lim_{n \to 0} \left[ (1 + nq)^{\frac{1}{n} - 1} dq + \left\{ (1 + nq)^{\frac{1}{n} - 1} Vq - V.(1 + nq)^{\frac{1}{n}} \right\} V(Vdq:Vq) \right]$$
$$= e^{q} dq + (e^{q} Vq - V.e^{q}) V(Vdq:Vq).$$

(5.) Differentiate any function of q that can be expressed in a series of powers of q (including the limit form  $\log_e q$ ) with scalar indices and coefficients.

$$\begin{aligned} fq &= \Sigma a_x q^x, \\ dfq &= \Sigma a_x d, q^x &= \Sigma a_x x q^{x-1} dq + (\Sigma a_x x q^{2-1} Vq - V\Sigma a_x q^x) V(Vdq : Vq) \\ &= f'q. dq + (f'q. Vq - Vfq) V(Vdq : Vq). \end{aligned}$$

(6.) Differentiate  $Fq = f_1 f_2 q$ , where  $f_1$  and  $f_2$  are any functions which have previously been proved that satisfy the general expression

$$dFq = df_{1}f_{2}q = f'_{1}f_{2}q \cdot df_{2}q + (f'_{1}f_{2}q \cdot Vf_{2}q - Vf_{1}f_{2}q) V (Vdf_{2}q : Vf_{2}q)$$

$$= f'_{1}f_{2}q \cdot df_{2}q + (f'_{1}f_{2}q \cdot Vf_{2}q - Vf_{1}f_{2}q) V (Vdq : Vq)$$

$$= f'_{1}f_{2}q \{f'_{2}q \cdot dq + (f'_{2}q \cdot Vq - Vf_{2}q) V (Vdq : Vq)\}$$

$$+ (f'_{1}f_{2}q \cdot Vf_{2}q - Vf_{1}f_{2}q) V (Vdq : Vq)$$

$$= F'q \cdot dq + (F'q \cdot Vq - VFq) V (Vdq : Vq)$$

$$(\because f'_{1}f_{2}q \cdot f'_{2}q = F'q).$$

The successive operation by either  $\mathcal{A}_q$  or  $\mathcal{A}_{\mathcal{V}_q}$  on fq has also general expressions. However, for simplicity, we shall first solve some questions connecting to them.

(1.) Find the values of  $\Pi S(Qdq)$ ,  $\Pi V(Qdq)$ ,  $\Pi S(QVdq)$ ,  $\Pi V(QVdq)$ , and  $\Pi V(Vdq:Vq)$ , where  $\Pi fdq$  denote -f1 + ifi + jfj + k/k.

Let q = w + ix + jy + kz and Q = W + iX + jY + kZ. Hence, -SQ = -W,  $iS \cdot Qi = -iX$ ,  $jS \cdot Qj = -jY$ , and  $kS \cdot Qk = -kZ$ ; thus,  $Q \upharpoonright S \cdot Qdq = -Q$ . [1] Again, -VQ = -iX - jY - kZ,  $iV \cdot Qi = -W + jY + kZ$ ,

$$jV. Qj = -W + iX + kZ$$
, and  $kV. Qk = -W + iX + jY$ ;  
 $\sigma[V. Qdq = -3SQ + VQ.$ 

thus,

Also,  $\Pi \int S \cdot QVdq = \Pi \int S \cdot Qdq$  without the first term = -VQ. [3] Similarly  $\Pi \int V \cdot QVdq = -3SQ + 2VQ.$  [4]

$$\mathbf{\mathcal{Q}} \int \mathbf{\mathcal{Q}} V dq = \mathbf{\mathcal{Q}} \int S \cdot \mathbf{\mathcal{Q}} V dq + \mathbf{\mathcal{Q}} \int V \cdot \mathbf{\mathcal{Q}} V dq = -3SQ + VQ.$$
 [5]

And

$$iV(i:Vq) = iV(i,Vq):Vq^2 = -(jy+kz):Vq^2,$$

similarly

 $jV(j:Vq) = -(ix+kz):Vq^2, \text{ and } kV(k:Vq) = -(ix+jy):Vq^2;$ therefore  $Q \int V(Vdq:Vq) = -2Vq:Vq^2 = -2Vq^{-1}.$  [6]

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[2]

(2.) Find the expressions of

 $\mathcal{A}_q(Sfq \cdot Vq^{-m}), \quad \mathcal{A}_q(Vfq \cdot Vq^{-m}), \quad \mathcal{A}_{Vq}(Sfq \cdot Vq^{-m}), \text{ and } \quad \mathcal{A}_{Vq}(Vfq \cdot Vq^{-m}),$ where *m* is an integer.

 $d(Sfq \cdot Vq^{-m})$  $= S(f'qdq) \cdot Vq^{-m} - mSfq \cdot Vq^{-m-1} \cdot Vdq - Sfq (m Vq^{-m} + V(Vq^{-m})) V(Vdq : Vq);$ thus  $\mathcal{T}_q(Sfq, Vq^{-m})$  $= \sigma \left[ S(f'qdq), Vq^{-m} - m\sigma \left[ Sfq, Vq^{-m-1}, Vdq - \sigma \left[ Sfq \right] m Vq^{-m} + V(Vq^{-m}) \right] V(Vdq; Vq) \right]$ But  $D \int S(f'q.dq) \cdot Vq^{-m} = -f'q \cdot Vq^{-m},$  $-m_{I} \int Sfq \cdot Vq^{-m-1} \cdot Vdq = 3mSfq \cdot S(Vq^{-m-1}) - mSfq \cdot V(Vq^{-m-1}),$ and  $- \mathcal{Q} \int Sfq \{m Vq^{-m} + V(Vq^{-m})\} V(Vdq:Vq)$  $= -\sigma \left\{ V(Vdq:Vq)Sfq.K\left\{mVq^{-m} + V(Vq^{-m})\right\} \right\}$  $= 2 V q^{-1} . S f q . K \{ m V q^{-m} + V (V q^{-m}) \}$  $= 2Sfq \cdot Vq^{-1} \cdot \{mS(Vq^{-m}) - (m+1)V(Vq^{-m})\}$  $= 2mSfq \cdot V(Vq^{-m-1}) - 2(m+1)Sfq \cdot S(Vq^{-m-1}).$  $\therefore D_q(Sfq, Vq^{-m})$  $= -f'q \cdot Vq^{-m} + (m-2)Sfq \cdot S(Vq^{-m-1}) + mSfq \cdot V(Vq^{-m-1})$  $= -f'q \cdot Vq^{-m} + (m-1)Sfq \cdot Vq^{-m-1} - Sfq \cdot K \cdot Vq^{-m-1}$  $= -f'q \cdot Vq^{-m} + \{m-1 - (UVq^2)^{m+1}\} Sfq \cdot Vq^{-m-1}$  $= -f'q \cdot Vq^{-m} + \{m-1+(-1)^m\} Sfq \cdot Vq^{-m-1},$ if m is integer.  $d(Vfq, Vq^{-m}) = V(f'qdq), Vq^{-m} + (f'q, Vq - Vfq)V(Vdq; Vq), Vq^{-m}$  $-mVfq.Vq^{-m-1}.Vdq - Vfq \{mVq^{-m} + V(Vq^{-m})\}V(Vdq:Vq);$ thus  $\mathcal{T}_q(Vfq.Vq^{-m})$  $= \sigma \int V(f'qdq) \cdot Vq^{-m} + \sigma \int (f'q \cdot Vq - Vfq) V(Vdq : Vq) \cdot Vq^{-m}$  $-m_{\mathbf{\mathcal{I}}} \int Vfq \cdot Vq^{-m-1} \cdot Vdq - \mathbf{\mathcal{I}} \int Vfq \{m Vq^{-m} + V(Vq^{-m})\} V(Vdq : Vq).$ But  $\sigma$  [ (f'q. Vq - Vfq) V(Vdq: Vq), Vq<sup>-m</sup>  $= \sigma \left[ V(Vdq:Vq) K(f'q,Vq-Vfq), Vq^{-m} \right]$  $= -2 Vq^{-1} \cdot K(f'q \cdot Vq - Vfq) \cdot Vq^{-m}$  $= -2(Vf'q.Vq - Sf'q.Vq + Vfq).Vq^{-m-1}$  $= -2Vf'q \cdot Vq^{-m} + 2Sf'q \cdot Vq^{-m} - 2Vfq \cdot S(Vq^{-m-1}) - 2Vfq \cdot V(Vq^{-m-1}),$  $-m_{f} \int Vfq \cdot Vq^{-m-1} \cdot Vdq = 3m Vfq \cdot V(Vq^{-m-1}) - m Vfq \cdot S(Vq^{-m-1}),$  $- \sigma \left[ Vfq \left\{ m Vq^{-m} + V(Vq^{-m}) \right\} V(Vdq:Vq) \right]$ and  $= - \prod V(Vdq:Vq)K\{mVfq.Vq^{-m} + Vfq.V(Vq^{-m})\}$  $= 2 V q^{-1} \{ (m+1) V f q \cdot V(V q^{-m}) - m V f q \cdot S(V q^{-m}) \}$  $= 2(m+1) Vfq . S(Vq^{-m-1}) - 2m Vfq . V(Vq^{-m-1}).$ 

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 $\begin{array}{l} \ddots \quad & \mathcal{T}_{q}(Vfq \cdot Vq^{-m}) \\ & = -Sf'q \cdot Vq^{-m} - Vf'q \cdot Vq^{-m} + m \, Vfq \cdot S(\,Vq^{-m-1}) + (m-2) \, Vfq \cdot V(\,Vq^{-m-1}) \\ & = -f'q \cdot Vq^{-m} + \{m-1 + (\,UVq^{2})^{m+1}\} \, Vfq \cdot Vq^{-m-1} \\ & = -f'q \cdot Vq^{-m} + \{m-1 - (-1)^{m}\} \, Vfq \cdot Vq^{-m-1}, \end{array}$ 

if m is integer.

 $\begin{array}{l} \mathcal{C}_{Vq}(Sfq\,.\,Vq^{-m}) \text{ and } \mathcal{C}_{Vq}(Vfq\,.\,Vq^{-m}) \text{ are exactly the same as } \mathcal{C}_q(Sfq\,.\,Vq^{-m}) \\ \text{and } \mathcal{C}_q(Vfq\,.\,Vq^{-m}) \text{ respectively, except replaced } q \text{ by } Vdq, \text{ i.e. } \mathcal{C}_q[Sfq'dq], Vq^{-m} \\ \text{and } \mathcal{C}_q[V(f'qdq)\,.\,Vq^{-m} \text{ by } \mathcal{C}_q[S(f'qVdq)\,.\,Vq^{-m} \text{ and } \mathcal{C}_q[V(f'qVdq)\,.\,Vq^{-m}, \text{ or } -f'q\,.\,Vq^{-m} \text{ and } -3\,Sf'q\,.\,Vq^{-m} + Vf'q\,.\,Vq^{-m} \text{ by } - Vf'q\,.\,Vq^{-m} \text{ and } -3\,Sf'q\,.\,Vq^{-m} \\ + 2\,Vf'q\,.\,Vq^{-m} \text{ respectively. The results are} \end{array}$ 

$$\begin{split} & \mathcal{Q}_{Vq}(S\!fq \,.\, Vq^{-m}) = - \,V\!f'q \,.\, Vq^{-m} + \{m-1 \,+ \,(-1)^m\} \,\, S\!fq \,.\, Vq^{-m-1}, \\ & \mathcal{Q}_{Vq}(V\!fq \,.\, Vq^{-m}) = - \,S\!f'q \,.\, Vq^{-m} + \{m-1 - (-1)^m\} \,\, V\!fq \,.\, Vq^{-m-1}, \end{split}$$

if m is integer.

and

Now, we can successively operate by  $\mathcal{A}_q$  and  $\mathcal{A}_{Vq}$  on fq without difficulty by using the foregoing four formulae.

As fq = Sfq + Vfq; therefore

$$\begin{aligned} & (I_q f q = -f' q - f' q - 2 V f q \cdot V q^{-1} = -2 S f' q - 2 V f' q - 2 V f q \cdot V q^{-1}, \\ & (I_q)^2 f q = 2 f'' q + 2 f'' q + 4 V f' q \cdot V q^{-1} + 2 f' q \cdot V q^{-1} - 2 V f q \cdot V q^{-2} \end{aligned}$$

$$= 4 Sf''q + 2 Sf'q \cdot Vq^{-1} + 4 Vf''q + 6 Vf'q \cdot Vq^{-1} + 2 Vfq \cdot Vq^{-2}, \&c.$$
eral,

In general,

$$\begin{split} \mathcal{Q}_{q}^{n} fq &= (-2)^{n-1} \left\{ -2Sf^{(n)} q - (n-1) Sf^{(n-1)} q \cdot Vq^{-1} - 2 Vf^{(n)} q \right. \\ &- (n+1) Vf^{(n-1)} q \cdot Vq^{-1} + (n-1) Vf^{(n-2)} q \cdot Vq^{-2} \right\}; \end{split}$$

because

$$\begin{aligned} \mathcal{Q}_{q}(-2)^{n-1} \{-2Sf^{(n)}q - (n-1)Sf^{(n-1)}q \cdot Vq^{-1} - 2Vf^{(n)}q \\ &- (n+1)Vf^{(n-1)}q \cdot Vq^{-1} + (n-1)Vf^{(n-2)}q \cdot Vq^{-2}\} \\ = (-2)^{n-1} \{2f^{(n+1)}q + (n-1)f^{(n)}q \cdot Vq^{-1} + (n-1)Sf^{(n-1)}q \cdot Vq^{-2} + 2f^{(n+1)}q + 4Vf^{(n)}q \cdot Vq^{-1} \\ &+ (n+1)f^{(n)}q \cdot Vq^{-1} - (n+1)Vf^{(n-1)}q \cdot Vq^{-2} - (n-1)f^{(n-1)}q \cdot Vq^{-2}\} \\ = (-2)^{n} \{-2Sf^{(n+1)}q - mSf^{(n)}q \cdot Vq^{-1} - (n+1)Vf^{(n-1)}q \cdot Vq^{-2} - (n-1)f^{(n-1)}q \cdot Vq^{-2}\} \\ = (-2)^{n} \{-2Sf^{(n+1)}q - mSf^{(n)}q \cdot Vq^{-1} - 2Vf^{(n+1)}q - (m+2)Vf^{(n)}q \cdot Vq^{-1} + 2Vf^{(n-1)}q \cdot Vq^{-2}\} \\ = (-2)^{n} \{-2Sf^{(n+1)}q - mSf^{(n)}q \cdot Vq^{-1} - 2Vf^{(n+1)}q - (m+2)Vf^{(n)}q \cdot Vq^{-2} + 2Vf^{(n-1)}q \cdot Vq^{-2}\} \\ = (-2)^{n} \{-2Sf^{(n+1)}q - mSf^{(n)}q \cdot Vq^{-1} - 2Vf^{(n+1)}q - (m+2)Vf^{(n)}q \cdot Vq^{-2} + 2Vf^{(n)}q \cdot Vq^{-2}\} \\ = (-2)^{n} \{-2Sf^{(n+1)}q - mSf^{(n)}q \cdot Vq^{-1} - 2Vf^{(n+1)}q - (m+2)Vf^{(n)}q \cdot Vq^{-2} + 2Vf^{(n)}q \cdot Vq^{-2}\} \\ = (-2)^{n} \{-2Sf^{(n+1)}q - mSf^{(n)}q \cdot Vq^{-1} - 2Vf^{(n)}q \cdot Vq^{-2} + 2Vf^{(n)}q \cdot Vq^{-2} + 2Vf^{(n)}q \cdot Vq^{-2}\} \\ = (-2)^{n} \{-2Sf^{(n+1)}q - mSf^{(n)}q \cdot Vq^{-1} - 2Vf^{(n)}q \cdot Vq^{-2} + 2Vf^{(n)}q \cdot Vq^{-2} + 2Vf^{(n)}q \cdot Vq^{-2}\} \\ = (-2)^{n} \{-2Sf^{(n+1)}q - mSf^{(n)}q \cdot Vq^{-1} - 2Vf^{(n)}q \cdot Vq^{-2} + 2Vf^{(n)}q \cdot Vq^{-2}\} \\ = (-2)^{n} \{-2Sf^{(n+1)}q - mSf^{(n)}q \cdot Vq^{-2} + 2Vf^{(n)}q \cdot Vq^{-2}\} \\ = (-2)^{n} \{-2Sf^{(n+1)}q - mSf^{(n)}q \cdot Vq^{-2} + 2Vf^{(n)}q \cdot Vq^{-2}\} \\ = (-2)^{n} \{-2Sf^{(n+1)}q - mSf^{(n)}q \cdot Vq^{-2} + 2Vf^{(n)}q \cdot Vq^{-2}\} \\ = (-2)^{n} \{-2Sf^{(n+1)}q - mSf^{(n)}q \cdot Vq^{-2}\} \\ = (-2)^{n} \{-2Sf^{(n)}q - mSf^{(n)}q \cdot Vq^{-2}\} \\ = (-2)^{n} \{-2Sf^{(n)}q - mSf^{(n)}q - Vq^{-2}\} \\ = (-2)^{n} \{-2Sf^{(n)}q - Vq^{-2}\} \\ = (-2)^{n} \{-2Sf^{(n)}q - Vq^{-2}\} \\ = (-2)^{n} \{-$$

 $= (-2)^n \{-2Sf^{(n+1)}q - nSf^{(n)}q \cdot Vq^{-1} - 2Vf^{(n+1)}q - (n+2)Vf^{(n)}q \cdot Vq^{-1} + nVf^{(n-1)}q \cdot Vq^{-2}\}.$  Similarly,

$$\begin{aligned} (I_{Vq}fq = -Vf'q - Sf'q - 2Vfq \cdot Vq^{-1} = -Sf'q - Vf'q - 2Vfq \cdot Vq^{-1}, \\ (I_{Vq}^{2}fq = Vf''q + Sf''q + 2Vf'q \cdot Vq^{-1} + 2Sf'q \cdot Vq^{-1} - 2Vfq \cdot Vq^{-2} \\ = Sf''q + 2Sf'q \cdot Vq^{-1} + Vf''q + 2Vf'q \cdot Vq^{-1} - 2Vfq \cdot Vq^{-2}, \&e. \end{aligned}$$

In general,

$$\begin{aligned} Q^{n}_{Vq} fq &= (-1)^{n} \left\{ Sf^{(n)}q + \left(n + \frac{(-1)^{n} - 1}{2}\right) Sf^{(n-1)}q \cdot Vq^{-1} + Vf^{(n)}q \\ &+ \left(n + \frac{1 - (-1)^{n}}{2}\right) Vf^{(n-1)}q \cdot Vq^{-1} - \left(n + \frac{(-1)^{n} - 1}{2}\right) Vf^{(n-2)}q \cdot Vq^{-2} \right\}; \end{aligned}$$

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because

$$\begin{split} \mathcal{Q}_{Tq}(-1)^{n} \left\{ Sf^{(n)}q + \left(n + \frac{(-1)^{n} - 1}{2}\right) Sf^{(n-1)}q \cdot Vq^{-1} + Vf^{(n)}q \right. \\ \left. + \left(n + \frac{1 - (-1)^{n}}{2}\right) Vf^{(n-1)}q \cdot Vq^{-1} - \left(n + \frac{(-1)^{n} - 1}{2}\right) Vf^{(n-2)}q \cdot Vq^{-2} \right\} \\ = (-1)^{n} \left\{ - Vf^{(n+1)}q - \left(n + \frac{(-1)^{n} - 1}{2}\right) Vf^{(n)}q \cdot Vq^{-1} - \left(n + \frac{(-1)^{n} - 1}{2}\right) \right. \\ \left. \times Sf^{(n-1)}q \cdot Vq^{-2} - Sf^{(n+1)}q - 2Vf^{(n)}q \cdot Vq^{-1} - \left(n + \frac{1 - (-1)^{n}}{2}\right) \right. \\ \left. \times Sf^{(n)}q \cdot Vq^{-1} + \left(n + \frac{1 - (-1)^{n}}{2}\right) Vf^{(n-1)}q \cdot Vq^{-2} + \left(n + \frac{(-1)^{n} - 1}{2}\right) \right. \\ \left. \times Sf^{(n-1)}q \cdot Vq^{-2} \right\} \\ = (-1)^{n+1} \left\{ Sf^{(n+1)}q - \left(n + 1 + \frac{(-1)^{n+1} - 1}{2}\right) Sf^{(n)}q \cdot Vq^{-1} + Vf^{(n+1)}q \right. \\ \left. - \left(n - 1 - \frac{1 - (-1)^{n+1}}{2}\right) Vf^{(n)}q \cdot Vq^{-1} - \left(n - 1 + \frac{(-1)^{n+1} - 1}{2}\right) Vf^{(n-1)}q \cdot Vq^{-2} \right\}. \end{split}$$

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V.

## THE ELECTRIC CHARGE ON RAIN.

# By PROFESSOR J. A. McCLELLAND, D.Sc., F.R.S., AND J. J. NOLAN, M.A., M.Sc., University College, Dublin,

Read 11th DECEMBER, 1911. Published FEBRUARY 5, 1912.

THE determination of the sign and magnitude of the electric charge brought down by rain to the Earth is obviously of great importance from its bearing on problems of atmospheric and terrestrial electricity. Measurements have been made by many observers; but their results have exhibited some discordance. The earlier observers, Elster and Geitel,<sup>1</sup> at Wolfenbüttel and Gerdien<sup>2</sup> at Göttingen, obtained results which seemed to be readily capable of explanation, and to harmonize with what was already known about atmospheric electricity. In general they found that the rain brought down an excess of negative electrification. It was supposed that condensation took place around the negative ions of the atmosphere as in the experiments of C. T. R. Wilson;<sup>3</sup> a negative charge was thus brought to Earth, and the positive ions remained in the atmosphere. The maintenance of the normal positive potential gradient above the surface of the Earth was thus accounted for. Measurements of the potential gradient during the fall of rain were also made by these observers. It was found that, in general, the sign of the potential is opposite to that of the charge on the rain.

The results of Weiss,<sup>4</sup> however, were not in agreement with those of the foregoing observers. He is supported by Kahler,<sup>5</sup> working at Potsdam in 1908, and by Simpson,<sup>6</sup> working at Simla in 1908–'09. Kahler found (1) that the rain was more frequently charged positively than negatively; (2) that the sign of the charge had no relation to the sign of the potential gradient; (3) that the intensity of the rain and the quantity of electrification brought down did not correspond.

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<sup>&</sup>lt;sup>1</sup> Elster and Geitel, Wien. Ber., vol. xcix, 1890, p. 421; Terr. Mag., vol. iv, 1899, p. 15.

<sup>&</sup>lt;sup>2</sup> Gerdien, Phys. Zeit., vol. iv, 1903, p. 837.

<sup>&</sup>lt;sup>3</sup> Wilson, Phil. Trans., 1897, p. 265; 1899, p. 403; 1900, p. 289.

<sup>4</sup> Weiss. Wien. Ber., cxv, 1906, p. 1825.

<sup>&</sup>lt;sup>5</sup> Kahler, Publ. of Met. Instit. of Prussia, coxiii, 1909.

<sup>&</sup>lt;sup>6</sup> Phil. Trans., ceix, 1909, p. 379; Proc. Roy. Soc. lxxxiii, 1910, p. 394.

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## Proceedings of the Royal Irish Academy.

Simpson's observations are the most complete that have yet been made upon this subject. His apparatus was self-recording, and measured the charge of the rain per c.c. as well as per unit time. The sign of the potential gradient was also automatically recorded. Simpson summarizes his results as follows :—

(1) During 71 per cent. of the time that charged rain fell the charge was positive.

(2) 75 per cent. of the electricity brought down by the rain was positive.

(3) Light rain was more highly charged than heavy rain.

(4) All rainfall that occurred at a greater rate than one mm. in two minutes was positively charged.

(5) The proportion of negative electricity brought down by the rain was slightly greater in the second than in the first half of the storms.

(6) The potential gradient was more often negative than positive during rain.

(7) No relationship between the sign of the potential gradient and the sign of the electricity of the rain could be detected.

Simpson also investigated the electricity brought down by snow.<sup>1</sup> He found that the proportion of positive to negative was about 3.6 to 1; but the most striking result was that the average charge per gramme was much greater than in the case of rain.

Observations have been made in 1910 by Baldit,<sup>2</sup> at Puy-en-Velay. He finds that positively charged rain falls more frequently than negatively charged rain, and that an excess of positive electricity is brought down.

It seemed to us important to have further observations of the charge on rain, as the later and more complete work was not in agreement with earlier work and ideas on the subject, but especially because the standard work by Simpson was carried out during the thunderstorm season at Simla, so that his results could not be assumed to hold under normal weather conditions. To this end we have made observations of the electric charge on rain at University College, Dublin. This paper deals chiefly with work started in March, 1911, and carried on to the end of June, a period of exceptionally small rainfall. The work was again taken up in October, and is being carried on during the winter months.

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<sup>&</sup>lt;sup>1</sup> Proc. Roy. Soc., lxxxiii, 83, 1910, p. 394.

<sup>&</sup>lt;sup>2</sup> Communication à la Société météorologique, séance du Mars, 1911. Le Radium, Avril, 1911, p. 153.

DESCRIPTION OF APPARATUS AND METHOD OF EXPERIMENT.

The general disposition of the apparatus may be gathered from the diagram. The rain is caught in a shallow, conical vessel, A B, 81.5 cms. in diameter. This is mounted inside a cubical wooden box, measuring about 108 cms. each way, and fitted with a zinc top C D, sloped so as to throw off



the rain which falls upon it. In this zinc top is a circular opening EF, 79 cms. in diameter, through which the rain falls into the receiving vessel. The edge of the zinc is turned up so as to form a rim about 5 cm. high around the opening. The zinc top is surmounted by a strong zinc cylinder GH, 91 cms.

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high, and 91 cms. in diameter. All this zinc, as well as the wooden box, is connected to Earth. The receiver is thus protected from the Earth's electrostatic field, from which it is furthermore shielded owing to the fact that the apparatus is placed in a small quadrangle, where the potential gradient is small. The receiver is connected by an insulated wire passing through an earthed metallic tube to a Dolezalek electrometer in a building about 4 metres distant. The receiver is supported on a tripod, from which it is insulated by paraffin wax I I. It was found that this insulation kept very good, even when the humidity of the air was high. Attached to the receiving vessel, and in electric connexion with it, is a tipping-bucket arrangement K, of the ordinary kind, into which the rain flows directly. This is adjusted to tip when 30 c.cs. of rain have flowed into it. The water discharged at each tip of the bucket is caught in a pan underneath, and flowing out through a pipe falls upon a little vessel V, supported by a spring, and causes it to make contact with mercury, and thus complete a circuit. The closing of the circuit causes a bell to ring close to the observer, and thus the arrival of each 30 c.c. of rain in the receiver is signalled. The little vessel is perforated, so that after the rush of water ceases, the strength of the spring restores it to its first position, and the contact is broken.

The charge brought down by the rain is measured by observing the increase of potential of the receiving vessel by means of a Dolezalek electrometer. In these experiments the capacity of the vessel, electrometer, and connexions was 324 cms. The sensibility of the electrometer was 464 mm. scale-divisions per volt, and was very approximately constant throughout the experiments. In general the charge on the rain was such that it was necessary to increase largely the capacity of the electrometer system by connecting a condenser. When a suitable capacity, depending upon the degree of electrification of the rain, is connected to the electrometer, the method of experiment resolves itself into noting the number of scale-divisions through which the electrometer needle is deflected in the interval between two discharges of the tipping-buckets. The electrometer is connected to Earth at each ring of the bell, and the deflection at the next ring noted. Thus the charge per c.c. of rain can be directly determined.

In the course of these experiments no attempt was made to use selfrecording apparatus. It was considered that more information could be gained by careful observation of the type of rain on each occasion, and of other attendant circumstances. Further, by personal attention, we have been able to observe the charge during *exceedingly* slight rainfalls as well as in the case of heavier rain. While the method has the disadvantages of only dealing with a portion of the total rainfall in any given period, and requiring much of the observer's time, the results obtained have led us to continue the work in the same manner.

During the observations of the charge on rain, the sign and variations of potential at a point in the air at some distance from the apparatus for collecting the rain were also observed. An insulated wire was connected to a suitable electroscope near the observer, and a sheet of lead-foil possessing induced activity was wrapped around the wire at the point where the potential was required. The electroscope consisted of a rather thick quartz fibre rendered conducting by being dipped in calcium chloride solution, and suspended between plates charged to equal and opposite potentials. The potentials of the plates could be readily altered and the sensitiveness of the electroscope varied at will.

## Possible Sources of Error.

The method of protecting the receiving vessel from the Earth's electrostatic field has already been described. The best proof that the protection was efficient is that when the vessel was disconnected from Earth, and no rain was falling, the electrometer-needle suffered no appreciable deflection, even after a considerable interval of time.

The most likely source of error in all such experiments on rain is the possibility of splashing of the rain, from surfaces exposed to the Earth's field, into the receiving-vessel. These drops would carry away an induced charge opposite in sign to that of the gradient, and possibly of very considerable magnitude, and would consequently prove a very potent source of error. It is considered that in the apparatus used, the protection against this source of error has been efficient. Rain hitting the edge or inner sides of the zinc cylinder is caught on the sloping zinc cover below and drains off. The rim which has been turned up around the edge of this cover tends to prevent splashing into the vessel below, which, even if it happens, is harmless so far as introducing a spurious charge is concerned, inasmuch as the field at the point is nil, owing to the protection afforded by the zinc cylinder. At most it means that a few uncharged drops get into the receiving-vessel. In general the apparatus may be said to have been protected from this effect owing to the proximity of the buildings around it, which, as has been already noted, to a great extent screened off the Earth's field. These buildings were not, however, so near that any possible splashing could take place from any of them into the receiver.

Another possible source of error has to be considered, namely, the Lenard effect. Lenard has shown that, when pure water splashes on a metal surface,

<sup>1</sup> Wied. Annal., vol. xlvi, 1892, p. 626.

the water takes up a positive charge, while the air becomes negatively charged. If the negatively charged air can be removed by ventilation, the charge on the water can be measured. Lenard was able to obtain in this way '15 electrostatic units per c.c. of water. In our experiments, owing to the position of the receiver and the improbability of any considerable circulation of air, it is impossible that more than a very small fraction of this amount of electrification could be developed by splashing, and most of the rain examined had charges per c.c. much greater than '15 electrostatic unit. Test experiments we tried by splashing uncharged water into the receiver convinced us that this source of error was sufficiently guarded against.

## Results.

We shall now deal with the results of the observations made during the period from 3rd March to 22nd June. Very little rain fell during this period; and as most of the small rainfall took place during the night, the total amount examined was small. Accurate measurements were obtained of the charge on 5795 c.c. of rain; and as the measurements were made on thirty-two separate occasions, they deal with a variety of types of rain, as we shall see later. These 5795 c.c. correspond to a rainfall of only 1.2 cm. Of this total 5113 c.c., or 88.2 per cent., were positively electrified, and the remaining 682 c.c., or 11.8 per cent., had a negative charge.

Considering the total charge brought down by the rain we find that the 5113 c.c. of positively charged rain had a charge of 4151.4 electrostatic units, and the 682 c.c of negatively charged rain had a charge of 289.7 electrostatic units. Thus, of the total charge of electricity brought down by the rain we examined, 93.5 per cent. was positive in sign.

At no time during these observations did thunderstorms actually occur in the immediate neighbourhood, although, on some occasions, thunderstorm conditions appeared to exist, and on one such occasion distant thunder could be heard. As the above figures show when compared with Simpson's results, the great excess of positive over negative charge on rain is equally marked under normal conditions as during thunderstorms.

Perhaps the most striking result of our observations is that rain consisting of *exceedingly small* drops appears to be *always* negatively charged. This class of rain is generally light; but its characteristic feature is the smallness of the drops rather than the rate of precipitation. Thus rain of this class was observed so light as almost to be imperceptible, and the same class of rain was dealt with falling at the rate of 002 cm. per minute. We examined this type of rain on fifteen separate occasions, and found it always negatively charged. McCLELLAND AND NOLAN-The Electric Charge on Rain. 87

In the remainder of the paper we distinguish between three different types of rain :---

- (α) Rain consisting of very small drops, as described above, and which will be referred to as "fine" rain.
- (b) Rain consisting of relatively larger drops. This rain is generally heavy; but for our purpose, it is a question of the size of the drops, and we have dealt with a rainfall as small as '0006 cm. per minute, which clearly consisted of these larger drops.

This type of rain will be referred to as "large" rain.

(c) Rain consisting of a mixture of types (a) and (b). Rain frequently falls which can be seen to consist of a mixture of large and very small drops. This type we shall refer to as "mixed" rain.

# " Fine " Rain.

As mentioned above, this type of rain consisting of exceedingly small drops was examined on fifteen separate occasions, and found to be always negatively charged. Although always negatively charged, the quantity of water falling in this form and the negative electricity brought down by it is small, so that its effect on the percentage of negative in the total charge brought down by rain is not of much importance. In all we collected about 450 c.c. of rain of this type.

A feature of this type of rain is the relative constancy of the charge per c.c. compared with the much greater variations of charge in the case of larger positive drops. On many occasions this "fine" rain was heavy enough to fill and tip the collecting-buckets; and in such cases its charge per c.c. was directly determined. On other occasions the rain was so slight that the surface of the collecting-vessel was able to retain and evaporate all that fell on it; but the charge could easily be detected by the electrometer. On some such occasions estimates of the charge per c.c. were made by exposing sheets of blotting-paper of known surface area for short times and finding their increase of weight.

The maximum and minimum limits of the negative charge per c.c. on "fine" rain were 24 electrostatic unit and 06 electrostatic unit; and the mean value of all the determinations made was 12 electrostatic unit per c.c.

As we shall see later, the charge per c.c. on the larger drops varied between much wider limits, and had a much greater mean value.

# " Large " Rain.

In the case of rain in which large drops were present we took some care to note whether the large drops were accompanied by rain of the "fine" type. That this distinction is necessary was clearly shown by what happened on some occasions. We noticed occasions when much fine rain was clearly accompanied by a relatively small number of large drops; and the electrometer deflections changed quickly from positive to negative as the number of large drops increased or diminished. We had little doubt from our observations of the rain and the electrometer-deflections that the "fine" rain was as usual negatively charged and the larger drops positively charged. Of course it is quite impossible to decide on every occasion whether the rain should be classed as "large" rain or "mixed" rain; but often it was clearly of the "mixed" type, and such cases are summarized in a separate class.

The charge on the rain consisting entirely of large drops was almost always positive. Sometimes in the case of such rain a sudden change takes place, and for a few minutes or less a negative charge is collected, followed by a quick return to the positive again.

The value of the positive charge on large rain is shown by the following Table (1), which gives the percentage of the total discharges of the tippingbuckets corresponding to charges between certain limits :—

Change new e e in	Floot		el. Tini	ka.			Daw		
charge per c.c. m	Electrostatic Chits,							rercentage.	
	< 1							3	
·1	~ `.ī							13	
	_	1						21	
1	-	2		•				46	
2		3						6	
3	-	4						3	
4	-	5						3	
5	-	9						5	

## TABLE I.

On almost half of the rain of this type examined the charge per c.c. was between 1 and 2 electrostatic units. The highest charge observed was 9.2 units per c.c.

As stated above, the charge per c.c. on the negatively electrified "fine" rain was between the limits '06 and '24 units per c.c.

On the occasions when a negative charge was observed on rain which could not be classed as fine rain higher values were found, reaching 4.9 units per c.c. on one occasion.

We noted on the occasions when very high charges per c.c. were present, especially positive charges, that thunderstorm conditions appeared to prevail, although no thunder was actually heard.

# " Mixed " Rain.

With rain of this class there were cases as stated above when the electrometer deflections changed frequently from positive to negative, and many cases when a charge always positive in sign, but small, was obtained. The following Table (II) shows the percentages of the rain of this type having charges between certain limits :—

## TABLE II.

Charge per c.c. in	Ele	etrostat	ie Unit	s.			Per	centage.
	2	1						17
·1	- '	5						62
•5		1		•				17
1	_	2	•				•	<b>4</b>
	<	2 .	•	•	•	•		0

Comparing this Table with Table I we see how much smaller the average charge is in the case of the mixed rain. Quite possibly the very small drops present in this mixed rain are always negatively charged even when the total charge is positive; but as the negative charge per c.c. found on such small drops when occurring alone is always so very small, we cannot directly ascribe the relatively small positive charges we are now dealing with to the fact that both positive and negative electricities are being collected. The fact that the rain is of the mixed type points rather to the circumstances attending its production being different from those in the case of the rain consisting only of large drops.

### Potential Gradient Observations.

It is well known that the normal positive potential gradient in fine weather is greatly disturbed when rain is falling. This fact was fully exemplified in our observations, the sign of the potential changing rapidly and frequently. It is not correct to state, as is sometimes done, that during rain the potential is negative. The noticeable feature is the frequent change of sign that occurs. On the whole, we noted a negative potential more frequently than a positive during rain.

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#### Electric Charge on Snow and Hail.

A few short showers of snow and hail occurred during the period covered by these observations. The apparatus is not specially suited for dealing with snow; but the charge could be accurately measured and the quantity of snow estimated at the end of the shower by collecting it and washing out the receiver with warm water. Five showers of snow occurred. In each case it was negatively charged. The average charge per gramme was 2.8 electrostatic units.

The potentials accompanying snow-showers are abnormal. On three of the five occasions on which snow fell the showers were quite heavy, although lasting for only a short time. Before the snow began to fall the electroscope giving the potential showed the normal positive value, which for the point in question was about 100 volts. On the arrival of the snow the potential changed quite quickly to a very high negative value outside the range of the electroscope, but which was measured by a less sensitive electroscope when the other showers occurred, and negative values as high as 2500 volts were found. This high negative potential was maintained during the showers, but fell away suddenly when the snow ceased, and the electroscope recorded a normal positive value as before.

We have stated that the snow observed was negatively charged; but one exception should be noted. During one shower the charge changed to positive for a period of less than a minute. It may be noted that Simpson usually found snow to be positively charged.

Only one shower of hail occurred, and it was positively charged, the average charge per gramme being approximately two electrostatic units. On two other occasions showers fell which consisted of mixtures of snow and hail. These showers gave further evidence that the snow was negatively charged and the hailstones positively charged. Thus when the hailstones visibly predominated, the charging of the receiver was positive, and *vice versa*. An excess of negative was recorded on both occasions; 7.6 units for 80 grammes in one shower, and 8.4 units for 200 grammes in the other.

#### SUMMARY.

The results in this paper may be summarized as follows :----

1. Of the rain tested 88.2 per cent. was positively electrified and the remainder negatively; of the electricity collected 93.5 per cent. was positive in sign.

2. Rain consisting of very minute drops was always negatively charged.

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3. Rain consisting of large drops was nearly always positively charged. The charge per c.c. on this rain varied between wide limits.

4. The negative charge per c.c. on rain consisting of minute drops was smaller and more constant.

5. Rain consisting of a mixture of minute and large drops was usually positively charged; but the charge was smaller than when large drops alone were present.

6. Snow and hail were observed on only a few occasions. The snow was charged negatively and the hail positively. Abnormally large negative potentials accompanied the fall of snow.

It is hoped to discuss these results more fully when the observations being made during the present winter months are ready for publication. The results are in good agreement with those of Simpson, so that the charges on rain are of the same type under ordinary atmospheric electrical conditions as during thunderstorms. The further results we are now obtaining are similar in character, but the average charge per c.c. is smaller than during the summer months, and the division of the rain into different types is not so well marked.

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# VI.

# SOME DIFFERENTIAL PROPERTIES OF THE ORTHOGONAL TRAJECTORIES OF A CONGRUENCE OF CURVES, WITH AN APPLICATION TO CURL AND DIVERGENCE OF VECTORS.

# BY REGINALD A. P. ROGERS, F.T.C.D.

Read FEBRUARY 12. Published APRIL 30, 1912.

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#### A. INTRODUCTORY.

Let  $\phi(a, b, c...)$  be a true proposition involving certain entities or terms a, b, c, etc.; then it is natural to inquire whether there is not a more general true proposition  $\phi(a, \beta, \gamma...)$ , a being a special case of a, b of  $\beta$ , etc. Many other motives co-operate, but on the whole the desire to find more comprehensive principles has been the main source of advance in pure mathematics.

The following investigation combines three generalisations. First, the property of a line of curvature is replaced by the notion of geodesic torsion, which vanishes for a line of curvature. Secondly, in considering, for example, Dupin's theorem, the variation and magnitude of the angle between two ROGERS-Orthogonal Trajectories of a Congruence of Curves. 93

surfaces are not confined. Thirdly, the conception of a one-parameter family of surfaces is replaced by the more general conception of a family of curves (integral curves) satisfying the Pfaffian equation

$$ldx + mdy + ndz = 0,^*$$

where l, m, n are functions<sup>†</sup> of *xyz*, and the condition of integrability is not necessarily satisfied.

This family of curves consists of the orthogonal trajectories of the congruence of curves defined by

$$\frac{dx}{l} = \frac{dy}{m} = \frac{dz}{n}.$$

The latter are illustrated by lines of force, lines of flow, lines of displacement, etc.; in some cases they might be defined by means of surfaces

$$f_1(x, y, z, a, b) = 0, \quad f_2(x, y, z, a, b) = 0$$

where a, b are variable constants, and the forms of  $f_1$  and  $f_2$  are determined.

## Nominal definitions.

The family of integral curves of the equation of the form

$$ldx + mdy + ndz = 0$$

will be referred to as  $\Pi$  or a  $\Pi$ -family. When  $l_r$ ,  $m_r$ ,  $n_r$  are used, the family will be described as  $\Pi_r$ .

In this paper it is assumed that  $l^2 + m^2 + n^2 = 1$ , i.e. l, m, n are actual direction-cosines.

<sup>\*</sup> A singly infinite system of curves of the family lies on any arbitrary surface (see Lie and Scheffers, Geometrie der Berührungstransformationen, 1896, Band i, p. 203, or Forsyth's Differential Equations, Arts. 150 ff.). This property may be regarded as a geometrical representation of the family; but a more inward geometrical representation—independent of arbitrary surfaces—is given by means of what are hereafter described as normal curves.

The pure differential method of treating the Pfaffian equation appears to have been used first by Voss (*Mathematische Annalen*, xvi, 1880, p. 556, and xxiii, 1884, pp. 45, 359) and afterwards with considerable variations by Lilienthal (*ib.* xxxii, 1883, p. 545), who also investigates the shortest integral curve of a Pfaffian equation (*ib.* lii, 1899). Both discuss in different ways the normal curvature of curves of the family (cf. D, below) as well as many other matters not referred to in this paper, the leading idea of which is the use of normal torsion, and its relation to normal curvature.

Lie has recognized that the general Monge equation, f(x, y, z, dx, dy, dz) = 0, has a geometry of its own (*Leipz. Berichte*, 1, 1898, also *Math. Ann.*, lix, 1904, p. 299); but he does not appear to have published much on the subject, except in reference to the special case of complexes of right lines.

<sup>†</sup> It will be assumed that, if x + x', y + y', z + z' be substituted for x, y, z, the corresponding values of l, m, n can be expressed by means of Taylor's theorem to any required degree of accuracy in the neighbourhood of the points x, y, z.

The line whose direction-cosines are l, m, n, drawn through the point P (x, y, z) may be termed the *normal*, and the perpendicular plane through P the *tangent-plane*, to the  $\Pi$ -family at P.

The angle of intersection at P of two families  $\Pi_p$ ,  $\Pi_q$  is defined as the angle between the normals, and is given by

$$\pm \cos \theta_{pq} = l_p l_q + m_p m_q + n_p n_q$$

A curve of intersection of two  $\Pi$ -families signifies an integral curve common to both. These curves form a curve-congruence, one passing through each point of space, the direction-cosines  $(\alpha, \beta, \gamma)$  of the tangent line being determined by

$$l_p \alpha + m_p \beta + n_p \gamma = 0, \quad l_q \alpha + m_q \beta + n_q \gamma = 0.$$

A curve whose principal normal at any point is the normal to  $\Pi$  at the same point will be termed a *normal curve* of the family  $\Pi$ . It is evidently a member of the family.

The normal torsion on  $\Pi$  of any integral curve of  $\Pi$  will signify the torsion of the normal curve of  $\Pi$  having the same tangent line at the point. The normal curvature is similarly defined.

The normal torsion on  $\Pi_p$  at P of its curve of intersection (through P) with  $\Pi_q$  will be denoted by  $\frac{1}{\tau_{nq}}$ .

Let 
$$I = l \left( \frac{dn}{dy} - \frac{dm}{dz} \right) + m \left( \frac{dl}{dz} - \frac{dn}{dx} \right) + n \left( \frac{dm}{dx} - \frac{dl}{dy} \right).$$

For a reason which will appear,  $\frac{1}{2}I$  will be termed the *mean torsion* of  $\Pi$  at the point *P*, or the mean torsion of the normal curves. In the language used in applied mathematics it is the magnitude of the component, along the direction of the unit-vector (l, m, n) of the curl of the vector.

Let 
$$J = \frac{dl}{dx} + \frac{dm}{dy} + \frac{dn}{dz}$$

It will be seen that  $\frac{1}{2}J$  is fitly described as the *mean curvature* of  $\Pi$  at the point *P*. It is the 'divergence' of the unit-vector (l, m, n) at the point.

## Normal Curves.

A family  $\Pi$  is geometrically determined by the orthogonal curve-congruence  $\frac{dx}{l} = \frac{dy}{m} = \frac{dz}{n}$ . But a more inward representation is by means of the *curve-complex* consisting of the normal curves. Any integral curve of  $\Pi$  is the envelope of some assemblage of normal curves, and in this way the normal curves represent the whole family. ROGERS - Orthogonal Trajectories of a Congruence of Curves. 95

The normal curves are evidently generalized geodesics, since they become geodesics on surfaces of a one-parameter family of surfaces when the condition of integration I = 0 is satisfied. In fact a normal curve is an integral curve whose osculating plane contains the normal to  $\Pi$  at each point. If a string under constant tension is in equilibrium in a field of force X, Y, Z, where X: Y: Z = l: m: n, it must lie along a normal curve, and if a particle can move with constant velocity in such a field, its path is a normal curve.

The normal curves are simply curves whose principal normals (l, m, n) are given functions of x, y, z. They form a *curve complex* in the sense that those passing through a point form a singly infinite system (and therefore generate a surface associated with the point), just as the lines of a complex of right lines through a point generate a cone. To prove that these curves form a complex, it is only necessary to show that a normal curve through a point Pis, in general, uniquely determined if its tangent line at P is known.

This can be proved by means of the Frenet-Serret formulae.<sup>\*</sup>  $\alpha$ ,  $\beta$ ,  $\gamma$ , l, m, n, being known at P,  $\frac{dl}{ds}$  is known since

$$\frac{dl}{ds} = a \frac{dl}{dx} + \beta \frac{dl}{dy} + \gamma \frac{dl}{dz}$$
, etc.,

and l, m, n are given functions of x, y, z. Using the formulae it will be found that  $\frac{da}{ds}, \frac{d^2a}{ds^2}$ , and all subsequent differentials are known. Therefore, since  $a = \frac{dx}{ds}, \beta = \frac{dy}{ds}, \gamma = \frac{dz}{ds}, x, y, z$  and all their differential coefficients are known. But we may assume that there cannot be two different continuous functions of s, possessing the same differential coefficients and the same value, for the same value of s. Hence, x, y, z are definite functions of s, and therefore the curve is unique.

## B. GENERALIZATIONS OF THEOREMS OF DUPIN, DARBOUX, AND JOACHIMSTHAL.

The special theorems referred to are-

Dupin's theorem :- The curves of intersection of any two surfaces of different families of a triply orthogonal system are lines of curvature on these surfaces.

Darboux's reciprocal theorem<sup>+</sup>:—The necessary and sufficient condition

Salmon's "Geometry of Three Dimensions," fifth edition, vol. i, p. 387.

<sup>†</sup> Darboux, "Leçons sur les Systèmes Orthogonaux," § 6.

that a 'doubly' orthogonal system of surfaces should belong to the same triply orthogonal system, is that the curves of intersection of any two surfaces of the two different families should always be lines of curvature on either surface.

Joachimsthal's theorem :—If two surfaces cut at a constant angle, their curve of intersection is a line of curvature on both or on neither; and if the curve of intersection of two surfaces is a line of curvature on both, they cut at a constant angle.

By the principles expressed in the following simple formulae, these theorems are summed up, and extended to all triads or pairs of one-parameter families of surfaces, and further, to all triads or pairs of  $\Pi$ -families :—

$$\frac{1}{\tau_{pq}} - \frac{1}{\tau_{qp}} = \pm \frac{d\theta_{pq}}{ds_{pq}},\tag{1}$$

$$\frac{1}{\tau_p} + \frac{1}{\sigma_p} = I_p, \tag{2}$$

where  $s_{pq}$  signifies the arc of the curve of intersection (through P) of  $\Pi_p$  and  $\Pi_q$ ,  $\frac{1}{\tau_p}$  and  $\frac{1}{\sigma_p}$  represent the normal torsions on  $\Pi_p$  for any two orthogonal curves of the family  $\Pi_p$ , intersecting at P, and the other letters have the meanings explained on p. 94.

Before proving these formulae we may deduce the special theorems mentioned.

Joachimsthal's theorem follows at once from (1); for if  $\theta_{pq}$  is constant, then  $\frac{1}{\tau_{pq}} = \frac{1}{\tau_{qp}}$ , and therefore both or neither of these normal torsions vanish at every point on the curve. And if both of those normal torsions vanish (or are equal) along a curve of intersection, the  $\Pi$ -families intersect at a constant angle along this curve. When  $I_p$  and  $I_q$  are both zero,  $\Pi_p$  and  $\Pi_q$ represent one-parameter families of surfaces, and normal torsion becomes geodesic torsion, which vanishes for a line of curvature. But it will be noticed that the disappearance of  $I_p$  and  $I_q$  is irrelevant to the proof, so that the correct statement of Joachimsthal's theorem even in its limited form is—If two  $\Pi$ -families intersect at a constant angle along any curve, the normal torsions of this curve vanish on both or on neither, and if the normal torsions are equal, the curves intersect at a constant angle.

Dupin's theorem is equivalent to the statement that if  $I_1 = I_2 = I_3 = 0$ , and  $\theta_{23} = \theta_{31} = \theta_{12} = \frac{\pi}{2}$ , then the six torsions  $\frac{1}{\tau_{23}}$ ,  $\frac{1}{\tau_{32}}$ ,  $\frac{1}{\tau_{31}}$ ,  $\frac{1}{\tau_{13}}$ ,  $\frac{1}{\tau_{12}}$ ,  $\frac{1}{\tau_{21}}$  vanish.

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But this evidently follows from the equations

$$\frac{1}{\tau_{23}} - \frac{1}{\tau_{32}} = 0, \quad \frac{1}{\tau_{31}} - \frac{1}{\tau_{13}} = 0, \quad \frac{1}{\tau_{12}} - \frac{1}{\tau_{21}} = 0,$$
$$\frac{1}{\tau_{12}} + \frac{1}{\tau_{13}} = 0, \quad \frac{1}{\tau_{21}} + \frac{1}{\tau_{23}} = 0, \quad \frac{1}{\tau_{31}} + \frac{1}{\tau_{32}} = 0.$$

The normal torsions reduce to geodesic torsions, and therefore the corresponding curves are directions of lines of curvature on each surface through the point.

Darboux' reciprocal theorem also follows very simply. If  $\Pi_1$ ,  $\Pi_2$  represent two mutually orthogonal systems of surfaces, then  $I_1 = I_2 = 0$ , and  $\theta_{12}$  is a right angle. Let  $\Pi_3$  represent the  $\Pi$ -family of curves which are the orthogonal trajectories of the congruence of curves in which surfaces of  $\Pi_1$  cut surfaces of  $\Pi_{2}$ .\* Then  $\theta_{23}$ ,  $\theta_{31}$  are right angles; hence the first five of the preceding six equations hold, and the sixth is replaced by

$$\frac{1}{\tau_{31}} + \frac{1}{\tau_{32}} = I_3.$$

The theorem now amounts to the statement that if

$$\frac{1}{\tau_{12}} = 0,$$

i.e. if the curves of intersection of surfaces of the systems  $\Pi_1$  and  $\Pi_2$  are lines of curvature on the surfaces of  $\Pi_1$ , then  $I_3 = 0$ ; that is to say  $\Pi_3$  represents a family of surfaces, and  $\Pi_1$ ,  $\Pi_2$ ,  $\Pi_3$  a triply orthogonal system. The proof is algebraically obvious.

### Proof of Equation (1).

If a,  $\beta$ ,  $\gamma$  are the direction-cosines of the tangent-line to a curve, l, m, n those of the normal and  $\lambda$ ,  $\mu$ ,  $\nu$  those of the bi-normal, then, by the Frenet-Serret formulae<sup>+</sup> or otherwise,

$$-\frac{1}{\tau} = \lambda \frac{dl}{ds} + \mu \frac{dm}{ds} + \nu \frac{dn}{ds}$$
$$= \begin{vmatrix} a & \beta & \gamma \\ l & m & n \\ \frac{dl}{ds} & \frac{dm}{ds} \frac{dn}{ds} \end{vmatrix}.$$

\*  $\Pi_3$  is defined by  $(m_1n_2) dx + (n_1l_2) dy + (l_1m_2) dz = 0.$ 

† Salmon's "Geometry of Three Dimensions," 5th ed., vol. i, p. 387.

Now the direction-cosines of the tangent-line to a curve common to the families  $\Pi_1$  and  $\Pi_2$  are

$$\frac{(m_1n_2)}{\sin\theta}, \quad \frac{(n_1l_2)}{\sin\theta}, \quad \frac{(l_1m_2)}{\sin\theta},$$

where  $(m_1n_2) = m_1n_2 - m_2n_1$ , and  $\theta = \theta_{12}$ ,  $s = s_{12}$ , and the signs are fixed by convention.

Thus

$$-\frac{\sin\theta}{\tau_{12}} = \begin{vmatrix} l_1 & m_1 & n_1 \\ l_2 & m_2 & n_2 \end{vmatrix} \begin{vmatrix} l_1 & m_1 & m_1 \\ \frac{dl_1}{ds} & \frac{dm_1}{ds} & \frac{dn_1}{ds} \end{vmatrix}$$
$$= l_2 \frac{dl_1}{ds} + m_2 \frac{dm_1}{ds} + n_2 \frac{dn_1}{ds} \cdot$$

In like manner, since  $a, \beta, \gamma$  have the same value as before, and  $l_1, m_1, n_1$  are interchanged with  $l_2, m_2, n_2$  in the rest of the expression for torsion,

$$\frac{\sin \theta}{\tau_{21}} = l_1 \frac{dl_2}{ds} + m_1 \frac{dm_2}{ds} + n_1 \frac{dn_2}{ds}$$

Hence

$$\left(\frac{1}{\tau_{21}} - \frac{1}{\tau_{12}}\right)\sin\theta = \frac{d}{ds}(l_1l_2 + m_1m_2 + n_1n_2) = \pm \frac{d}{ds}(\cos\theta) = \mp \sin\theta \frac{d\theta}{ds}$$
  
Therefore  $\frac{1}{\tau_{12}} - \frac{1}{\tau_{21}} = \pm \frac{d\theta_{12}}{ds_{12}}$ , the suffixes being restored.

This formula may be verified by spherical representation. Let  $T, N_1, B_1$ and  $T, N_2, B_2$  be the points on the unit-sphere representing the commontangent line, the normals, and the bi-normals of the normal curves on the two  $\Pi$ -families. Let  $N_1', B_1'$  and  $N_2', B_2'$  be 'consecutive' positions. The points  $N_1N_2B_1B_2$  lie on the same great circle. The preceding equation is now equivalent to proving

$$N_1N_1' \sim N_2N_2' = B_1B_1' \sim B_2B_2'$$

This will be found to follow from the fact that the angles  $B_1'B_1B_2$  and  $B_2'B_2B_1$ , or their supplements, are small quantities of the first order.

### Proof of Equation (2).

The torsion for any curve (C) is given as before by

$$-\frac{1}{\tau} = \lambda \frac{dl}{ds} + \mu \frac{dm}{ds} + \nu \frac{dn}{ds}$$
$$= \lambda (a_1 a + a_2 \beta + a_3 \gamma) + \mu (b_1 a + b_2 \beta + b_3 \gamma) + \nu (c_1 a + c_2 \beta + c_3 \gamma)$$
where  
$$\frac{dl}{dt} = \frac{dm}{dt} = \frac{dm}{dt} = \frac{dm}{dt} = \frac{dm}{dt}$$

 $a_1 = \frac{dl}{dx}, \quad a_2 = \frac{dl}{dy}, \quad b_1 = \frac{dm}{dx}, \quad c_1 = \frac{dn}{dx}, \text{ etc.}$ 

The torsion  $\frac{1}{r}$  of a curve (C') whose normal is l, m, n and whose tangent line at the point is perpendicular to the tangent line  $(a, \beta, \gamma)$  of C, is found by interchanging  $a, \beta, \gamma$  with  $\lambda, \mu, \nu$ , and changing the sign (since the orientation of the tangent line, normal and bi-normal is altered<sup>\*</sup>). Thus,

$$\frac{1}{\tau'} = a \left( \alpha_1 \lambda + \alpha_2 \mu + \alpha_3 \nu \right) + \beta \left( b_1 \lambda + b_2 \mu + b_3 \nu \right) + \gamma \left( c_1 \lambda + c_2 \mu + c_3 \nu \right)$$

Hence, putting  $l = \mu\gamma - \nu\beta$ ,  $m = \nu a - \lambda\gamma$ ,  $n = \lambda\beta - \mu a$ , we have

$$\frac{1}{\tau} + \frac{1}{\tau'} = l\left(\frac{dn}{dy} - \frac{dm}{dz}\right) + m\left(\frac{dl}{dz} - \frac{dn}{dx}\right) + n\left(\frac{dm}{dx} - \frac{dl}{dy}\right),$$

which is the formula in question.

This gives a very definite geometrical meaning to the quantity I, whose vanishing expresses the condition that the  $\Pi$ -family of curves may determine a one-parameter family of surfaces. The sum of the normal torsions along two perpendicular directions at a given point is constant and is equal to I.  $\frac{1}{2}I$  may therefore be described as the mean torsion of the  $\Pi$ -family at the point.

More generally the magnitude of the component, along the direction of a vector, of the curl of the vector is equal to the magnitude of the vector, multiplied by the mean torsion of the  $\Pi$ -family defined by

$$Xdx + Ydy + Zdz = 0$$

where X, Y, Z are the magnitudes of the components of the vector at the point. For

$$\Sigma l\left(\frac{dZ}{dy} - \frac{dY}{dz}\right) = R\Sigma l\left(\frac{dn}{dy} - \frac{dm}{dz}\right),$$
$$X = lR, \ Y = mR, \ Z = nR.$$

where

### C. GENERAL CONFORMAL REPRESENTATION AND NORMAL TORSION.

The conformal representation of space on itself is expressed by a transformation in which corresponding directions at corresponding points are unaltered. Only *inversion* need be considered, since this and a repetition of inversions are the only types in which the shapes of finite figures are altered, the other types—similarity, rotation, translation, reflexion—being quite simple.

It is known that lines of curvature on a surface invert into lines of curvature on the inverse surface, + and this suggests the more general question. What effect has inversion on the normal torsions of a  $\Pi$ -family ?

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The radius of inversion being unity, the point P(x, y, z) and its inverse  $P_1(x_1, y_1, z_1)$  are connected by the equations

$$x_1 = \frac{x}{r^2}, \quad y_1 = \frac{y}{r^2}, \quad z_1 = \frac{z}{r^2}$$

where  $r^2 = x^2 + y^3 + z^2$ , the origin being the centre of inversion.

If x, y, z moves along a curve of the  $\Pi$ -family defined by

ldx + mdy + ndz = 0

where  $l^2 + m^2 + n^2 = 1$ , it is easily seen that  $x_1, y_1, z_1$  moves along the family  $\Pi_1$  defined by  $l_1 dx_1 + m_1 dy_1 + n_1 dz_1 = 0$ 

$$l_1 = l - \frac{2x}{r^2} P$$
,  $m_1 = m - \frac{2y}{r^2} P$ ,  $n_1 = n - \frac{2z}{r^2} P$ ,

and

$$P = lx + my + nz$$
; also  $l_1^2 + m_1^2 + n_1^2 = 1$ .

Using the equations before employed, the normal torsion  $\left(\frac{1}{\tau_1}\right)$  on  $\Pi_1$ , for the direction  $dx_i$ ,  $dy_1$ ,  $dz_1$  inverse to the direction dx, dy, dz, is given by

$$-\frac{ds_{1}^{2}}{\tau_{1}} = \begin{vmatrix} dx_{1} & dy_{1} & dz_{1} \\ l_{1} & m_{1} & n_{1} \\ dl_{1} & dm_{1} & dn_{1} \end{vmatrix} = \Delta_{1}.$$
$$dl_{1} = dl - 2Pdx_{1} - 2x_{2}dP, \text{ etc.}$$

Now,

The terms  $2Pdr_1$ ,  $2Pdy_1$ ,  $2Pdz_1$  disappear in  $\Delta_1$ , and  $x_1, y_1, z_1$  are expressed in terms of x, y, z.

If we border the determinant  $r^2\Delta_1$  by an upper row 1, x, y, z, and by a left-hand column 1, 0, 0, 0, and add obvious multiples of the upper row from each of the remaining three rows, we find

$$r^{2}\Delta_{v} = \begin{vmatrix} 1 & x & y & z \\ \frac{2rdr}{r^{2}} & dx & dy & dz \\ \frac{2P}{r^{2}} & l & m & n \\ \frac{2dP}{r^{2}} & dl & dm & dn \end{vmatrix}$$

Now P = lx + my + nz, and ldx + mdy + ndz = 0, therefore dP = xdl + ydm + zdn.

Multiplying the second, third, and fourth columns by  $\frac{2x}{r^2}$ ,  $\frac{2y}{r^2}$ ,  $\frac{2z}{r^2}$ 

respectively, and subtracting the sum from the first column, the second, third, and fourth members of the first column vanish, and

$$r^{2}\Delta_{1} = - \begin{vmatrix} dx & dy & dz \\ l & m & n \\ dl & dm & dn \end{vmatrix}.$$

The last written determinant is equal to  $\frac{ds^2}{\tau}$ . Thus

$$-\frac{1}{\tau_1} = \frac{1}{r^2 \tau} \left( \frac{ds}{ds_1} \right)^2 = \frac{1}{r_1^2 \tau} = \frac{r^2}{\tau} \cdot$$

If k, instead of unity, is the radius of inversion,  $\frac{ds}{ds_1} = \frac{r}{r_1} = \frac{r^2}{k^2}$ , and therefore the normal torsion, on the inverse family, of the inverse curve at the inverse point is equal to the normal torsion, on the original family, of the original curve at the original point, divided by minus the linear magnification. (It should be remembered that normal curves do not invert into normal curves.)

Taking into account the simpler cases of conformal representation, it is easy to see that for any conformal representation of  $\Pi$ -families, the new normal torsion is equal to the old divided by the linear magnification, the plus or minus sign being taken according as the representation is 'direct' or 'inverse.'\*

A corollary is that curves of zero normal torsion invert into curves of zero normal torsion on the inverse family, and in particular lines of curvature on a surface invert into lines of curvature on the inverse surface. It will be seen that there are two curves of zero normal torsion through each point in space, and these may be either real or imaginary.

### D. TORSION AND CURVATURE OF NORMAL CURVES.

The investigation of the differential properties of the normal curves passing through a given point P in space, may be simplified (as for surfaces) by taking P for origin and the axis of z for the  $\Pi$ -normal. Then, near the origin, neglecting higher powers of x, y, z,

$$l = a_1x + a_2y + a_3z, \quad m = b_1x + b_2y + b_3z, \quad n = 1,$$

the coefficients of x, y, z in n disappearing since the differentials of  $l_{1}^{2} + m^{2} + n^{2}$ ,

<sup>\* &#</sup>x27;Inverse' representation occurs in an odd number of inversions or reflexions with regard to a point or plane, 'direct' in translation, rotation, and shrinkage or expansion.

with regard to x, y, z, vanish owing to the relation  $l^2 + m^2 + n^2 = 1$ . Also at the origin

$$a_1 = \frac{dl}{dx}, \quad a_2 = \frac{dl}{dy}, \quad b_1 = \frac{dm}{dx}, \quad \text{etc.}$$

### The Indicatrix of Curvature.

The  $\Pi$ -indicatrix of curvature at a point P is simply the Dupin indicatrix of the surface (S), generated by the normal curves through P; but since this surface varies from point to point (even if we move from P along the surface S associated with it), the  $\Pi$ -indicatrix of curvature is a more general conception than the Dupin indicatrix of a one-parameter family of surfaces.

Let  $\frac{1}{\rho}$  be the curvature of a  $\Pi$ -curve whose tangent-line normal and binormal are  $a, \beta, \gamma; l, m, n; \lambda, \mu, \nu;$  then, by the Frenet-Serret formulae,\*

$$\frac{dl}{ds} = -\left(\frac{a}{\rho} + \frac{\lambda}{\tau}\right), \text{ etc.},$$
therefore
$$\frac{1}{\rho} = -\left(a\frac{dl}{ds} + \beta \frac{dm}{ds} + \gamma \frac{dn}{ds}\right).$$

and

Using the special axes  $a = \cos \theta$ ,  $\beta = \sin \theta$ ,  $\gamma = 0$ , where  $\theta$  is the angle between the tangent line and the axis of x. Therefore

$$-\frac{1}{\rho} = \frac{dl}{ds}\cos\theta + \frac{dm}{ds}\sin\theta.$$

Now

$$\frac{dl}{ds} = a \frac{dl}{dx} + \beta \frac{dl}{dy} + \gamma \frac{dl}{dz} = a_1 \cos \theta + a_2 \sin \theta,$$

and  $\frac{dm}{ds}$  similarly =  $b_1 \cos \theta + b_2 \sin \theta$ . Therefore  $-\frac{1}{\alpha} = \alpha_1 \cos^2 \theta + (\alpha_2 + b_1) \sin \theta \cos \theta + b_2 \sin^2 \theta.$ 

The conic  $a_1x^2 + (a_2 + b_1)xy + b_2y^2 = \text{constant}$  may be described as the indicatrix of curvature at the point. It may be supposed to lie in the tangent plane at the point; and its properties as regards curvature are similar to those of the Dupin indicatrix. Referred to its axes it may be written

$$\frac{x^2}{\rho_1} + \frac{y^2}{\rho_2} = \text{const.},$$

\* Salmon, op. cit., Art. 368 (a).

where  $\frac{1}{\rho_1}$ ,  $\frac{1}{\rho_2}$  are the *limiting curvatures* at the point. These may be described as extreme curvatures. The curvature for any direction is proportional to the square of the corresponding radius vector of the indicatrix. If  $\rho_1$  and  $\rho_2$  have opposite signs, the indicatrix will be a hyperbola and its conjugate.

There are two inflexional directions at each point, for which  $\frac{1}{\rho} = 0$ , corresponding to the asymptotes of the indicatrix, and the normal curves in these directions are inflected at the point. The inflexional curves form a congruence of curves in space, two passing through each point.

Points in space may evidently be classified, with reference to a given family, as elliptic or synclastic and hyperbolic or synclastic, according as  $\rho_1 \rho_2$  is positive or negative.

If we use general axes,  $\frac{1}{\rho}$  may be expressed as a quadric function of  $\alpha$ ,  $\beta$ ,  $\gamma$ ,

$$-\frac{1}{\rho} = \left(\alpha_{1}, \alpha_{2}, \alpha_{3}, \frac{1}{2}(b_{3} + c_{2}), \frac{1}{2}(c_{1} + \alpha_{3}), \frac{1}{2}(\alpha_{2} + b_{1})\right)(a, \beta, \gamma)^{2},$$

where

$$a_1 = \frac{dl}{dx}$$
,  $a_2 = \frac{dl}{dy}$ ,  $b_1 = \frac{dm}{dx}$  etc.

We have thus a first generalization of lines of curvature, viz. the curves of extreme curvature, the tangent-line at any point being a direction of maximum or minimum curvature. These curves plainly form a congruence, since two can be drawn through each point in space. They cut at right angles, and they must be real; but they do not, except for surfaces, coincide with the directions of zero torsion, which, as we shall see, may be imaginary and may cut at any angle.

The differential equation satisfied by the lines of extreme curvature for general rectangular axes is

$$\begin{vmatrix} dx & dy & dz \\ l & m & n \\ a_1dx + hdy + gdz & hdx + b_2dy + fdz & gdx + fdy + c_3dz \end{vmatrix} = 0$$

where  $2f = b_3 + c_2$ ,  $2g = c_1 + a_3$ ,  $2h = a_2 + b_1$ , and the directions are determined by solving for dx: dy: dz from this equation and

$$ldx + mdy + ndz = 0.$$

The Indicatrix of Torsion.

 $\sim$ 

By the Frenet-Serret formulae

	a	p	$\gamma$	
$-\frac{1}{2} = \lambda \frac{dl}{dr} + \mu \frac{dm}{dr} + \nu \frac{dn}{dr} =$	l	m	n	
$\tau$ ds ds ds	$\frac{dl}{ds}$	$\frac{d}{ds}$	$\frac{dn}{ds}$	

Using the special axes, for which

 $\alpha = \cos \theta$ ,  $\beta = \sin \theta$ ,  $\gamma = 0$ , l = m = 0, n = 1, res

 $-\frac{1}{2} = a_0 \sin^2 \theta - b_1 \cos^2 \theta + (a_1 - b_2) \sin \theta \cos \theta.$ 

this gives

The conic  $a_2y^2 - b_1x^2 + (a_1 - b_2)xy = \text{const.}$  (with its conjugate if a hyperbola) may be named the *indicatrix of torsion*, since the normal torsion in any direction is proportional to the square of the corresponding radius vector of the conic.

Since, for the axes used,

$$I = \frac{dm}{dx} - \frac{dl}{dy} = b_1 - a_2.$$

the condition that the curves of the family  $\Pi$  may lie on a one-parameter family of surfaces is equivalent to the condition that the indicatric of torsion may be an equilateral hyperbola.

If the indicatrix of torsion be referred to its axes, it may be written

$$\frac{x^2}{\tau_1} + \frac{y^2}{\tau_2} = \text{const.}$$

where  $\frac{1}{\tau_1}$  and  $\frac{1}{\tau_2}$  are limiting torsions, or *principal torsions* at the point.

There are two directions of zero normal torsion at each point, corresponding to the asymptotes of the indicatrix of torsion. These directions may be real or imaginary according as the torsional indicatrix is an hyperbola or ellipse. The curves along which the normal torsion is zero form a congruence, two passing through each point.

These curves are a second generalization of lines of curvature,\* with which they coincide when I = 0. But in general they do not cut at right angles and they may be imaginary.

<sup>•</sup> Voss (Math. Ann., xxiii, 1884, p. 70. ff.) calls the curves of extreme curvature 'Hauptkrümmungslinien' and the curves of zero torsion 'Krümmungslinien.' but he does not use directly the conception of torsion.

The equation for determining the directions of zero torsion for general axes is of course

$$\begin{array}{ccc} dx & dy & dz \\ l & m & n \\ dl & dm & dn \end{array} = 0$$

combined with ldx + mdy + ndz = 0.

### Relation between Torsion and Curvature.

Let  $\rho_1'$ ,  $\rho_2'$  be the radii of curvature, and  $\tau_1'$ ,  $\tau_2'$  the radii of torsion of normal curves touching the axes of x and y. Then, from the preceding,

$$\frac{1}{\rho_1'} = -\alpha_1, \quad \frac{1}{\rho_2'} = -b_2, \quad \frac{1}{\tau_1'} = b_1, \quad \frac{1}{\tau_2'} = -\alpha_2;$$

therefore,

$$\frac{1}{\rho} = \frac{\cos^2 \theta'}{\rho_1'} + \left(\frac{1}{\tau_2'} - \frac{1}{\tau_1'}\right) \sin \theta' \cos \theta' + \frac{\sin^2 \theta'}{\rho_2'},$$
$$\frac{1}{\tau} = \frac{\cos^2 \theta'}{\tau_1'} + \left(\frac{1}{\rho_1'} - \frac{1}{\rho_2'}\right) \sin \theta' \cos \theta' + \frac{\sin^2 \theta'}{\tau_2'},$$

 $\theta'$  being the angle which the normal curve makes with the axis of x.

Taking the directions of extreme curvatures for axes, and putting  $\theta$  for  $\theta'$ ,  $(a_1, b_2, \text{ etc., changing with the axes})$ ,

$$\frac{1}{\rho} = \frac{\cos^2\theta}{\rho_1} + \frac{\sin^2\theta}{\rho_2}, \qquad (3)$$

$$\frac{1}{\tau} = \frac{1}{2}I + \left(\frac{1}{\rho_1} - \frac{1}{\rho_2}\right)\sin\theta\,\cos\theta,\tag{4}$$

where

$$I = b_1 - a_2 = \frac{1}{\tau_1'} + \frac{1}{\tau_2'},$$

and for general axes

$$I = \Sigma l \left( \frac{dn}{dy} - \frac{dm}{dz} \right) \cdot$$

Also for the special axes

$$\frac{1}{\tau_2'} - \frac{1}{\tau_1'} = 0; \qquad I = \frac{2}{\tau_1'} = \frac{2}{\tau_2'}.$$

The equation (4) is an extension of Bonnet's well-known formula for geodesic torsion, to which it reduces when I = 0. We verify what was proved before that the sum of the normal torsions of two perpendicular directions is constant at a point, being equal to  $\frac{1}{2}I$ , which we named the mean torsion at the point. The mean torsion is equal to the normal torsion for either direction of

extreme curvature, and is equal to half the magnitude of the component, along the direction of the unit vector l, m, n, of the 'curl' of the vector.

Let the axes of the torsional indicatrix, i.e. of the directions of extreme torsion, be taken for axes of x and y. Let  $\tau_1$  and  $\tau_2$  be the extreme or principal radii of torsion. For these axes we have  $b_2 - a_1 = \frac{1}{\rho_1'} - \frac{1}{\rho_2'} = 0$ , and if we put

$$J = \frac{dl}{dx} + \frac{dm}{dy} = a_1 + b_2 = \frac{1}{\rho_1'} + \frac{1}{\rho_2'} = \frac{1}{\rho_1} + \frac{1}{\rho_2},$$

we have, replacing  $\theta'$  by  $\phi$ ,

$$\frac{1}{\tau} = \frac{\cos^2 \phi}{\tau_1} + \frac{\sin^2 \phi}{\tau_2}$$
(5)

$$\frac{1}{\rho} = \frac{1}{2}J + \left(\frac{1}{\tau_2} - \frac{1}{\tau_1}\right)\sin\phi\,\cos\phi.$$
(6)

Since for the axes used  $\frac{dn}{dz} = 0$ , the quantity J is equal to the 'divergence' of the unit-vector (l, m, n), i.e. for general axes,

$$J = \frac{dl}{dx} + \frac{dm}{dy} + \frac{dn}{dz} \cdot$$

The sum of the curvatures at any point for two perpendicular directions is constant and is equal to J. Thus  $\frac{1}{2}J$  may be named the *mean curvature* at the point; the mean curvature is equal to the curvature for either direction of extreme torsion, and is equal to half the divergence of the unit vector l, m, n.

The extreme torsions and the extreme curvatures are not independent, and the relation between them may be expressed by saying that the *'deviation' of torsion is equal to the 'deviation' of curvature*, 'deviation' being taken to mean the difference between the mean and either extreme. For it is easy to see, from (4) or (6), by finding the limiting values of  $\frac{1}{\tau}$  or  $\frac{1}{\rho}$ , that

$$\frac{1}{\tau_1} - \frac{1}{\tau_2} = \pm \left(\frac{1}{\rho_1} - \frac{1}{\rho_2}\right) \cdot$$

Also the directions of extreme curvature and of extreme torsion bisect each other. For

$$\frac{2}{\tau} = I + \left(\frac{1}{\rho_1} - \frac{1}{\rho_2}\right) \sin 2\theta;$$

therefore the limiting values of  $\tau$  are given by  $\theta = \frac{\pi}{4}, \frac{3\pi}{4}$ .

Let  $\tau_1$  be the extreme radius of torsion for  $\theta = \frac{\pi}{4}$ . Then, since

$$I = \frac{1}{\tau_1} + \frac{1}{\tau_2}$$

this implies

$$\frac{1}{\tau_1} - \frac{1}{\tau_2} = \frac{1}{\rho_1} - \frac{1}{\rho_2} = D$$
, say.

It may be of interest to notice that the differential properties of the normal curves, torsion, and curvature are determined at a point by means of the  $\Pi$ -tangent plane, and the three quantities  $\frac{1}{2}I$ ,  $\frac{1}{2}J$ , and  $\frac{1}{2}D$  (i.e. the mean torsion, mean curvature, and deviation), provided a particular direction be associated, say, with  $\rho_{1}$ . For then the principal radii are given by

$$\frac{1}{\rho_{1}} = \frac{J+D}{2}, \qquad \frac{1}{\rho_{2}} = \frac{J-D}{2},$$
$$\frac{1}{\tau_{1}} = \frac{I+D}{2}, \qquad \frac{1}{\tau_{2}} = \frac{I-D}{2},$$

and thus  $\frac{1}{\rho}$  and  $\frac{1}{\tau}$  can be expressed in terms of  $\theta$ , *I*, *J*, *D* by equations (3) and (4), which become

$$\frac{2}{\rho} = J + D \cos 2\theta, \quad \frac{2}{\tau} = I + D \sin 2\theta.$$

### E.—VARIOUS FORMULAE, GEOMETRICAL EXPRESSIONS OF CONDITIONS OF INTEGRABILITY.

The following results may easily be proved :----

(a) The angles which the two inflexional directions make with a direction of principal curvature are given by

$$\tan^2\theta = -\frac{\rho_2}{\rho_1} = \frac{D+J}{D-J},$$

and the angles they make with a direction of principal torsion satisfy

$$\sin 2\phi = \frac{\frac{1}{\rho_1} + \frac{1}{\rho_2}}{\frac{1}{\rho_1} - \frac{1}{\rho_2}} = \frac{J}{D} = -\cos 2\theta.$$

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(b) The corresponding angles for the two directions of zero torsion are given by

$$\sin 2\theta' = \frac{\frac{1}{\tau_1} + \frac{1}{\tau_2}}{\frac{1}{\tau_2} - \frac{1}{\tau_1}} = -\frac{I}{D} = \cos 2\phi',$$
$$\tan^2 \phi' = -\frac{\tau_2}{\tau_1} = \frac{D+I}{D-I}.$$

(c) The curvatures for the directions of zero torsion are

$$\frac{1}{2}J \pm \frac{1}{\sqrt{-\tau_1\tau_2}} = \frac{1}{2}(J \pm \sqrt{D^2 - I^2}).$$

(d) The torsions for the directions of zero curvature are

$$\frac{1}{2}I \pm \frac{1}{\sqrt{-\rho_1\rho_2}} = \frac{1}{2}(I \pm \sqrt{D^2 - J^2}),$$

the last being a generalization of Enneper's formula,<sup>\*</sup> to which it reduces when I = 0.

(e) To find the radius of curvature of any curve of the  $\Pi$ -family whose normal is given, we use a theorem which is equivalent to Meunier's for surfaces,<sup>†</sup> and is proved in the same way. The curvature of any  $\Pi$ -curve is equal to the curvature of the normal curve having the same tangent line, multiplied by sec  $\phi$ , where  $\phi$  is the angle between the normal to the  $\Pi$ -family and the principal normal of the curve.

Using the general notation of p. 97 and p. 102, and denoting the corresponding elements of the non-normal curve by adding the suffix 1, we have

$$\cos \phi = ll_1 + mm_1 + nn_1 = \rho_1 \left( l \frac{da_1}{ds_1} + m \frac{d\beta_1}{ds_1} + n \frac{d\gamma_1}{ds_1} \right)$$
$$= -\rho_1 \left( a \frac{dl}{ds_1} + \beta \frac{dm}{ds_1} + \gamma \frac{dn}{ds_1} \right),$$

since  $la_1 + m\beta_1 + n\gamma_1 = 0$  at all points of the curve, and at the point considered  $a = a_1$ ,  $\beta = \beta_1$ ,  $\gamma = \gamma_1$ . Now *l*, *m*, *n* are functions of *x*, *y*, *z*; therefore, if *p* is equal to *l*, *m*, or *n*,  $\vdots$ 

$$\frac{dp}{ds_1} = \frac{dp}{dx} \cdot \frac{dx}{ds_1} + \frac{dp}{dy} \cdot \frac{dy}{ds_1} + \frac{dp}{dz} \cdot \frac{dz}{ds_1} = a \frac{dp}{dx} + \beta \frac{dp}{dy} + \gamma \frac{dp}{dz} = \frac{dp}{ds}$$

Hence the coefficient of  $\rho_1$  is

$$-\left(a\frac{dl}{ds}+\beta\frac{dm}{ds}+\gamma\frac{dn}{ds}\right)=\frac{1}{\rho}$$

<sup>\*</sup> Salmon, op. cit., p. 426.

<sup>†</sup> Lie extends Meunier's theorem to any Monge equation f(x, y, z, dx, dy, dz). Leipz. Berichte, 50, 1898.

Therefore

$$\frac{\cos\phi}{\rho_1}=\frac{1}{\rho}.$$

(f) To find the torsion of any  $\Pi$ -curve we must be given the rate of variation of  $\phi$ ; and we can use the formula (1) on p. 96, which gives

$$\frac{1}{\tau'} = \frac{1}{\tau} + \frac{d\phi}{ds} \, .$$

This corresponds to the known formula for surfaces,  $\phi$  being the angle between the principal normal and the normal to the surface.<sup>\*</sup>

(g) The condition that the expression

$$ldx + mdy + ndz$$

may be an exact differential or a multiple of one, is equivalent to any one of these geometrical conditions:

(1) The mean torsion is everywhere zero.

(2) The curves of limiting curvature coincide with those of zero torsion.

(3) The curves of zero torsion intersect at right angles.

(4) The Indicatrix of Form is a conic (see G, below).

(h) In conformal representation in space (see p. 99), the difference between the principal curvatures is divided by  $\kappa$  where  $\pm \kappa$  is the linear magnification, and the relation between the principal curvatures for corresponding directions is given by

$$\frac{1}{\rho_1} - \frac{1}{2}J_1 = \frac{1}{\kappa}\left(\frac{1}{\rho} - \frac{1}{2}J\right)$$

Hence also directions of principal curvature as well as directions of zero torsion (p. 101) transform into each other by inversion. These results follow from the theorem already proved that the torsion  $\left(\frac{1}{\tau}\right)$  for any direction is transformed into  $\frac{1}{\kappa\tau}$  for the corresponding direction.

(i) We have noticed that the two equivalent defining properties of a line of curvature on surfaces (zero geodesic torsion and limiting curvature) become separated when I = 0. Corresponding to this logical bifurcation, we have *two* generalizations of the surface of centres. On a  $\Pi$ -family, the directions of zero torsion at P are those along which the normal (l, m, n) intersects the 'consecutive' normal, and they are given by their equation

$$\begin{vmatrix} dx & dy & dz \\ l & m & n \\ dl & dm & dn \end{vmatrix} = 0$$

 $[15^*]$ 

<sup>\*</sup> Salmon, op. cit., p. 426.

combined with ldx + mdy + ndz = 0. Let *r* represent either of the distances from *P* of the points *Q*, *Q'* where the normal meets the consecutive normal. Then by expressing the condition that the normal at *x*, *y*, *z* may intersect the normal at x + dx, y + dy, z + dz, at the point  $\xi$ ,  $\eta$ ,  $\zeta$ , where  $\xi = x + rl$ ,  $\eta = y + rm$ ,  $\zeta = z + rm$  we find, since  $d\xi = d\eta = d\zeta = dr = 0$ ,

$$dx + rdl = 0, \quad dy + rdm = 0, \quad dz + rdn = 0,$$

dl, dm, dn being total variations.

and therefore eliminate dx, dy, dz the quadratic for  $\frac{1}{x}$  is

$$\begin{vmatrix} a_1 + \frac{1}{r} & a_2 & a_3 \\ b_1 & b_2 + \frac{1}{r} & b_3 \\ c_1 & c_2 & c_3 + \frac{1}{r} \end{vmatrix} = 0,$$

where

$$a_1 = \frac{dl}{dx}, a_2 = \frac{dl}{dy}, b_1 = \frac{dm}{dx},$$
 etc.

the absolute term vanishing, since  $l^2 + m^2 + n^2 = 1$ . The points Q, Q' corresponding to the point P are then determined from the equations  $\xi = x + rl$ , etc. It is easy to see that as P moves along the  $\Pi$ -family ldx + mdy + ndz = 0, Q and Q' move along some one of two different groups of  $\Pi$ -families (corresponding to the two sheets of a surface of centres); for  $\xi, \eta, \zeta$  satisfy differential equations of the form

$$pd\xi + qd\eta + rd\zeta = 0, \qquad p'd\xi + q'd\eta + r'd\zeta = 0.$$

p, q, r, p', q', r' are one-valued functions of x, y, z, but many-valued functions of  $\xi, \eta, \zeta$ . Thus the original  $\Pi$ -family is associated with a finite number of other  $\Pi$ -families, the differential geometry of which might yield some interesting results.

(j) If we use our special axes, it will be found that the quadratic for  $\frac{1}{r}$  may be written

$$\frac{1}{r^2} - \frac{1}{r} \left( \frac{1}{\rho_1} + \frac{1}{\rho_2} \right) + \frac{1}{\rho_1 \rho_2} + \frac{1}{4} I^2 = 0.$$

In fact the values of r, it is obvious, are the radii of curvature for the directions of zero torsion [See (c).] The sum of the reciprocals of the values of r is always equal to the sum of the principal curvature, and, if J = 0, it

may be seen that their product is equal to the product of the principal torsions.

(k) A second generalization of the surface of centres might be investigated similarly; by considering the family of curves described by the centres of principal curvature as the point P moves along its  $\Pi$ -family, the coordinates of the two centres of curvature being given by

$$\xi = x + \rho l, \quad \eta = y + \rho m, \quad \zeta = z + \rho n,$$
  
where  $\frac{1}{\rho}$  is a root of  $\frac{1}{\rho^2} - \frac{J}{\rho} - K = 0,$   
and  
$$K = \begin{pmatrix} a_1 & h & g & l \\ h & b_1 & f & m \\ g & f & c_1 & n \\ l & m & n & 0 \end{pmatrix}, \quad 2f = b_3 + c_2, \text{ etc.}$$

As in (g), there are two groups of  $\Pi$ -families described by  $\xi, \eta, \zeta$ .

### F.—FURTHER GENERALIZATIONS OF DUPIN'S THEOREM, ETC.

The following is a second generalization of Dupin's theorem :—If three II-families are mutually orthogonal, the necessary and sufficient condition that their common curves should be curves of extreme curvature on the families to which they belong is  $I_1 = I_2 = I_3$ , i.e. the mean torsions are equal. This follows from the formulae (1) and (2) (p. 96), combined with the principle (p. 105) that the torsions for the directions of extreme curvature are equal to  $\frac{1}{2}I$ .

In particular, if one family lies on a one-parameter system of surfaces, the same is true of the others; for if  $I_1$  vanishes,  $I_2$  and  $I_3$  also vanish.

But a more general theorem is the following :— The necessary and sufficient condition that a curve of intersection of  $\Pi_1$  and  $\Pi_2$  should be a curve of extreme curvature on  $\Pi_1$ , where the three systems are orthogonal, is  $I_2 = I_3$ .

For since the curve is a direction of extreme curvature on  $\Pi_1$ , we have

$$\frac{1}{\tau_{12}} = \frac{1}{2}I_1 = \frac{1}{\tau_{13}}, \quad \text{and using} \quad \frac{1}{\tau_{12}} - \frac{1}{\tau_{21}} = \frac{d\theta_{12}}{ds_{12}} = 0, \quad \text{etc.}, \quad \text{we have}$$
$$\frac{1}{\tau_{13}} = \frac{1}{\tau_{31}} = \frac{1}{\tau_{13}} = \frac{1}{\tau_{12}} = \frac{1}{\tau_{21}} = I_2 - \frac{1}{\tau_{23}} = I_2 - \frac{1}{\tau_{32}} = I_2 - I_3 + \frac{1}{\tau_{31}},$$
$$\text{therefore} \qquad \qquad I_2 - I_3 = 0.$$

Hence we have a theorem analogous to Darboux's 'reciprocal' theorem (p. 95). If the curves common to two out of three mutually orthogonal  $\Pi$ families be curves of extreme curvature on both, the three common curves (twoby-two) are curves of extreme curvature on the families on which they lie. The data for the conclusion are necessary and sufficient.

All these theorems are special cases of the principles expressed in the following equivalent formulae, which are true of any three  $\Pi$ -families :—

$$I_{2} - I_{3} + D_{2} \sin 2\phi_{2} - D_{3} \sin 2\psi_{3} = \pm 2 \frac{d\theta_{23}}{ds_{23}},$$

$$I_{3} - I_{1} + D_{3} \sin 2\phi_{3} - D_{1} \sin 2\psi_{1} = \pm 2 \frac{d\theta_{31}}{ds_{31}},$$

$$I_{1} - I_{2} + D_{1} \sin 2\phi_{1} - D_{2} \sin 2\psi_{2} = \pm 2 \frac{d\theta_{12}}{ds_{12}},$$
(7)

where  $\pm D_1$ ,  $\pm D_2$ ,  $\pm D_3$  are twice the deviations (p. 106), and  $\phi_1$  is the angle between a chosen direction of extreme curvature on  $\Pi_1$  and the curve  $\Pi_1\Pi_2$ , and  $\psi_1$  is the angle between the same direction and the curve  $\Pi_1\Pi_3$ , while  $\phi_2, \psi_2, \phi_3, \psi_3$  have corresponding meanings in cyclical order. Also we have  $\phi_1 \sim \psi_1 = \theta_{23}$ , etc. The formulae (7) then follow directly from (1) on p. 96, and (4) on p. 105.

### G. THE INDICATRIX OF FORM.

The Dupin indicatrix has two functions which become separated for general  $\Pi$ -families. It gives the curvature of geodesics through the point and also the limiting form of sections of the surface by planes parallel to the tangent plane, as the former planes approach the latter. For a  $\Pi$ -family the indicatrix of curvature is one generalization of the Dupin indicatrix. But we may also consider the limiting forms of families of  $\Pi$ -curves lying in planes parallel to the  $\Pi$ -tangent plane, as the former planes approach the latter. This family will be a generalization of the Dupin indicatrices for a oneparameter family of surfaces.

Using the special axes and taking the principal directions of curvature for axes of x and y ( $b_1 + \alpha_2 = 0$ ), we find the intersections of

$$(a_1x + a_2y + a_3z) dx + (-a_2x + b_2y + b_3z) dy + dz = 0$$

with z = z', where z' is a constant 'of the second order of small quantities,' x, y, dx, dy being regarded as small quantities of the first order. If we

integrate on the assumption that  $a_1$ ,  $a_2$ ,  $a_3$ ,  $b_2$ ,  $b_3$  are constant,\* the result will be the family of curves defined by

$$a_1xdx + b_2ydy + a_2(ydx - xdy) = 0,$$

that is

$$\frac{1}{2} \log (a_1 x^2 + b_2 y^2) - a_2 \int \frac{d\left(\frac{y}{x}\right)}{a_1 + b_2 \frac{y^2}{x^2}}.$$

These are two different types of curves according as  $a_1b_2$  which  $=\frac{1}{\rho_1\rho_2}$  is positive or negative.

First, let  $a_1b_2$  be positive and  $= t^2$ . This may be named the *elliptic* or *spiral* type. Since  $I = b_1 - a_2 = -2a_2$ , it will be found that the curves form the family

$$\frac{x^2}{\rho_1}+\frac{y^2}{\rho_2}=ke^{\phi},$$

where

$$\phi = \frac{1}{2} \frac{I}{\sqrt{\rho_1 \rho_2}} \tan^{-1} \frac{y}{x} \sqrt{\frac{\rho_1}{\rho_2}}.$$

These curves are evidently *spirals* round the origin; they reduce to equiangular spirals if  $\rho_1 = \rho_2$ . When I = 0, they are suddenly transformed into ellipses—the Dupin indicatrices.

Secondly, let  $\frac{1}{\rho_1\rho_2}$  or  $a_1b_2$  be negative and  $= -t^2$ . This we call the *hyperbolic* or *non-spiral* type. The indicatrix will be the family of curves

$$\xi^{1-p} \eta^{1+p} = \text{constant},$$

where  $\xi$ ,  $\eta$  are the (real) factors of  $\frac{x^2}{\rho_1} + \frac{y^2}{\rho_2}$  and  $p = \frac{I}{2\sqrt{-\rho_1\rho_2}}$ . Generally

speaking, they resemble hyperbolas,  $\xi = 0$ ,  $\eta = 0$  being the asymptotes, but they are unsymmetrical.

Considering the indicatrix of either type as a family of curves lying in the tangent plane at P, it has the following properties :—

(a) If we proceed from P along any  $\Pi$ -curve to a point Q, the tangentplane at Q, in the limit when Q approaches P, cuts the tangent plane at P in a line whose direction is that of the tangent line to any curve of the indicatrix

<sup>\*</sup> This assumption is justified by the fact that the integrated equations give rise to the differential equations, even if  $a_1$ ,  $a_2$ , etc., are variable, the small quantities of the third order being neglected,

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at the point where it meets PQ. Thus to any direction PQ we have a *pseudo-conjugate* direction PQ'; but the pseudo-conjugate of PQ' is not PQ, unless I = 0, when we get the ordinary theorem of conjugate directions. If the coordinates of Q are x, y, 0, x and y being small, and  $\alpha', \beta', 0$  the direction-cosines of the pseudo-conjugate of PQ, the conditions give

$$a'(a_1x + a_2y) + \beta'(b_1x + b_2y) = 0.$$

Comparing this with the differential equation for the indicatrix, the theorem is proved.

(b) The directions of zero normal torsion are those which are perpendicular to their pseudo-conjugates.

(c) The inflexional directions are those of the two right lines  $\xi = 0$ ,  $\eta = 0$ , which are included in the indicatrix, and are asymptotes of all its curves.

### Curves on a Surface.

The points of contact of a surface U = 0 with a  $\Pi$ -family may be defined as the points where the surface touches the tangent plane of the family, and are the intersections of the surface with the curve

$$\frac{1}{l} \frac{dU}{dx} = \frac{1}{m} \frac{dU}{dy} = \frac{1}{n} \frac{dU}{dz}.$$

From the preceding it would appear that all the curves of the singly infinite system in which the surface cuts the  $\Pi$ -family collect spirally round the 'spiral' or 'elliptic' points of contact, and that one curve passes through each hyperbolic or non-spiral point, having a double point thereat.

### H. GEOMETRICAL EXPRESSION FOR DIVERGENCE AND CURL OF A VECTOR BY MEANS OF TORSION AND CURVATURE.

A vector is defined by a direction (l, m, n) and a magnitude R, i.e. by the quantities X, Y, Z, where X = lR, Y = mR, Z = nR. If X, Y, Z are functions of three variables, we can associate a vector with each point in space. The Curl of the vector is the vector the magnitudes of whose components are  $\frac{dZ}{dy} - \frac{dY}{dz}$ , etc., and the Divergence of the vector is the magnitude  $\frac{dX}{dx} + \frac{dY}{dy} + \frac{dZ^*}{dz}$ .

<sup>\*</sup> Cf. Memorandam on Notation in Whittaker's History of the Theories of Ether and Electricity.

#### The Unit-vector.

When always  $l^2 + m^2 + n^2 = 1$ , we have a system of unit-vectors; and it is evident that the Divergence (cf. p. 106) and the Curl are geometrically definable by means of the  $\Pi$ -family

$$ldx + mdy + ndz = 0.$$

Let u, v, w be magnitude of the components of the Curl of the unitvector (l, m, n). Then

$$u = \frac{dn}{dy} - \frac{dm}{dz}$$
, etc.,

using the special coordinates (p. 101),  $u = -b_3$ ,  $v = a_3$ ,  $w = b_1 - a_2 = I$ . Thus the magnitude of the normal component of the Curl is equal to twice the mean torsion, as we have already seen. To determine the geometrical meanings of  $a_3$  and  $b_3$ , we must investigate the curvature of the orthogonal trajectory of the  $\Pi$ -family, this trajectory belonging to the congruence

$$\frac{dx}{l} = \frac{dy}{m} = \frac{dz}{n} \cdot$$

Let l', m', n' be the direction-cosines of the principal normal of the orthogonal trajectory, s' and  $\rho'$  its arc and radius of curvature.

Since the direction-cosines of the tangent line are l, m, n,

$$\frac{l'}{\rho'} = \frac{dl}{ds'} = l\frac{dl}{dx} + m\frac{dl}{dy} + n\frac{dl}{dz} = \alpha_3;$$
$$\frac{m'}{\rho'} = \frac{dm}{ds'} = b_3, \quad n' = 0.$$

and similarly

Hence, 
$$w = -\frac{m'}{\rho'}, \quad v = \frac{l'}{\rho'}, \quad w = I,$$

and therefore l'u + m'v + n'w = 0, i.e., the direction of the Curl of the unit-vector is parallel to the principal tangent plane of the orthogonal trajectory of the  $\Pi$ -family, it makes with the normal to the  $\Pi$ -family an angle  $\chi$  where

$$\tan \chi = \frac{\frac{1}{\rho'}}{\frac{1}{\tau_1} + \frac{1}{\tau_2}}$$

$$\sqrt{\frac{1}{\rho'^2} + \left(\frac{1}{\tau_1} + \frac{1}{\tau_2}\right)^2}$$

and its magnitude is

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### Vectors of variable magnitude.

When the magnitude R of the vector is variable, the Curl-vector and the Divergence cannot be expressed by means of curvature and torsion alone. We require in addition to know R and the vector-gradient of R, i.e. the vector whose components are  $-\frac{dR}{dx}$ ,  $-\frac{dR}{dy}$ ,  $-\frac{dR}{dz}$ .

There is one vector associated with each point in space, and thus the whole system of vectors is represented by a  $\Pi$ -family and a one-parameter system of surfaces, R = constant. The magnitudes of the components of the vector are lR, mR, nR, and therefore the magnitudes (u, v, w) of the curl, using the special axes, are—

$$u = \frac{d}{dy} (nR) - \frac{d}{dz} (mR) = -b_3R + \frac{dR}{dy} = -\frac{m'}{\rho'}R + \frac{dR}{dy},$$

$$v = \frac{d}{dz} (lR) - \frac{d}{dx} (nR) = a_3R - \frac{dR}{dx} = \frac{l'}{\rho'}R - \frac{dR}{dx},$$

$$w = \frac{d}{dx} (mR) - \frac{d}{dy} (lR) = RI.$$
Let
$$R = g \sqrt{\left(\frac{dR}{dx}\right)^2 + \left(\frac{dR}{dy}\right)^2 + \left(\frac{dR}{dz}\right)^2} = g \frac{dR}{d\nu},$$

where  $\nu$  is the arc of the orthogonal trajectory of R = const. Then g is a linear quantity and represents the magnitude of the original vector divided by the magnitude of the gradient. In order to represent geometrically the direction of the Curl, take the normal of the orthogonal trajectory of the  $\Pi$ -family for axis of x, the binormal being axis of y; then l' = 1, m' = n' = 0. If  $\theta$ ,  $\phi$ ,  $\psi$  are the direction-cosines of the direction of the vector-gradient of R,

$$\cos\theta = -\frac{g}{R}\frac{dR}{dx}, \quad \cos\phi = -\frac{g}{R}\frac{dR}{dy}, \quad \cos\psi = -\frac{g}{R}\frac{dR}{dz}.$$

Thus, the magnitudes of the components of the Curl along the normal, binormal and tangent line of the orthogonal trajectory of the  $\Pi$ -family are

$$u = -R \frac{\cos \phi}{g}, \quad v = R\left(\frac{1}{\rho'} + \frac{\cos \theta}{g}\right), \quad w = R\left(\frac{1}{\tau_1} + \frac{1}{\tau_2}\right),$$

where  $\theta$ ,  $\phi$  are the angles made by the direction of the gradient of R with the normal and binormal of the orthogonal trajectory.

The Divergence of the vector is

$$\frac{d}{dx}(lR) + \frac{d}{dy}(mR) + \frac{d}{dz}(nR) = R\left(\frac{1}{\rho_1} + \frac{1}{\rho_2}\right) + l\frac{dR}{dx} + m\frac{dR}{dy} + n\frac{dR}{dz},$$
$$= R\left(\frac{1}{\rho_1} + \frac{1}{\rho_2} - \frac{\cos\psi}{g}\right).$$

Hence the Divergence of a vector is equal to twice the mean curvature of the  $\Pi$ -family multiplied by the magnitude of the vector, diminished by the magnitude of the component, along the normal to this family, of the vector-gradient of R. It will be noticed that the Curl is independent of the mean curvature, and the Divergence is independent of the mean torsion.

### Irrotational motion, Laplace's equation, etc.

The following results may be of interest:-

(a) The conditions for pure strain, irrotational motion, etc., viz., u = v = w = 0, may now be expressed by saying that the mean torsion is zero; the direction of the gradient lies in the osculating plane of the line of flow or displacement

 $\phi = 90^{\circ}$ ), and makes with this line an angle  $\psi$  whose sine is  $\pm \frac{g}{\rho'}$ . Hence in this case g is never greater than  $\rho'$ .

(b) We can now give a geometrical meaning to Laplace's equation  $\nabla^2 V = 0$ . Let  $X = \frac{dV}{dx}$ , etc., and the equation reduces to

$$\frac{1}{\rho'^2} + \left(\frac{1}{\rho_1} + \frac{1}{\rho_2}\right)^2 = \frac{1}{g^2}$$

since  $\phi = 90^\circ$ ,  $\cos \theta = -\frac{g}{\rho}$ , and  $\sin \psi = \pm \cos \theta$ .

(c) In general

$$\nabla^2 \quad \mathcal{V} = R\left(\frac{1}{\rho_1} + \frac{1}{\rho_2} \pm \sqrt{\frac{\rho'^2 - g^2}{g\rho'}}\right).$$

(d) A circuital vector is geometrically defined by d

$$\cos\psi=g\left(\frac{1}{\rho_1}+\frac{1}{\rho_2}\right);$$

hence for such a vector  $\frac{1}{2g}$  must be greater than the mean curvature.



## PROCEEDINGS

OF THE

## ROYAL IRISH ACADEMY

## VOLUME XXIX

# SECTION B.—BIOLOGICAL, GEOLOGICAL, AND CHEMICAL SCIENCE.



D'UBLIN: HODGES, FIGGIS, & CO., LTD LONDON: WILLIAMS & NORGATE 1911-1912



THE ACADEMY desire it to be understood that they are not answerable for lany opinion, representation of facts, or train of reasoning that may appear in any of the following Papers. The Authors of the several Essays are alone responsible for their contents.

DUBLIN : PRINTED AT THE UNIVERSITY PRESS BY PONSONBY AND GIBBS.

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### ERRATA.

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:

p. 36, l. 4. For ? Abth read II Abth
p. 50, l. 14. For tergites read sternites
p. 98, col. 2, l. 3 from bottom. For zonotoides read zonitoides
p. 125, col. 1, l. 2 from bottom. For Lake read Lakes
p. 134, l. 1. For Hyrgomia read Hygromia
p. 162, l. 14. For West Cork read South Kerry
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p. 231, l. 26. For Silurian read Lower Silurian
Plate XII, explanation of fig. 1. For Capitoluim read Capitolium

### PROCEEDINGS

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## THE ROYAL IRISH ACADEMY

### PAPERS READ BEFORE THE ACADEMY

I.

### A BACTERIAL DISEASE OF THE POTATO PLANT IN IRELAND AND THE ORGANISM CAUSING IT.

BY GEORGE H. PETHYBRIDGE, PH.D., B.Sc., Economic Botanist to the Department of Agriculture and Technical Instruction for Ireland,

AND PAUL A. MURPHY, Temporary Assistant.

PLATES I.-III.

Read DECEMBER 12, 1910. Published FEBRUARY 6, 1911.

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### I. INTRODUCTORY AND HISTORICAL.

THE study of the bacterial diseases of plants is a comparatively young branch of vegetable pathology. Seeing that bacteria play such an important part in the diseases of animals, it is rather remarkable that more attention has not hitherto been devoted to the study of their pathogenic behaviour towards plants. Up to about fifteen years ago, apart from some pioneer work which had been carried on in the United States of America, very little had been done in this direction. Indeed, in some quarters, the opinion was somewhat

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strongly held about that time that bacterial diseases of plants as such did not really exist. That this view was entirely erroneous was, however, soon clearly proved by the irrefutable evidence brought forward by E. F. Smith  $(26)^1$ ; and during the years that have followed our knowledge of the bacterial diseases of plants in general, and of the potato in particular, has rapidly increased.

Under the name of gangrene of the stem, a disease of the potato plant which had hitherto not been noticed there was described as occurring in France, in the year 1890, by Prillieux and Delacroix (24). The disease was described as being characterized by a profound alteration of the tissues at the base of the stem, which progressed from below upwards. No insects or fungi could be found present to account for the trouble; but bacteria were very plentiful in the dead, brown cells. Infection experiments were carried out, using as inoculating material the raw, bacteria-containing dead tissues of an affected stem, and the disease was reproduced when such material was transferred to healthy stems. The description given of the disease and its cause is a very short one, and no details are given as to the isolation of the pathogenic organism in pure culture. Nevertheless, the authors believed that the disease was a bacterial one; and they gave the provisional name of Bacillus caulivorus to the organism which they supposed was the cause of it. In their "Maladies des Plantes Agricoles" the same authors state that this organism, when grown in broth or gelatine, produces a very well-marked uranium-green colouration of these media, which increases in intensity on shaking. Later on Delacroix, in dealing with *B. caulivorus*, speaks of it as most probably identical with Bacillus fluorescens liquefaciens Flugge, a common saprophytic form, which, he suggests, may perhaps under certain special conditions become parasitic. It should, however, be noted that, as far as we are aware, it has never really been proved that *B. caulivorus* actually is pathogenic to the potato. It is not sufficient merely to obtain an organism from a diseased tissue, and regard it as a cause of disease; successful inoculation experiments with pure cultures and the re-isolation of the same organism in pure culture from the diseased tissues, can alone provide actual proof of pathogenicity. Griffon (15) has quite recently stated that various investigations have made it seem probable that both Bacillus fluorescens liquefaciens and B. fluorescens putridus may be the cause of diseases in cultivated plants, he having found them associated with diseased turnips and cauliflowers. No account, however, is given of infection experiments; and, as Riehm<sup>2</sup> points out, the mere presence of these organisms in cases of disease in plants is no proof of their pathogenic character.

A bacterial disease of the tomato, egg-plant, and Irish potato was described

<sup>&#</sup>x27; The numbers in brackets refer to the Bibliography at the end of the paper.

<sup>&</sup>lt;sup>2</sup> Zeitschrift für Pflanzenkrankheiten xx, 1910, p. 426.

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in 1896 by Erwin F. Smith (25) as occurring in the United States of America. Smith's work leaves no room for doubt as to the real cause of the malady in this case, it being due to a hitherto undescribed organism to which he gave the name of *Bacillus solanacearum*. The disease is characterized by the sudden wilting of the foliage, and later on by a shrivelling and turning black of the stems, the organism proceeding from above downwards, and ultimately reaching the tubers underground through their rhizomes, and causing a brown or black rot in them. *B. solanacearum* Smith is an organism which does not liquefy gelatine, or "at most (?) does so very feebly, and not until after five or six weeks." It produces a brown colouration when grown in nutrient agar, and has a tendency to produce a zoogloea and a pellicle in the upper layers of broth and peptone water. This organism does not appear with certainty to have been met with up to the present by any observers working in Europe.

In Germany a potato disease known as "Schwarzbeinigkeit" or "Stengelfäule" was first made the subject of investigation by Frank (14) in 1899. This "Black-leg" or "Stem-rot" is characterized as follows :- In the spring, soon after the potato plants have come up and the stalks are about a foot high, individual plants here and there are seen to become sickly and to die, whilst the portion of the stem beneath ground, and sometimes part of it just above the soil-level, is found to be black and rotten. The consequence is that growth is stopped, the foliage becomes gradually wilted and yellow, and the whole plant dries up and becomes dead. Fungus mycelium and bacteria are to be found in the decaying stalks, and they advance from below upwards, carrying the rot with them. An organism, which he named Micrococcus phytophthorus, and which he had found to be the cause of rotting in potato tubers, was found by Frank constantly associated with the rotten stalks of these potato plants. This organism was isolated and obtained in pure culture, and with it Frank succeeded in inoculating cut stalks of the living potato plant, and in producing the symptoms of rot in them. He does not appear to have attempted the inoculation of potato plants growing in the soil; nevertheless there is little doubt but that Frank was dealing with an organism really pathogenic to the potato-plant, and responsible for the disease named.

Iwanoff (19) described in 1899 a bacterial disease of potato-stalks which he had observed on a somewhat large scale during the previous year in the neighbourhood of St. Petersburg. The trouble was confined to the portions of the plants above ground, and did not pass to the tubers. Bacteria were abundant in the diseased tissues; and two kinds were isolated, neither of which, however, proved to be pathogenic. Infection experiments with the dead bacteria-containing cells from the diseased tissues introduced into healthy stems succeeded. Although he did not succeed in isolating a pathogenic

[A 2]

organism, Iwanoff considered that the disease was of the same type as that produced in America by *Bacillus solanacearum*.

At the beginning of the present century Delacroix paid considerable attention to a bacterial disease of the potato in France, which was entirely different from the gangrene of the stem studied about ten years previously by Prillieux and himself. In his first communication on the subject (9), he states that in the early stages of the disease the foliage becomes yellow, and then by degrees dries up. The stems become thinner and die from below upwards, and the tubers are also found to be diseased. Microscopic examination of the tissues of the affected stems showed a development of yellowish gummy matter and of thyloses in the wood vessels. The bacteria found were, he then considered, not dissimilar to the Bacillus solanacearum of E. F. Smith in America. This first communication is further of interest because Delacroix states that, from the oral testimony of Dr. Johnson, of Dublin, and from the inspection of a small specimen sent three years before, the same disease appeared to be common in Ireland. It should, however, be noted that the evidence of the presence of this particular disease in Ireland does not rest on any experimental basis, as no cultures appear to have been made from the Irish material.

In a second paper on the same subject, Delacroix (10) enters more into detail regarding the characteristics of the organism concerned in the disease. Whereas, as mentioned above, he at first thought it was perhaps identical with Smith's *B. solanacearum*, he now concludes that this is not the case, and describes his organism as a new one under the name of *Bacillus solanincola*. This organism grows well on the ordinary culture-media without colouring them. Broth is rendered viscous by it; and a pellicle is formed on the surface. He states here that gelatine is liquefied by this organism, but only slowly, and merely on the surface. In Delacroix and Maublanc's "Maladies parasitaires des plantes cultivées," published in 1909, however, it is stated on p. 38 that it was by error that *B. solanincola* was described as liquefying gelatine; hence it must now be regarded as a non-liquefier. Other details of the organism are given; and the successful results of inoculation experiments with pure cultures are described; so that *B. solanincola* may be looked upon as having been proved with certainty to be pathogenic to the potato.

In a further paper (11) Delacroix repeats and amplifies his earlier accounts of this disease and of the organism producing it; and here again he states that from the inspection of further specimens of diseased plants, and of microscopical preparations supplied by Dr. Johnson, he is convinced that the same disease exists in Ireland. It must, however, again be pointed out that the mere inspection of diseased plants and of microscopical preparations is not

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by any means sufficient to judge of the identity of diseases in plants when bacteria are concerned; and in the absence of cultural experiments, there is no proof that the Irish plants were really attacked by B. solanincola. Delacroix in this paper identifies much of what is known in France as "brunissure" (browning) of the potato as being caused by the attacks of the above organism. The disease does not show itself as a rule earlier than the second fortnight in the month of July. The shoots of the plants cease to develop, the leaves yellow and become of a greyish fawn colour, and then dry up. The base of the stem often shows on its surface livid spots, and, in cross-section, transparent brown patches reaching more or less high up the stem. The underground parts often show wounds which may or may not be healed. It is through these, Delacroix considers, that the potato plant becomes attacked. For. while not denying that the disease may be spread by means of affected tubers which give rise to diseased plants, he believes that the chief source of attack is from the soil, B. solanincola being regarded as being essentially a soilorganism. The tubers may also be affected, becoming brown, starting from the "heel" end. As mentioned before, the production of gum and thyloses in the wood vessels of the stem is a well-marked character. The organism usually exists as single individuals, and is rarely found in pairs, and never as a zoogloea. It is scarcely motile, bears no flagella, and does not produce spores. It is quite clear, therefore, that Delacroix had before him a wellmarked disease of the potato caused by the definite organism B. solanincola. It seems certain that a somewhat similar disease existed at the time in Ireland. Johnson (21), in 1902, refers to his communications with Delacroix, and states that his first specimens were thought by the French observer to be attacked by Bacillus caulivorus. Specimens, however, seen a couple of years later, were put down as being attacked by Bacillus solanincola. Judging from cultures he had made, Johnson states that he concludes that B. caulivorus, B. solanincola, and B. solanacearum, are all present as disease-producers in the potato in Ireland. That all these organisms pathogenic to the potato should be found carrying on their destructive work in Ireland seems, judging from analogy with other countries, at least highly improbable; and up to the present at least no really clear evidence on the matter has been published.

In the course of the study of the bacterial diseases of a variety of plants, van Hall (16), in the year 1902, described, under the name of "Zwartbeenigkeid," a bacterial disease of the potato in Holland, which he had observed for the first time during the previous summer. The disease shows much the same characteristics as the "Schwarzbeinigkeit" of German authors, and the Black Stalk-rot which we are about to describe. An organism was isolated which proved highly toxic to the potato-plant, and less so to other plants. It occurs usually as single rods of variable length, rarely in pairs, and occasionally in chains of four to ten. It is actively motile, and possesses long flagella—the number of which is not stated. It liquefies gelatine media when alkaline, but, on the whole, does not appear to be a strong producer of liquefaction. Inoculations of living potato-plants and tubers were carried out with somewhat varying success: and although van Hall did not entirely succeed in reproducing the exact symptoms of disease in potato-stalks as they occur in the field, there is little doubt but that he had before him a virulent organism highly toxic to the potato-plant, which, with practical certainty, was the cause of the stem-rot observed.

During his experimental investigations as to the ways and means of how best to pit potatoes for their successful preservation over the winter, Appel [1] became convince l contrary to the then somewhat generally accepted views of Wehmer, that there undoubtedly did exist bacteria capable of attacking and destroying the perfectly healthy tissues of sound potato-tubers. In a preliminary communication (2) published in 1902. Appel gives a brief account of his isolation of such an organism, and of its destructive action on the tuber. He exhibited cultures of the organism, and showed the results of its inoculation on living potato to the German Society of Botanists in January of that year. A month later (3) he was able to describe and show preparations of an organism to which he gave the name of Bacillus phytophticates, and which he had been able to prove, by means of inoculation experiments, to be the cause of the well-known "Schwarzbeinigkeit" in p-tato-plants. This organism he obtained by isolations, both from rotting tubers as described in his previous note, and also from the stalks of potatoplants suffering from the disease in question.

Two years later he published a very full and complete account of this disease (4) as it occurs in Germany, and of the organism which causes it. With regard to the latter, although *B. phetophethorus* is the organism dealt with in detail, Appel is of opinion that the same disease may be due, not to this particular organism only, but also possibly to others closely allied to it. It is possible, as Appel points out, that the organism he was dealing with was identical with the one described as *Micrococcus phytophthorus*, previously is dated by Frank and mentioned above. Frank's description of his organism, however, was too meagre to admit of a complete proof of their identity; but it seems doubtrul, at least, whether the toxic organism with which Frank worked was really a micrococcus. The symptoms of disease are, in most respects, very similar to those of the disease which we are about to describe as occurring in Ireland, and there is therefore no necessity to enter into details concerning them at this point. With regard to the organism, it may be stated that it is

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of rod-like shape, of very varying length, very frequently arranged in pairs, and possessing several flagella. It is very actively motile, and produces rapid liquefaction in neutral or slightly alkaline gelatine media, but none in those which are acid. Its most striking characteristic is its power of destroying rapidly the living tissues of healthy potato-tubers, producing in them a brown discolouration. Appel maintains that the potato-plant may become attacked directly from the soil, but is also convinced that the spread of the disease is as much or more due to the planting of affected tubers. A more popular and succinct, but withal scientific, account of the disease was published (5) in leaflet form, with a coloured illustration, in August, 1904.

Since the appearance of Appel's account, several workers in different countries claim to have observed the same disease and the same organism; but in most cases the absence of published details renders it somewhat difficult to judge whether the organisms in question really were identical with *B. phytophthorus* or not. Delacroix (12), writing in 1906, states that, although up to two years previously nothing was known of this disease or this organism in France, he has now had cases of it, although the disease is by no means widespread in that country. It differs from the "brunissure," caused by *B. solanincola* in appearing much earlier in the season; and the organism differs from that one in that *B. phytophthorus* liquefies gelatine; whereas *B. solanin-cola* does not. Nevertheless Delacroix states that the similarity in the general characters of the two diseases is so marked that the only satisfactory way of distinguishing between them is that of isolating the causative organisms.

Johnson (22), in 1906, states that he got clear evidence of the existence of B. phytophthorus as a general cause of "yellow-blight," "black-leg," and potato-tuber rot in Ireland. Unfortunately the evidence is not produced; and it is impossible, therefore, to be sure in the matter. If this organism exists in this country in addition to the three others (mentioned on p. 5), which this author states he has found here, then Ireland is indeed unfortunate in possessing more than her fair share of the world's varieties of bacteria pathogenic to the potato! Some doubt may fairly be said to exist as to the correctness of Johnson's diagnosis in the last case from a consideration of the single infection experiment described and figured. A potato-plant in a pot was inoculated (whether with a pure culture or with raw, diseased tissue is not stated) and complete wilting of the inoculated stalk occurred within twenty-four hours. Such rapidity of action would be extraordinary in the case of B. phytophthorus, which, as a rule, only exhibits its pathogenicity under such conditions after a considerable lapse of time, and not by a sudden wilting. Working with an organism which is certainly closely allied to the one named, we have found that under ordinary outdoor summer conditions a

period of over three weeks elapses before the first signs of disease become apparent in inoculated stalks. It seems fairly certain, therefore, that—at least in the experiment named—some cause other than B. phytophthorus must have been at work.

In 1906 Appel (7) described an entirely different bacterial disease of the potato, to which he gave the name "Ringkrankheit." The name is derived from the fact that attacked tubers when cut open frequently show the "vascular ring" as a brown line running parallel to the skin of the tuber. The rot which arises in the tuber is one which proceeds from within out-Affected sets usually produce no plants at all, or but feeble ones wards. which soon die after coming above ground. Bacteria of several nearly allied varieties are put down as the cause of the disease; but up to the present no extended description of them has been published, our knowledge of the disease being chiefly confined to that published in popular leaflet form only. The disease would seem to belong, as far as external appearances go, to that group of maladies which had hitherto been aggregated together under the general name of "Kräuselkrankheit" (curl). A fuller study of this disease and of the bacteria causing it is at present a desideratum. So far as we are aware it does not exist in this country : for, although a look-out has been kept for it for a considerable period, it has so far not come before our notice. In India, however, Coleman (8) has published a more or less popular report on a disease of this character. known locally as "Bangadi," A more extensive and scientific paper on the subject is already promised by this author, from which, doubtless, our knowledge of this disease and its cause will be considerably extended.

The latest account of a serious bacterial disease of the potato hails from Canada. Harrison (18) described, in 1906, a disease which was particularly troublesome during the two previous years in the province of Ontario. The symptoms were, he states, in many respects similar to those of "Schwarzbeinigkeit," in Germany, but different from the bacterial diseases in France described by Prillieux and Delacroix. Plants here and there among the rows present a sickly appearance, with drooping, somewhat yellow or discoloured leaves. The stems gradually fall until they rest upon the ground, and ultimately the stems and leaves shrivel up. The stems are usually blackened near the ground, and sometimes also further up. The tubers also show the disease in a characteristic way. Harrison isolated from the affected plants a hitherto undescribed micro-organism, which he called *Bacillus solanisaprus*, and proved most conclusively that this organism was the cause of the disease. It is a rod-shaped form of variable length, actively motile, and possessing from five to fifteen flagella. In beef-peptone-gelatine stab cultures liquefaction

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was not noticed until after a period of thirty-five days; but, in certain other gelatine cultures, liquefaction set in very much earlier; so that on the whole the organism must rather be looked upon as a liquefier than a nonliquefier. On raw potato the organism grows well, producing a softening and maceration of the tissues, accompanied by the development of a brown or black stain. Harrison presents an enormous mass of details concerning the growth of the organism on media, both living and dead, of the most varied kind, which need not concern us here. They will be dealt with when necessary further on in this paper.

From this summary, therefore, it will be seen that during the course of the last twenty years bacterial diseases of the potato have been observed widely distributed in various countries, both of the New and Old World; and no less than six organisms pathogenic to the potato plant have been described, more or less in detail, for all of which, with the possible exception of B. caulivorus, valid proof of pathogenicity has been supplied.

With regard to Ireland the presence of one or more bacterial diseases of the potato has been assumed for the past eight or nine years, the first intimation of it having been given, as stated, by Delacroix; but the matter has not been closely inquired into. It was in order to clear up any uncertainty on this point, and to obtain information as to the nature and cause of what appeared to be a fairly widespread disease of this character, that the following investigation was undertaken. The work was started by one of us in the summer of 1909, and was continued and extended conjointly during the summer of the present year in a small temporary laboratory (and on the plots adjoining it) erected in the west of Ireland by the Department of Agriculture and Technical Instruction for Ireland, for the purpose of studying the various diseases to which the potato is subject there. It must not be supposed, however, that this disease is by any means confined to the west of the country; it is prevalent to a greater or less extent in every part of the country where potatoes are grown, and seems to be making itself more seriously felt during each succeeding season. A preliminary description of the disease was given by one of us early in the present year (23); and the following is a more complete and detailed account of our present knowledge concerning the disease and its cause.

### II. CHARACTERS OF THE DISEASE.

As mentioned previously, the disease in question has a good many characters in common with the German "Schwarzbeinigkeit" or "blackleggedness." Since, however, the term "Blackleg" is one which is already [B]

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in common use in this country for a disease prevalent among cattle, it seems strongly advisable, in order to avoid confusion, not to use the term "blackleg" for the present disease; and we have, therefore, decided to distinguish it by the name of "Black Stalk-rot." It may be stated that, amongst farmers in general in this country, this disease has not hitherto been known by any distinct name-probably because no particular attention has been paid to it. In the west, however, plants suffering from the disease are often said to be " haughed"; but the same term is perhaps more frequently applied to plants which are suffering from the "Stalk Disease" caused by the fungus Sclerotinia sclerotiorum Massee. Formerly, before the disease was perhaps fully recognized as being one sui generis, it lay hidden along with some others under the somewhat indefinite description of "yellow blight." As has, however, recently been pointed out by one of us (23), the "yellow blight" proper or the "yellowing" of the potato is a condition of the plant involving a state of disharmony with its non-living environment, and is not a disease due to bacterial or fungoid parasites.

Black Stalk-rot makes its appearance early in the season-indeed it is, perhaps, the earliest to appear of all the diseases to which the potato is subject in this country, coming considerably before the blight (*Phytophthora*) arrives, or has, at any rate, made any headway. It may be seen as early as the second week in June; but its appearance may be later than this. Affected plants catch the eve as they stand distributed in a more or less scattered and isolated fashion through the drills or ridges. They stand out most often perhaps owing to the lighter colour of their foliage as compared with that of the neighbouring healthy plants, and, as a rule, by their somewhat more stunted growth. The foliage is very frequently yellow or, in the earlier stages, of a lighter green than normal; and it is sometimes more or less spotted. The leaflets, particularly of the younger leaves, are frequently folded along their midribs, and exhibit symptoms resembling "leaf-roll," although this is not always the case. The uppermost internodes of the stem frequently remain short and undeveloped; while the leaves often assume a rather stiff, semivertical position, instead of spreading out more or less horizontally.

Frequently no signs of disease are to be seen on the portion of the stalk itself above ground, although sometimes that part of it near the surface of the soil is somewhat discoloured or blackened. If the stalk be pulled, it will be found to come away easily, showing that the strength of its anchorage in the soil is but slight. The underground part of the stalk, or, at least, portion of it, will be found to have decayed away, very often leaving strands at its lower end, which consist of the more resistant vascular tissues of the stalk. In some cases the entire cortical and other tissues of the stem outside the wood
will be found to be absent on the portion of the stalk below ground, having completely rotted away; in others, these tissues will be found to be present, but in a state of decay, and consequently the stalk in this region looks black externally. The upper portion of the part of the stalk below ground may still be provided with roots and with rhizomes with small tubers on them, but these are absent from the lower portions. The parent "set," from which the plant was derived, will be found to have decayed away, leaving nothing but its skin. When a set has given rise to more than one stalk, it sometimes happens that some of the stalks may be diseased, while, for a time at least, one or more of the others remains healthy. Ultimately, however, all the stalks succumb.

If the diseased stalk be split longitudinally with a knife, it will be found that the soft tissues within the woody cylinder have become destroyed and blackened for a distance of some inches, usually extending up to and often a couple of inches beyond the level of the soil. Most frequently, at about this level, there is a sharp line of demarkation between the lower diseased and the upper apparently healthy tissues; but in some cases this sharp line is absent, and occasionally one finds that the pith has become disorganized and quite pulpy for a considerable distance up the stem, without, however, losing its light green colour and hence without becoming black, although, in other cases, the blackening may extend for a considerable distance up the interior of the stalk.

If diseased stalks be cut transversely, two things will be noticed : first, the stem is tough to cut, and quite different in this respect from a healthy stalk, which, at this stage, "cuts like a cucumber"; secondly, on the cut surface, the three principal vascular bundles, situated at the three angles of the stem, display a strong brown discolouration, especially in the region of the wood.

The distance to which this discolouration of the vascular bundles may extend in the stalks varies according to the progress of the attack at a given time. In severe cases it can be traced to the very topmost extremity of the stem, and even into the petioles of the upper leaves. In other cases it can be traced up to the penultimate internode; and, in still others, where the attack at the moment is but slight, it may have reached but a short distance above soil-level. Examination of sections of the affected stalks with the microscope shows in the majority of cases an absence of fungal hyphae. On the other hand, actively motile bacteria are present in abundance. In the diseased parenchymatous tissues, such as the pith, the cells are found to be isolated or macerated, although they still retain their starch grains intact. Between them bacteria are present in great abundance. The brown discolouration of the wood is found to be due partly to the formation of a yellowish brown gummy material situated in the cavities of the vessels, but more particularly

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to the development of a brown colour in the walls of the vessels themselves, especially in those nearest the pith. Bacteria are to be seen in the vessels, but not in very great numbers. When a stalk is cut across, a drop of blackish liquid occasionally exudes from the cut ends of the vascular bundles, which liquid may also contain bacteria, but, as a rule, not in great quantity. The cavities of the wood vessels are also nearly always choked with a development of thyloses.

Summarized shortly, then, the chief characters by which the disease may be recognized are: (a) the stunted appearance of the plants, together with the yellowing of the foliage and the folding of the leaflets; (b) the toughness of the stalk on cutting, and the three prominent vascular bundles seen on the crosssection; (c) the decay of the portion of the stalk below ground. Fig. 4, Plate II, shows the general appearance of a stalk affected as described.

As time goes on the affected stalks die away and shrivel up, and the positions which such diseased plants occupied become obliterated owing to the growth of the neighbouring plants. This is rather an important point, because on looking casually over a field of potatoes—say, in August—the crop may appear to be an entirely healthy one; whereas, had it been examined during June or at the beginning of July, quite a considerable proportion of plants affected with Black Stalk-rot might well have been observed.

Although by far the greater proportion of attacked plants are seen early in the season, yet in some cases the disease does not develop and show itself until considerably later, when the stalks have already made considerable growth; so that, as the season progresses, there is a more or less continuous appearance of plants showing the disease. The number of these, however, is generally small, and tends to grow less as the season becomes more advanced. The symptoms here are very similar to those already given. There is, however, perhaps somewhat more wilting and drooping of the foliage, and the stalks themselves often show black lines or marks on their surfaces. Where leaves break off or where branches break away, as frequently happens, the interior of the stalks is seen to be black and rotten. Fig. 1, Plate I., shows such a diseased plant in a drill amongst its healthy neighbours. Another somewhat important difference between the earlier and later attacks is that whereas in the former there has been but little chance for the formation of new tubers. in the latter a considerable number of new tubers may have been formed; and some of them at least are always found to be attacked with the disease, entry having occurred invariably at the heel end through the rhizome. The difference between the healthy and attacked portions of such tubers can usually be quite clearly discerned from an external examination of them. The diseased portion is usually covered with a more or less discoloured skin, which

is not infrequently marked off sharply from that covering the healthy portion by a sharp black line. The lenticels, too, on the diseased area are very frequently much emphasized as distinct black dots. These points are shown in Fig. 2, Plate I. Further, in badly diseased tubers there has usually been an exudation of liquid, which causes the surrounding soil to adhere to that part of the tuber which is diseased; and hence, even from a dry soil, such tubers do not come up clean. The diseased portion of the tuber is not nearly so firm to the touch as the healthy portion, and when squeezed a watery fluid is exuded. On cutting open an affected tuber the diseased portion, which may show one or more cavities, quickly takes on a pinkish tinge, owing to contact with the air. This tinge gradually deepens, until at the end of a space of a few hours it is of a deep violet-brown colour, almost black. The juice expressed from a healthy tuber is, as is well known, slightly acid to litmus paper; but the juice from the diseased tissue is even more distinctly acid at first. After standing in the air for some time, however, and after blackening has occurred, the diseased tissue produces an alkaline reaction with litmus. The diseased tissue in the interior of affected stalks we have always found to be distinctly alkaline to litmus. Fig. 3, Plate I., shows an affected tuber in longitudinal section.

Somewhat similar symptoms to those described, especially for the later attacked plants, are to be found when pathogenic bacteria are not present. Thus the wilting and withering of the foliage, together with the presence of the three discoloured vascular bundles in a cross-section of the stem, are also characteristic of the later stages of "leaf-roll." In this case, however, pulling the stalk immediately gives the clue; for in Black Stalk-rot the portion of the stalk below ground has decayed away, while this is not the case with "leaf-roll." Again, the caterpillar of the Frosted Orange Moth (*Gortnya ochracea*) has been found on several occasions burrowing in the bases of potato-stalks, and producing in the foliage symptoms strongly resembling those of Black Stalk-rot. But the real cause is not difficult to discern in such cases.

Furthermore, it does not always happen that the decay of the stalk below ground occasioned by the Black Stalk-rot leads to the immediate destruction of the stalks and foliage. On the contrary, not infrequently there still remains on the upper portion of the stalk below ground a tolerably good development of healthy roots, sufficient to keep the foliage supplied, temporarily at least, with enough water and dissolved salts to enable it to carry on its proper functions. The consequence is that the manufactured food passed downwards from the leaves, having its natural places of deposit—the tubers—below ground cut off, accumulates in the buds formed in the axils of

the leaves on the stalks; and hence it happens that small aerial tubers are formed in these positions. Such aerial tubers are also formed in other cases, where, owing to the agency of grubs or other means, sometimes mechanical, the base of the stalk becomes injured. Hence it is that although not infrequently such aerial tubers are found on stalks affected with Black Stalk-rot, yet their presence there is by no means an infallible sign of the presence of this particular disease.

#### III. ISOLATION OF THE ORGANISM CAUSING THE DISEASE.

During the summer of 1909, attempts were made by one of us, and with some success, to isolate the organism which was presumably responsible for the disease. That the decayed, pulpy, dead tissues from affected stalks contained some organism highly toxic to living potato-tissue, was easily and repeatedly demonstrated by placing some of it—usually a not inconsiderable amount, weighing perhaps a gramme-on the cut surface of living tubers kept for a day or two in a covered moist dish, when a characteristic rot was nearly always set up, control experiments conducted at the same time giving negative results. From such raw material an organism was isolated on two or three occasions by means of potato-gelatine plate-cultures, which, when placed on slices of living tubers, and inoculated into cut-pieces of stalks, produced a characteristic rot in them. Inoculation with a pure culture into the healthy living stalk of a growing plant was also carried out in one instance, taking the usual aseptic precautions. Unfortunately, owing to a severe attack of the ordinary blight (Phytophthora), the inoculated plant, as well as the remainder of the crop at the Investigation Station, became seriously damaged, and the experiment had to be brought to a premature conclusion at the end of sixteen days. During this time, however, a small cavity had developed in the region of the stab, the sides of which were lined with a blackish pulpy material swarming with motile bacteria. For a distance of two or three inches up the stem from the wound, the three principal vascular bundles had developed the brown stain characteristic of the disease, and thyloses had also developed in the cavities of the vessels.

The organism isolated was one which liquefied gelatine rapidly, being rodshaped and exceedingly motile. Certain difficulties were encountered in obtaining with certainty positive results right through a series of inoculations on potato slices, even when the same materials were used. It was found that, on the whole, more certain results were obtained when the inoculating material consisted of a fairly large quantity of the raw pulpy material from an affected stem than when merely a platinum loopful of a pure culture was

placed on the surface of a cut slice of the tuber. Apparently the drying up of the potato-slices, and probably also the formation of a layer of protective cork cells on their surfaces, were of influence in preventing infection from taking place. For it was found that rotting was produced with more certainty when the surface of the slice was cut in concave fashion, so that a little pool of the inoculating fluid containing the pure culture could remain there for some little time, and success was also rendered more certain when the inoculating material was stabbed into the slice, instead of being merely laid on its surface. On the whole, it was found easier to cause rotting in cut portions of living stalks by stabbing into the pith than to produce it on slices of tubers. The age and degree of ripeness of the tubers used would also doubtless be of some influence, and this point will be referred to again later on.

Owing to the fact that a large amount of time had to be devoted to diseases of the potato other than the Black Stalk-rot, it was impossible to make any very great headway in the study of the organism causing the disease during that summer; but the above-described investigations, although of a preliminary and very incomplete nature, served well as a basis for further work during the summer of 1910. During this latter period the disease and its cause have been studied without interruption, from the end of June up to the middle of October, the work being carried out as before at the Temporary Station for the Investigation of Plant Diseases, at Clifden, County Galway.

Care having been taken to ensure in the plots an adequate supply of diseased plants, work was started on the re-isolation of the pathogenic organism. The medium used for this purpose was potato-juice gelatine, made at first strictly according to the directions laid down by Appel (5). It was found, however, that a satisfactory potato-juice gelatine medium fulfilling all our requirements could be prepared without having recourse to the twenty-four hours' soaking of the tubers in strong soda solution, and also omitting the addition of citric acid before sterilization. It was not necessary to have a gelatine of particularly high melting-point, since all our cultures in this medium were kept merely at laboratory temperature which did not rise to The medium as prepared was always rendered very slightly alkaline, 20° C. the indicator used being litmus. We may state, however, that our experience with the organism which we have isolated has shown that it has no very strongly-marked predilection in favour of a gelatine medium prepared from potato-juice; and it grows almost equally well in a similar medium prepared from Liebig's extract of meat with Witte's peptone, although perhaps in this latter the rate of liquefaction is if anything very slightly less rapid.

In the first series of isolations a number of diseased plants, ten in all, were plated from during the course of as many days. The material for the platings was usually obtained at a point where the diseased and healthy tissues met in the pith of the stalks of affected plants which had been carefully opened by a longitudinal cut with a sterile knife. In some cases the tissues here were rather black and dry; in others they were soft, greenish, and somewhat pulpy. In one case the material was obtained from a discoloured vascular bundle at a considerable distance up the stalk, where it was completely surrounded by apparently healthy tissue. In most of these cases a rough test of the toxicity of the pulp was made at the same time as the platings were carried out by placing a little of it direct on slices of living potatoes (with controls) in Petri dishes, when a characteristic rot was found to develop in them.

In all cases the plates showed after a period of about forty-eight hours at laboratory temperature a varying number of colonies according to the dilution employed. After a further period of twenty-four hours it was clear that, in all cases except one, liquefying organisms were in great preponderance, being accompanied by only a few colonies of non-liquefiers. The colonies of liquefiers were, as far as could be seen with the naked eye, lens, and microscope, all of one type, and consisted of actively motile, rod-shaped organisms of varying length. Not a single colony displaying green fluorescence was observed during these platings; but in other platings made later, on one or two occasions an isolated colony having this characteristic did appear. Although repeated attempts were made to cause a rot in potato-tubers with this fluorescent organism, not the slightest success was met with; and we are very doubtful whether the pathogenic characters ascribed to this type of organism are really possessed by it.

Before replating from the colonies which had developed from the first series of plates, preliminary tests were made as to the pathogenicity of the organisms in them by inoculations made in a manner presently to be described into fresh, young, living potatoes. In the case of the liquefiers rot was set up in all instances; but with the non-liquefiers this was so in some instances, and not in others. Particular attention was then paid to these nonliquefying colonies since the organisms isolated, both by Smith(*B. solanacearum*), and Delacroix (*B. solanincola*), are described as being non-liquefiers; and we considered that we might possibly have before us toxic forms of both liquefying and non-liquefying kinds. In every single instance, however, where inoculation from an apparently non-liquefying colony produced a rot in the potato tuber, it was found, on further culture, from the original colony that this was not pure, but consisted of a mixture of liquefiers and non-liquefiers. When, after

a few successive platings, the non-liquefiers were obtained in absolutely pure culture, it was found impossible to induce a rot in the tuber from them; and throughout our work we have never yet come across a non-liquefying organism which causes such a rot. From what has been said, the great importance of securing absolutely pure colonies by a succession of platings starting from the original material is clearly demonstrated.

With regard to the colonies of liquefiers, after successive cultivations, these were inoculated into potato-tubers; and in all cases they produced the same kind of characteristic rot. From each of the series a pure sub-culture of the toxic organism was obtained, and from the comparative tests made of them we have no reason to suppose that they differed amongst themselves; on the other hand, we have every reason for believing that they consisted of one and the same organism only.

Seeing that during the previous year the method of inoculating by placing the material on the surface of cut slices of fresh potatoes did not always give satisfactorily concordant results, a slightly different method was adopted, although the method mentioned was frequently used in addition. The modified method employed was as follows :--Smallish or medium-sized tubers were freshly dug for the purpose of the experiment, a short portion of the rhizome being left on each. They were thoroughly washed and scrubbed with a soft brush in rain-water; and as the land in which the potatoes were grown was reclaimed bog, it was an easy matter to get the tubers quite clean. They were then dried in a clean towel, and the heel-ends of them were dipped into a solution of mercuric chloride, which was allowed to dry on them. Immediately before inoculation, the small projecting portion of the rhizome was cut off flush with the surface of the tuber with a pair of scissors with sterile blades; and by means of a sterile, steel, lancet-pointed needle a stab of about half an inch to an inch in depth was made into the heel end of the tuber through the cut end of the rhizome. Into the stab thus made the inoculating material, usually from a three days' old culture, was introduced by means of a sterile platinum wire. After inoculation the tubers were placed in covered glass dishes, and in every instance along with them control-tubers were placed, which had received exactly the same treatment, except that the inoculating material was not introduced into them. A convenient method of sterilizing the steel needle and scissors was found to be that of keeping them immersed in strong alcohol, and immediately before use lifting them out and Thus sterility igniting the liquid adhering to them and letting it burn off. was obtained and excessive heating of the needle and scissors avoided. As a general rule, the inoculated tubers and their controls were kept at laboratory temperature. Some of the experiments, however, performed later on in the

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season, were carried on in an incubator at  $25^{\circ}-27^{\circ}$  C. in order to obtain the results more quickly.

All of what we may call our early, critical inoculation experiments were carried out as thus described; later on it was found that the mercuric chloride treatment could safely be dispensed with, and the inoculations were not in every case made exactly through the cut-surface of the rhizome. In all such cases, it is scarcely necessary to add, control-tubers stabbed, but not inoculated, were used as before; and throughout the whole of the work such controltubers remained, without exception, sterile and unaffected, and up to about the end of September, as will be mentioned later on, we had not a single case of failure to rot when the organism, presently to be described in detail, was inoculated into a tuber in the manner indicated.

The difference between the tubers inoculated with the organism and the controls was clearly evident, as a rule, after a period of twenty-four hours. By that time the open end of the stab in the case of the controls showed a very slight discolouration, if any, and had practically dried up. In the inoculated tubers, on the other hand, the wounds were moist-looking, and almost black in appearance. This difference increased as time went on, very frequently a small quantity of a dark-looking liquid being exuded from the stabs in the inoculated tubers, while the skin in the immediate neighbourhood of the stab became blackened. The differences were even more strongly marked when. after a total period of seventy-two hours, the tubers were cut through longitudinally. In the case of the controls there was an empty cavity where the stab had been made, the walls of which were quite firm and free from any marked discolouration. In the inoculated tubers this cavity was filled with a soft, discoloured, pulpy mass, and the adjacent tissues were becoming similarly soft and pulpy, and were in some cases blackened. Fig. 5, Plate III, shows an inoculated tuber cut longitudinally through the stab.

Further details regarding the action of the organism on the tubers will be found when its cultural characteristics are being discussed. From some of the tubers, in which the characteristic rot had been thus artificially produced, platings were made of the decayed tissues, with the result that the organism used for inoculation purposes was re-isolated in pure culture.

In addition to isolating it from diseased potato-stalks, we were successful in obtaining the same organism twice out of three times from affected tubers borne on deceased plants. The failure in the third instance was in all probability due to the fact that the rot in the tuber had, at the time of the experiment, reached an advanced stage, when not only the pathogenic organism but also an abundance of other forms were present. In this case the tuber presented a large cavity when cut open, lined by a fairly thick layer of a blackish

semi-liquid pulp. Since no very special precautions were taken in this particular instance to select the inoculating material from a position in close and direct proximity to the still healthy tissue, our non-success is easily understood. Unfortunately whilst the isolation experiments from this tuber were in progress, and before we had realized our failure to obtain the pathogenic organism from it, the tuber itself was discarded, so that a fresh attempt with the same tuber was rendered impossible. There is little doubt, however, that . the tuber had been primarily attacked by the organism in question, especially in view of the fact that one of the successful isolations mentioned above was made from a diseased tuber borne by the same plant.

An attempt was also made to isolate the organism from the soil, but without success. Infection-experiments carried out with the organisms isolated in pure culture from the soil gave nothing but negative results. This disposes of the view recently brought forward by Hegyi,<sup>1</sup> without sufficient experimental evidence, that any or all of the common soil organisms may cause the disease by effecting an entrance into the portions of the stalks below ground through wounds caused by insects or other animals.

The soil of the particular plot in question-reclaimed bog-had not, it is true, given any indications during the previous season of being infested with any organism toxic to the potato plant; but in it had been planted a large number of tubers which were known to have been derived from plants which, during the previous season, had suffered badly from Black Stalk-rot. As a consequence, the plants arising from these tubers were, to the extent of ninety-four per cent., attacked with this disease during the summer; and as a matter of fact the sample taken for isolation purposes was selected from a spot rather near a rotting tuber borne by one of these plants. Nevertheless the organism was not obtained. This particular plot has now been enriched by the addition to it of a number of tubers and stalks affected with the disease; and it will be interesting to observe next year whether plants derived from perfectly sound tubers of known origin, which it is intended to plant in it, will become diseased. A fresh opportunity will then be afforded of ascertaining whether the organism is present in that soil or not.

Again, an endeavour was made to obtain the organism from the stalks of affected plants of the previous season, which had been allowed to become airdry, and which had been hanging up in a bundle in the laboratory for a period of about ten months. In this case also we were not successful. It is true we have never observed the formation of spores by this organism; but we have at present no certain knowledge of its powers of resistance to dessication, and too much stress must not be laid on the negative results given by a single experiment.

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<sup>&</sup>lt;sup>1</sup> Zeitschrift für Pflanzenkrankheiten, xx. 1910, p. 79.

#### IV. INOCULATION EXPERIMENTS WITH LIVING PLANTS.

In this connexion two distinct series of experiments were carried out. In the first, inoculations were made on single healthy potato stalks, which were removed from the soil and placed with their washed lower ends (on which the roots were allowed to remain) submerged in flasks partially filled with rain-water kept in the lobby of the laboratory, standing in a window facing west. Tufts of cotton wool placed in the necks of the flasks helped to support the stalks, and prevented too rapid loss of water by evaporation. What loss there was was made up occasionally by the addition of fresh water. In the second the inoculations were made on plants grown for the purpose from small tubers (variety "Champion"), planted in ordinary pots on May 9th. These plants, although well grown, were small, and therefore were convenient for handling at the time the inoculations were made. They remained out of doors the whole season, and were very thoroughly sprayed twice, in order to ward off the attacks of *Phytophthora*—a very necessary precaution which successfully accomplished its purpose.

(a) Inoculation of stalks standing in water.—For several reasons this method of experiment did not prove a very satisfactory one. The time taken for the organism to cause a very appreciable amount of damage to the stalks was a prolonged one; and although they remained on the whole fresh enough, they were evidently not very happily situated, with their roots merely in rainwater. During the period, in one or two of the flasks, a considerable growth of fungus mycelium developed about the roots of the stalks, which, however, did not seem to adversely affect them in any way, and which was from time to time washed off. No protection was afforded to the flasks against the action of light, and in all of them, towards the end of the experiment, a more or less considerable growth, of a bright red unicellular alga, had accumulated, chiefly on the bottoms and sides of the flasks. Nevertheless the results, as will be seen, cannot be said to have been altogether unsuccessful.

Seven flasks in all were set up as described. The inoculations made on July 27th were carried out, as was previously the case with tubers, first by stabbing into the stem with a sterile steel needle, and then introducing the inoculating material on a sterile platinum wire. Two of the stalks were stabbed and the platinum wire introduced into the wound without being first dipped into the culture of the organism. These served as controls, and it may be stated at once that throughout the experiment neither of these controls showed any signs of the disease—the stabs, indeed, soon dried up, and were not easily discernible. Of the other five, three stalks were inoculated in a region which was within the flask, but above the water-level, so that the surface of the wound was kept continuously surrounded by a moist atmosphere;

the remaining two were stabled in a region outside of the flask, and exposed to the surrounding air. One of the control stalks was stabled within and the other outside of the flask.

After two days the stabs on the stalks within the flasks were plainly visible as black marks, and there was an indication of the commencement of attack. This was the case also, but to a more limited extent, with the two stabs made outside the flasks, whereas in the case of the controls the wounds could only be found with difficulty. The signs of attack increased during the next three days, by which time it was quite clear that in the case of two at least of the stabs within the flasks the inoculation had "caught on." After twenty-one days, one of the stalks which was stabbed outside the flask was practically dead. It was split longitudinally, and a certain amount of blackening, accompanied by rotting of the tissues, was found to have occurred both above and below the wound over a total distance of about one inch. After thirty-four days one of the stalks which had been stabbed within the flask was found to be wilted, and had fallen over at a point above the place of inoculation. On cutting it open, the pith was found to have rotted away for about a total distance of four inches above and below the wound, the rot having extended through two solid nodes, rendering them hollow. The cavity was blackened and dry, without pulp, and the indications were clearly those of an attack of Black Stalk-rot. An attempt was made to recover the organism from the decayed tissues, but it was not successful.

After forty-seven days a second one of the stalks which had been inoculated within the flask was examined, the signs of decay being similar to, but less extensive than, in the case just described. Here also an attempt to recover the organism was attended with no success.

After fifty-six days the third and last of the stalks inoculated within the flask was examined, and showed the same signs as in the previous cases. The attempt to recover the organism here, however, met with complete success. At the same time the remaining stalk of the two which were inoculated outside of the flask was examined. The signs of rot here were but meagre, and no attempt was made to recover the organism.

It will thus be seen that in all five cases where the stalks were inoculated with the organism a certain degree of rotting was set up, greater in some cases than others, and that in one case the pathogenic organism was re-isolated from the decayed tissues with certainty.

(b) Inoculation of plants grown in pots.—Much greater success was obtained in this series of inoculations. Seven plants were used in the experiment, two of them being used as controls—that is, being treated like the remainder as regards stabbing, but the culture of the organism being withheld. In three

of the remaining five plants there was more than one stalk to each plant; but in each case only one stalk was stabled and inoculated, the others serving as additional controls, being, however, not stabled. The inoculations were made just below soil-level, and after they had been made the pots were filled to the brim with additional soil; so that the wounds were well below the soil, and hence were kept moist, the controls receiving exactly the same treatment in this respect. The inoculated stalks were marked by tying pieces of coloured wool around them. The experiment was started on July 30th.

Not until a period of twenty-four days had elapsed were any signs of attack noticeable in the foliage of the inoculated stalks. At this time two of them began to show signs of wilting, which was very marked in one case. After a further period of six days these signs were considerably more pronounced, and in another two days a third stalk out of the five inoculated also displayed similar signs. The signs were in all respects similar to those which had been observed on plants growing in the open attacked with the disease. The photograph reproduced on Plate III, fig. 6, shows clearly the appearance presented by one of the plants at this date, the contrast between the healthy and the inoculated stalks being plainly evident.

At this time one of the control plants, being less well staked than its fellows, was broken down during a storm of wind, but revealed no signs of Black Stalk-rot. The other control plant, as well as the non-stabbed stalks of the inoculated plants, remained perfectly healthy up to the end of the experiment. On the other hand, up to September 21st all five inoculated stalks had shown unmistakable signs of the disease. Doubtless had the experiment been started earlier in the year, and therefore had longer time for development been available, some or perhaps all of the non-stabbed and noninoculated stalks belonging to the same plants as the inoculated stalks would have become diseased.

The stalks which had become affected were examined, one on Sept. 6th, two on Sept. 19th, and the remaining two on Sept. 21st. It is scarcely necessary to describe in detail the exact appearance presented by the decayed portion of each stalk; suffice it to say that a rot characteristic of the disease was found in all cases proceeding from the inoculation wound, it being in some cases somewhat more strongly developed than in others. What is important is that in four cases out of the five the original pathogenic organism was recovered in pure culture on plating out from the decaying tissues. In the fifth case the organism was also proved to be present with certainty, but it was not obtained in pure culture.

These experiments prove in the clearest possible fashion that the organism, the characters of which are about to be described, is the cause of the disease.

#### V. DESCRIPTION OF THE ORGANISM.

#### A. Morphological Characters.

(1) Form and Arrangement.—The organism when examined in hanging drop prepared from a young agar-slant culture is rod-shaped, occurring very frequently in pairs, sometimes in threes, and not infrequently in long chains. In stained preparations, made direct from diseased tissues, these long chains were not observed.

(2) Size.—In breadth it varies but little, being usually about  $0.9 \mu$  broad. The length, however, is very variable. Single individuals range from  $1.3 \mu$  to  $1.8 \mu$ ; pairs are found up to  $2.5 \mu$ ; and the long chains measure from  $20 \mu$  to  $70 \mu$  in length. The individuals composing the long chains are usually themselves very long; the first three members of one such chain, for example, measured  $8.2 \mu$ ,  $9.3 \mu$ , and  $7.4 \mu$  respectively. When taken direct from diseased tissues, the organism is found on the whole to be slightly smaller, being about  $0.7 \mu$  broad, and from  $0.9 \mu$  to  $1.7 \mu$  long. All measurements were made on fixed and stained preparations.

(3) Motility and Flagella.—The organism, whether obtained direct from diseased tissues or from artificial cultures, exhibits very active movements of a rapid swimming or "darting" kind. Some little difficulty was at first experienced in satisfactorily demonstrating the presence, number, and mode of attachment of the flagella. Trials with Bunge's and Peppler's mordants, followed by staining with carbol-fuchsin, gave unsatisfactory results. By following closely, however, the details of the method given by Ellis (13), using Löffler's "Fuchsin-Tinte" (freshly prepared) as a mordant, followed by an alcoholic solution of fuchsin as a stain, good results were obtained. The number of flagella found varied from one to five; and the arrangement was found to be peritrichous.

(4) Staining.—No time was expended in comparative trials with different stains, it being found that carbol-fuchsin gave satisfactory results. Gram's method produced a negative result both in young and in old cultures.

(5) Spores.—Spores were not observed in any of the cultures, and, as previously stated, an attempt to obtain the organism from affected stalks, which had been hanging since the previous summer in the laboratory, failed.

#### B. Cultural Characters.

(6) Gelatine Plates.—The colonies appear to the naked eye when plated out in potato-gelatine on the second day at laboratory temperature as minute whitish dots with no appearance of liquefaction if submerged, but somewhat shiny and with slight indications of liquefaction if on the surface. After the second day liquefaction proceeds rather rapidly, circular depressions being formed filled with liquefied gelatine of a greyish tinge if the bacteria are uniformly distributed through it. If, as is frequently the case, the distribution is less uniform, a greyish white, irregularly shaped deposit is found in the depression. In ordinary beef-extract-peptone gelatine the appearances are similar; but the rate of liquefaction is slightly less rapid. In no case is there the slightest trace of any green fluorescence. The liquefied gelatine is strongly alkaline to litmus, and when a moistened red litmus paper is attached to the inside of the lid of a Petri-dish containing colonies of the organism and the lid replaced, the litmus is quickly turned blue, indicating the presence of a volatile alkali. There is, however, no smell of ammonia.

(7) Gelatine Stab.—After twenty-four hours at room temperature a more or less continuous line of growth along the stab is visible, usually extending to the bottom of the tube. By the second day liquefaction has started at the surface, and proceeds downwards at a fairly rapid pace, the liquefied portion being somewhat elongated, broadly funnel-shaped, liquefaction being strongest in the uppermost layers near the air. The accumulated bacterial growth forms more or less flocculent masses which gradually settle downwards.

(8) Gelatine Streak.—After twenty-four hours the streak is visible, by means of a lens, in the form of a fine discontinuous line of a whitish grey colour. Liquefaction sets in within forty-eight hours, the margin of the liquefied portion being of an irregular nature, and spreading rather rapidly.

(9) Agar Plates.—The colonies on beef-extract-peptone agar appear after forty-eight hours at 25° C. as small whitish dots when submerged, similar to those in gelatine. On the surface the colonies are larger, dull grey, with sometimes a white centre. Owing to the exudation of water from this medium, the surface colonies soon become merged into a general surface growth over the plate so that their individual characters become lost.

(10) Agar Stab.—At laboratory temperature after twenty-four hours a greyish white, faint line of growth is seen along the stab, which at this time does not usually reach the bottom of the tube. By the third day the surface of agar in the tube is covered by a greyish white growth. The line of growth meanwhile has reached the bottom of the tube, the margin of it being somewhat crenated.

(11) Agar Streak.—At  $22^{\circ}$  C. to  $25^{\circ}$  C. a slight greyish white growth develops within forty-eight hours, which quickly spreads over the surface, aided by exuded water.

(12) Ordinary Broth.--In beef-extract-peptone broth, growth is by no means vigorous. Within forty-eight hours at laboratory temperature the amount of turbidity in the liquid is but slight; and even after standing for a

considerable time very little sediment is found in the bottom of the tube. At 25° C. the growth is but little, if any, more pronounced. No characteristic odour is produced; but broth, which is neutral to litmus at the start, remains neutral. No traces whatever of the formation of a pellicle were ever observed.

(13) Glucose Broth, 2 per cent.—At 25° C. growth is considerably more profuse than in ordinary broth at the same temperature. The turbidity is well marked; and a fair amount of deposit settles down in the tube. In a fermentation-tube with one arm closed, gas is produced in small amount, but quite constantly. The reaction of the broth is changed from that of slight alkalinity to that of distinct acidity.

(14) Cane-Sugar Broth, 2 per cent.—The growth here is very similar to that in glucose broth. Both gas and acid are produced.

(15) Lactose Broth, 2 per cent.—Growth here is also similar to that produced in the presence of the other two sugars. A rough quantitative analysis of the  $CO_{2} = 1$ 

gas produced was made here, and the proportions found to be  $\frac{CO_2}{H} = \frac{1}{4}$ .

(16) Potassium Nitrate Broth, 2 per cent.—Growth is slightly better than in ordinary broth at 25° C. After forty-eight hours nitrites were present (KI and starch test, with control); and they were still present after a period of thirty-three days. When a plug of vaseline was left on the surface of the inoculated broth, gas was always produced (controls treated similarly gave no trace of gas); but the amount of it was always small and the pressure developed never sufficient to push the vaseline up the tube. The broth, which was neutral at the start, became alkaline.

(17) Glycerine Broth, 2 per cent.—Growth at 25° C. is but poor, only a slight sediment being produced. No gas is formed in a fermentation-tube, and no acidity develops.

(18) Sterilized Potato-juice (Appel's).—Active growth occurs within twentyfour hours at 25° C.; the liquid becomes turbid, and a brownish flocculent deposit settles down in the tube. The neutralized juice becomes distinctly acid. There is no trace of pellicle-formation.

(19) Sterilized Potato-juice + 2 per cent. Glucose.—Growth very similar to that in the juice without glucose. Acid is produced, but no gas. Pellicles absent.

(20) Sterilized Potato-juice + 2 per cent. Cane Sugar.—Similar to (19).

(21) Glucose-agar and Cane-Sugar-agar Shake-Cultures.—Gas-bubbles are produced in both cases.

(22) Agar superimposed over Agar Stab.—Growth along the stab and between the two masses of agar; hence the organism is not particularly strongly aerobic.

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(23) Sterilized Skim-Milk.—At 25° C. curdling occurs within forty-eight hours; at laboratory temperature in five days. The curd does not form a very firm compact column. The milk, absolutely neutral before inoculation, becomes distinctly acid. After long standing the curd contracts somewhat, but little, if any, peptonization appears to occur. On shaking, gas-bubbles arise from the curd; and when the milk is provided with a vaseline plug after inoculation, gas accumulates after ten days, and the plug is slightly shifted up the tube.

(24) Neutral Litmus-Milk.—Within forty-eight hours at 25° C. the litmus is completely turned red. After eight days it begins to be decolourized, beginning at the surface, and proceeding downwards, the process being practically complete in fourteen days. On shaking the tube and exposing the contents in a thin layer to the air, the litmus regains its red colour within a few minutes.

(25) *Production of Indol.*—No production of indol could be traced in cultures up to fourteen days old.

(26) Action on Starch.—Although the starch-grains in the macerated tissues of stalks and tubers attacked by this organism appear to be intact, it nevertheless exerts a diastatic action on potato-starch paste. To ordinary beef-extract-peptone agar sterilized, thin potato-starch paste was added sufficient to produce a strong blue colour with a solution of iodine in potassium iodide. Plates of this medium were poured and allowed to set, some of them being inoculated in the centre with the organism—one other, used as a control, being not inoculated. After ten days at  $25^{\circ}$  C. the organism had produced a circular patch of growth in the inoculated dishes, the margin of which reached to within one quarter of an inch of the edge of the plate. On flooding the plates with iodine in potassium iodide solution, and allowing to stand a short time, the portion of the agar covered by the growth (which was not so thick as to prevent the solution from quickly penetrating to the agar below it) remained brown, while the margin turned blue. The control-plate had remained sterile, and a blue colour developed all over its surface.

(27) Thermal Death-point.—A preliminary test of this showed that when the organism was suspended in sterile rain-water, and exposed for ten minutes to a temperature of 50° C., it was entirely killed. Heating for the same period at  $45^{\circ}$  C. failed to kill. Hence the thermal death-point lies between  $45^{\circ}$  C. and  $50^{\circ}$  C.

(28) Production of an Enzyme.—Doubtless the organism produces an enzyme capable of dissolving the middle lamella of cells. A single attempt was made to obtain it, which was not successful. Owing to the somewhat limited resources of our small temporary laboratory, further attempts were not proceeded with.

 $\mathbf{26}$ 

(29) Sterile Slices of cooked Potato.—At 25° C. a yellowish, slimy, shining growth occurs in two days, which gradually spreads over the surface without being raised above it to any extent. This is the only medium on which we have found the organism to exhibit any chromogenic character. After six days the portions of the potato-slices not covered by bacterial growth become brownish; control, non-inoculated slices remain uncoloured. The potato-slices became alkaline, controls remaining acid.

(30) Slices of living Potato aseptically prepared.—At room-temperature a slight brown discolouration and a slight sinking-in of the tissues occur within twenty-four hours. By the third day the depression is well marked, the bottom and sides of it being of a lightish brown colour, and the margin a deeper brown or almost black. On standing longer the depression frequently becomes somewhat deeper and more or less blackened all over. Fig. 7, Plate III., shows the results of four days' growth of the organism on living potato-slices. The tissues become soft and pulpy to the bottom of the slice if about half an inch thick. Microscopic examination of the pulp shows that the middle lamellae of the cells have become dissolved, leaving the cells themselves free and with slightly browned protoplasmic contents, but with intact starch-grains in which the lines of stratification are often very well marked. The inception and progress of the attack on raw potato-slices in Petri dishes are largely dependent on the presence of moisture. Success is best attained when care is taken to keep the interior of the Petri dish well moistened.

(31) Whole Potatoes inoculated through the "heel."-The method used has already been described on p. 17. At room-temperature, within forty-eight hours a slight, slimy exudation can be observed, together with a blackening around the edge of the wound. This blackening frequently spreads centrifugally over the skin, being marked off by a fairly sharp line from the normal skin. The rot extends beneath this discoloured skin; and if lenticels be present on this area, they often stand out sharply as black spots. When affected or artificially inoculated tubers are of a red variety-that is, when the cells of a few layers of the tissue immediately below the true cork cells of the skin contain anthocyan in solution in the cell-sap-the colouring-matter becomes destroyed in the attacked portions, and the surface of the tuber no longer shows the colour characteristic of the healthy tuber over these areas. When cut longitudinally through the inoculation-stab, the cavity is more or less filled with a soft, pulpy mass usually of a light brown colour. This pulp is frequently marked off from the still unattacked tissues by a distinct black line. In some cases the organisms pass into the "vascular ring," and cause it to become brown for a greater or less portion of its circumference. (See fig. 5, Plate II.) In some cases the pulpy materialis almost pure white; and the dark

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line mentioned above may be absent. In others, especially where the stab was a large one, its sides become blackened, probably owing to the access of air to its interior, for, on exposure to air, the pulp above mentioned gradually darkens, often becoming almost black.

The reaction of this pulp to litmus was carefully studied. It may be recalled that, in tubers naturally infected from the parent plant, the diseased tissues give at first a distinctly acid reaction; later on, after blackening has occurred, the reaction becomes alkaline. Care being taken to avoid the naturally acid sap of the healthy tissue, it was found that, if a little of the pulp were placed on a blue litmus paper, it was immediately reddened. If. however, a little of the same pulp was placed at the same time on a piece of red litmus paper, a slight blue colouration was produced. Thus at this stage the pulp shows an amphoteric reaction, the acidity being, however, more strongly marked than the alkalinity. On exposure to air, however, the reaction gradually becomes alkaline. If a moistened red litmus paper be left on the inside of the lid of a dish in which potatoes are rotting, it gradually becomes blue, as is the case with cultures in artificial media. The odour produced by rotting tubers is but a faint one, somewhat resembling a mixture of stale fish and potatoes. There is no smell of butyric acid.

It will be convenient to give at this point a brief account of the action of the organism on tubers of the same variety, of different ages, and on those of different varieties. Up to the end of September the inoculations had always been made on tubers freshly, or very recently, dug for the purpose. On starting experiments to ascertain the susceptibility of different varieties of potatoes to the attacks of the organism, tubers were at first used which, in some cases, had already been dug and stored in sprouting-boxes for a week or two. Whereas up to this time we had no case of failure to rot when the organism was inoculated into a tuber, we now found, somewhat to our surprise, that some varieties, which had previously taken infection easily, now did so only with difficulty or scarcely at all. The results of the following experiment seem to show it is more difficult to produce a vigorous rotting in ripe and lifted potatoes than in unripe ones still in the ground and attached to the plant.

On October 3rd seven Champion tubers which were freshly dug, and seven others which had been dug and boxed four weeks earlier, were inoculated with what was ascertained to be a quite virulent culture of the organism. With the seven fresh tubers the rot proceeded vigorously in all cases. Rotting also occurred in six out of the seven old tubers; but it was decidedly less vigorous than in the fresh tubers, and in three cases it apparently came to a standstill after a few days.

At this time it was impossible to secure tubers of the different varieties grown in our plots of similar degrees of ripeness and storage, seeing that they had already been lifted at different dates during the month. In spite of this slight disturbing factor, however, the results of three series of inoculation tests of fourteen different varieties, summarized in the following table, are not without interest. A + sign indicates that a decided rot was set up in the tuber; a - sign, on the other hand, indicates that no rot whatever occurred; and  $a \pm sign$  shows that the signs of rot were but slight.

VARIETY.				Test 1.			Test. 2.			Test 3.		
Clifden Seedling,				+	_	+	4	+	+	+	+	+
Black Skerry,				+	+	+	-	+	±	+	+	+
British Premier,			•••	±	+	-	+	+	+	+	+	+
Shamrock, .	•••				+	+	+	+	±	±		-
Irish Queen,				+	ŧ	_	+	+	+	+	_	_
British Queen,				+	_	_	+	+	·	+	_	_
Scottish Queen,		• •		+	+	+	±	±	+	-	-	-
Flour Ball,		••		+	±	±	_		_	+	+	+
Duchess of Cornwa	11,			+	+	_	_	±	-	+	+	_
Champion,		• •		+	+	+	-	+	_	-	-	_
Beauty of Bute,		••		+	_		-	_	_	-	_	_
Brian Boru,	• •	• •		±	<u>±</u>	-	-	_	-	-	_	_
Red Cup,		••		-	_	_	-	-	±	-	-	_
Wild Champion,		•••		_	_		_	_	_	-		_

#### VI. PATHOGENICITY TOWARDS PLANTS OTHER THAN THE POTATO.

When pieces of turnip, swede, carrot, and parsnip, prepared with aseptic precautions, and kept in covered glass dishes, were inoculated with the organism in a similar manner to that described for potatoes, it was found that a rot was readily produced in all cases in a short time at laboratory temperature. Controls showed no signs of rotting. In the case of the turnip, the rot was as rapid and complete as in the potato, or even more so, the tissues being quickly reduced to an evil-smelling brownish pulp. On the other hand, all attempts to produce a similar rot in mangels failed. Bacterial rot of the turnip and swede is of course of fairly common occurrence in Ireland as in other countries; and we have occasionally met with cases of rotting in carrots, evidently of a bacterial nature. The question naturally

arises as to whether the organism causing Black Stalk-rot of the potato may also produce rotting of the turnip under natural conditions in the field, A complete answer to this question must be left for future work to provide; but from a swede, which was attacked by a brown bacterial rot, we succeeded in isolating an organism which would rot swedes, but which could not be induced to cause a rot in potatoes. A quite different type of bacterial rot of a white kind was observed in turnips, one of the characteristics of which was that the foliage of the affected plants became strongly wilted. Preliminary trials with the pulp of such rotten turnips showed that it did produce a rot in potato tubers. This pulp was then plated out, and ultimately an organism was isolated from it which caused a rapid rot in the turnip and also in potato-tubers. In the latter, however, the rot was neither rapid nor profound, and it did not show quite the characters of the decay produced by the Black Stalk-rot organism. The organism was a peritrichously multi-flagellate rod, which in size was both distinctly broader and longer than the Black Stalk-rot organism. Hence it would appear that turnip-rot and Black Stalk-rot are probably not caused by identical organisms, although the Black Stalk-rot organism does not seem to be specifically pathogenic to the potato, as is stated by van Hall to be apparently the case with his Bacillus atrosepticus. Much further work is, however, required in this direction before it would be possible to decide with certainty whether one and the same organism may be responsible for rotting both in potatoes and turnips.

# VII. Comparison of the Organism causing Black Stalk-rot with allied Organisms.

It may be recalled that the following organisms have been described as being responsible for bacterial disease in potatoes, viz., Bacillus caulivorus Prill. et Del (France), Bacillus solanacearum Smith (U.S.A.), Bacillus solanincola Del. (France), Bacillus atrosepticus van Hall (Holland), Bacillus phytophthorus Appel (Germany), and Bacillus solanisaprus Harrison (Canada). When compared with these, it is quite clear that our organism is not identical with any of the first three named, for the first of them produces a green fluorescence in its culture media, and the two others are non-liquefiers of gelatine, whereas our organism produces no green colour, and is decidedly a liquefier. With regard to the three last named, a comparison of characters shows that our organism has some points in common with each of them. It differs, however, from Bacillus atroscyticus, since that organism is described as occurring chiefly as isolated individuals, whereas ours is more frequently found in pairs. The former is also decidedly smaller in size, in spite of variations in both cases, and its action on milk appears to be different from

that found in our case. We were unfortunately unable to obtain a copy of the detailed characters of B. atrosepticus before our own work was concluded. Hence we were not able to make a comparative study of the behaviour of our organism and that of van Hall in many of the media which he used; but sufficient has been done to show that the organisms are not identical. There are even greater differences between our organism and B. solanisaprus. The latter possesses far more flagella, forms no gas in glucose and cane-sugar cultures, forms a distinct ring on the surface of potato-juice, and produces a raised, creamy-white growth on cooked potato, all of which characters serve to distinguish it from our organism. Between B. phytophthorus and the organism isolated by us, however, there exist marked resemblances, so much so that we are strongly tempted to regard the latter as probably only a variety of the former. Nevertheless there are certain differences which, if slight, are yet quite constant, as repeated tests have convinced us. Thus in Appel's sterile potato-juice, we have never been able to obtain the slightest signs of a pellicle; whereas B. phytophthorus produces a strong one. Again, in nitrate broth we find that our organism produces a small amount of gas, while this is apparently not the case with B. phytophthorus. Further, the growth in milk is dissimilar in the two cases. Our organism causes the separation of the curd as a not very compact mass, and produces a distinct acidity in a comparatively short time, whereas B. phytophthorus causes milk to change only on long standing, forming then a compact cylinder of precipitated curd and giving a reaction which is amphoteric to litmus. Evidently, however the two organisms, if not identical, are at any rate closely allied; and it is perhaps with some reluctance that we regard it as a distinct species, and suggest the name of Bacillus melanogenes for it.

A careful comparison has also been made, as far as circumstances permitted, between our organism and a group of organisms which have been recently submitted to a long series of comparative studies by Harding and Morse (17), and which have been described by various authors as causing a soft rot in many fleshy vegetables of the North Temperate Zone, and of which *Bacillus* carotovorus Jones serves as a type. The pathogenicity of *B. carotovorus* and its allies towards potatoes is, as far as we are aware, not known; hence a comparison on this vital point cannot be made. *B. carotovorus* produces indol, though in feeble amount. *B. melanogenes* does not do so at all. *B. carotovorus* produces a white growth on cooked potato, *B. melanogenes* a distinctly yellow one. *B. carotovorus* has up to ten flagella; in *B. melanogenes* we have never seen more than five. These differences are quite sufficient to show that the organism obtained by us is not identical with *B. carotovorus* and its allies.

## VIII. PRACTICAL CONSIDERATIONS.

We have no exact data on which to base any estimate as to the losses caused by this disease in this country, but they cannot be inconsiderable. It may be pointed out that these losses occur both in the growing crop and in the stored produce, and further, that of these the latter is in all probability the greater. As stated previously, the diseased plants are scattered here and there throughout the field or plot; and the loss of a small percentage of plants would not cause a particularly appreciable diminution in the total yield. In the pits, however, each diseased tuber may serve as a centre from which the rot may spread to the surrounding healthy ones; and it is quite possible, therefore, for a whole pit to be rendered more or less completely useless.

An instructive experiment was performed, which shows that there would be no difficulty in perfectly sound tubers becoming infected by contact with diseased ones. A sound tuber which had been placed in water for twelve hours, allowed to dry for a further twelve hours, and finally soaked for another twelve in order to make it thoroughly damp, and to induce a certain amount of proliferation of the tissues at the lenticels, was painted over with a pure culture of the organism, placed in a covered dish, and kept at laboratory temperature. The liquid culture drained to a certain extent down over the surface of the tuber, and a thin layer came to lie between the latter and the bottom of the dish. At this point infection took place through a lenticel, and the tuber rotted in characteristic fashion. A control tuber which was painted with sterile water remained sound. That the soaking in water did not affect the vitality of the tubers is clear from the fact that they have since produced normal sprouts. In a pit, especially if made at a time when the tubers were not thoroughly dry, or if faultily constructed, so that wet was not properly excluded, the conditions would be very similar to those in the above experiment; and it is easy to see how, by means of infection through the lenticels. very serious rotting could take place. In order to avoid this, it is necessary first to exclude attacked tubers from the pit; and, secondly, to construct it as far as possible when the tubers are thoroughly dry, and in such a manner that it can remain dry, and also cool; for, of course, the rot is much accelerated by a rise of temperature.

It would, therefore, seem a wise precaution to remove and destroy, as far as practicable, all plants attacked with this disease, as soon as possible, from fields or plots where it appears, in order that the tubers produced by them which, though they may be few, are bound to be diseased to some extent may not find their way to the pit with healthy ones. Leaving such affected plants and tubers on the land means that the soil will, at least at these spots-

become enriched with an organism pathogenic to the potato. On large farms, where a proper system of rotation can be carried out, this is, perhaps, not of so much practical consequence; but on small farms, and in gardens where potatoes are, unfortunately, too often grown for several successive seasons on the same land, there is the not inconsiderable risk of the new season's crop contracting the disease from the organisms left in the soil by the previous one. For although it has not as yet been definitely proved, in the case of this particular organism, that plants may contract the disease from the soil, there can be little doubt, arguing from analogy with similar species, that such is likely to be the case; and experiments are arranged for next season which, it is hoped, will settle the point. It is just on such small areas that removing the individual diseased plants would be most feasible.

It is, however, doubtful whether infection of the plant from the soil is in the main responsible for the occurrence of this disease, or, at any rate, for its spread in this country. It seems certain that this is due rather to the planting of affected tubers. It has already been shown that, under certain circumstances, a tuber may be infected, and the rot may come at least to a temporary halt. Such a tuber might show little or no external signs of being diseased, and might easily be passed as suitable for "seed." When, however, such a tuber is planted in the soil, the conditions of warmth and moisture are such as to facilitate the resumption of activity by the parasitic bacteria, with the result that sooner or later the stalks developing from such a tuber will succumb to the disease.

The following experience bears out this view. In 1909 tubers of the variety British Premier were planted on land which did not grow potatoes in the previous season, and which was manured with farmyard manure and artificials. Early in July the plants were found to be suffering to the extent of 25 per cent. from Black Stalk-rot. The disease increased, and at the end of the third week in the month the whole crop was raised. It consisted of a considerable number of small potatoes, some of which it was easy to see were attacked; and they were therefore destroyed. The remainder were boxed for planting in 1910. The tubers kept well over the winter; and at planting time there was nothing to indicate from an external examination of them that they were otherwise than sound. Half a square perch of land, which had grown healthy potato plants in 1909, and which received artificial manure only, was planted with these tubers in 1910. No less than ninety-four per cent. of the plants succumbed to the disease during the summer. On a control plot of the same kind of land, similarly treated and planted with the same variety of potato, the "seed," however, being the produce of a perfectly sound crop the previous year, not a single plant was attacked by the disease.

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In spite of the fact that the origin of the seed was known, it must be confessed that such a large proportion of diseased plants was quite unexpected. It is abundantly evident that the disease can be spread by means of affected "seed" which may appear to be sound. This being the case, the advisability or removing diseased plants as far as practicable from the field, in order to prevent the apparently sound tubers of diseased plants from being selected for "seed," is clearly indicated. It is perhaps a counsel of perfection to recondened that only those tubers should be used for "seed" purposes which can be guaranteed to be the produce of a crop free from Black Stalk-rot; but the time is not far distant when it will be necessary to pay more attention to the sources of potatoes for "seed" purposes from the point of view of their being carriers of disease not only in the case of Black Stalk-rot, but also in that of some others, such as Leaf-Roll and Curl. Experiments are now in progress to ascertain whether the organism present in slightly affected tubers can be killed by heat without injury to the tubers themselves. As regards immunity we have as yet little satisfactory evidence to go upon; but it will be noted on reference to the table on p. 29 that we did not succeed in a single instance in causing an infection in tubers of the Wild Champion variety. As a cropper, and for quality, however, this variety is not one which would recommend itself for wide culture.

#### IX.—SUMMARY.

This paper deals with a bacterial disease of the potato plant (including the tubers) in Ireland, of which, as is shown in the historical introduction, no detailed study has up to the present been published.

The characters of the disease are described in detail, the main features being discolouration and drying-up of the tollage, browning of the principal vascular londles of the stem, decay of the underground portion of the stalkand rotting of the tubers.

An account is given of the isolation of a pathogenic organism from the diseased tissues and of incodation and re-isolation experiments made with it on healthy plants, which prove conclusively that it is the cause of the disease.

The organism is described in detail both as to its morphological and physiological characteristics. It is a multiflagellate, peritrichous bacillus. liquetying gelatine, practically non-chromogenic, and evidently allied to, but not identical with, certain other organisms which have been described in other countries, both in the Old and New World, as causing a similar disease in potatoes. The name *Bacillus melanogenes* is suggested for it.

It is pointed out that, although the disease may probably be contracted from the soil, the evidence at hand shows clearly that the planting of affected 'seed" is mainly responsible for the spread of the disease, which causes losses, not only in the growing crop, but considerably greater ones during storage. Preventive measures should therefore aim at the destruction of diseased plants, the exclusion of affected tubers from the pits, and the procuring of tubers for "seed" purposes from crops in which the disease has not appeared.

## X. BIBLIOGRAPHY.

- 1 APPEL: Untersuchungen über das Einmieten der Kartoffeln. Arb. a. d. biol. Abt. a. Kais. Gesundheitsamt, Bd. ii., 1902, p. 373.
- 2 Zur Kentniss der Bakterienfäule der Kartoffeln. Ber. d. deutsch. bot. Ges., Bd. xx., 1902, p. 32.
- 3 Der Erreger der Schwarzbeinigkeit bei den Kartoffeln. *ib.*, p. 128.
- 4 ----- Untersuchungen über die Schwarzbeinigkeit und die durch Bakterien hevorgerufene Knollenfäule der Kartoffeln. Arb. a. d. biol. Abt. a. Kais. Gesundheitsamt, Bd. iii., 1904.
- 5 Die Schwarzbeinigkeit und die mit ihr zusammenhängende Knollenfäule der Kartoffel. Kais. Gesundheitsamt, Biol. Abt. f. Land- u. Forst-wirtschaft, Flugblatt Nr. 28, 1904.
- 6 Neuere Untersuchungen über Kartoffel- und Tomatenerkrankungen. Jahresber. d. Vert. d. angew. Botanik, iii. Jahrgang, 1904/05, p. 122. Berlin, 1906.
- 7 Die Bakterien-Ringkrankheit der Kartoffel. Kais. Biol. Anstalt f. Land- u. Forstwirtschaft, Flugblatt Nr. 36, 1906.
- 8 COLEMAN: The Ring Disease of Potatoes. Bull. 1. Mycological Series, Dep. of Agric., Mysore State. Bangalore, 1909.
- 9 DELACROIX : Sur une maladie bactérienne de la pomme de terre. Compt. rend., exxxiii, 1901, p. 417.
- 10 Contributions à l'étude d'une maladie nouvelle de la pomme de terre, produit par le Bacillus solanincola n. sp. ib., p. 1030.
- 11 Rapport sur une maladie bactérienne nouvelle de la pomme de terre.
   Bull. du Ministère de l'agric., No. 5, Paris, 1901, p. 1013.
- 12 Sur une maladie de la pomme de terre produite par Bacillus phytophthorus (Frank) Appel, Compt. rend., exliii, 1906, p. 383.

- 13 ELLIS : On the discovery of cilia in the genus Bacterium. Centralblatt für Bakt., ii. Abth., Bd. xi., 1903, p. 241.
- 14 FRANK : Die Bakterienkrankheiten der Kartoffeln. Centralblatt für Bakt. ? Abth. Bd. v., 1899, p. 98.
- 15 GRIFFON: Sur le rôle des bacilles fluorescents de Flügge en Patologie végétale. Compt. rend., July 5, 1909, p. 51.
- 16 VAN HALL: Bijdragen tot de Kennis der bakterieelle Plantenziekten. Dissertation. Amsterdam, 1902.
- 17 HARDING AND MORSE: The Bacterial Soft Rots of certain Vegetables. Part I. The Mutual Relationships of the Causal Organisms. New York Agric. Exp. Station, Tech. Bull. No. 11, 1909.
- 18 HARRISON: A Bacterial Rot of the Potato, caused by Bacillus solanisaprus. Centralblatt für Bakt., ii. Abth., Bd. xvii., 1906, p. 34.
- 19 IWANOFF: Ueber die Kartoffelbakteriosis in der Umgegend. St. Petersburgs im Jahre 1908. Zeitschr. f. Pflanzenkrankheiten. Bd. ix., 1899, p. 129.
- 20 JENSEN: Versuche über Bakterienkrankheiten bei Kartoffeln. Centralblatt für Bakt., ii. Abth., Bd. vi., 1900, p. 641.
- 21 JOHNSON : Diseases of the Potato and other Plants in Ireland. Journ. Dep. Agric. & Tech. Inst. for Ireland, vol. iii., 1902, p. 8.
- 22 Some Injurious Fungi found in Ireland. Econ. Proc. Royal Dublin Soc., vol. i., 1899-1909, p. 345.
- 23 PETHYBRIDGE: Potato Diseases in Ireland. Journ. Dep. Agric. & Tech. Inst. for Ireland, vol. x., 1910, p. 241.
- 24 PRILLIEUX ET DELACROIX : La gangrène de la tige de la pomme de terre, maladie bacillaire. Comptes rend., cxi., 1890, p. 208.
- 25 SMITH: A Bacterial Disease of the Tomato, Egg Plant, and Irish Potato. U.S. Dep. of Agric., Div. of Veg. Phys. & Path., Bull. No. 12. Washington, 1896.
- 26 Entgegnung auf Alfred Fischer's "Antwort" in Betreff der Existenz von durch Bakterien verursachten Pflanzenkrankheiten. Centralblatt für Bakt., ii. Abth., Bd. vii., 1901, p. 88.



Fig. 1.



Fig. 2.

Fig. 3.

PETHYBRIDGE-BACTERIAL DISEASE OF POTATO.

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Plate II.



Fig. 4.



PETHYBRIDGE-BACTERIAL DISEASE OF POTATO.

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Plate III.



Fig. 6.



Fig. 7.

PETHYBRIDGE-BACTERIAL DISEASE OF POTATO.

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## EXPLANATION OF PLATES.

## PLATE I.

- Fig. 1. A large plant with several stalks all attacked with Black Stalk-rot, with a background of healthy plants. Variety, "British Queen." Photographed in July.
- Fig. 2. The "heel" or proximal end of an affected tuber, showing the discoloured diseased area on the skin and prominent lenticels. Variety, "British Premier."
- Fig. 3. An attacked tuber cut longitudinally, showing the blackened diseased tissues with cavities in them situated at and spreading from the heel end. The terminal "eye" has produced a short sprout. Variety, "Clifden Seedling."

#### PLATE II.

- Fig. 4. A single affected stalk, showing the abnormal foliage and decay at its base. Variety, "Champion."
- Fig. 5. A tuber which was artificially inoculated with **B**. melanogenes split longitudinally, showing the progress of decay at the stab and in the "vascular ring."

#### PLATE III.

- Fig. 6. A potato plant inoculated with *B. melanogenes.* The left-hand diseased stalk was inoculated below the present surface of the soil; the right-hand still healthy stalk was not inoculated. Variety, "Champion."
- Fig. 7. Four slices of living potato prepared under aseptic conditions, showing four days' growth of *B. melanogenes*.

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## II.

## A SYNOPSIS OF THE FALSE-SCORPIONS OF BRITAIN AND IRELAND.

#### Br H. WALLIS KEW.

#### PLATES IV,-VI

#### [COMMUNICATED BY PROFESSOR G. H. CARPENTER, B.SC., M.R.I.A.]

#### Read DECEMBER 12, 1910. Published FEBRUARY 1, 1911.

THE present account of our false-scorpions was taken in hand some years ago with the consent and co-operation of the Rev. O. Pickard Cambridge, Professor G. H. Carpenter, the Rev. Robert Godfrey, Dr. A. Randell Jackson, Mr. Frank P. Smith, and other leading British and Irish Arachnologists; and with the support of Mr. Edvard Ellingsen of Kragerö (Norway), who was so good as to examine an almost complete collection of specimens from these islands. M. E. Simon also has kindly examined some specimens and has favoured me with others from his collection for comparison; while Mr. C. J. With of Copenhagen, who has greatly advanced our knowledge of these animals during recent years, has generously helped me in various ways. Acknowledgments are due also to Mr. Albert Tullgren of Stockholm; to the authorities of the British Museum and of the National Museum of Ireland; to the Rev. C. R. N. Burrows, Mr. E. A. Butler, Mr. W. Ruskin Butterfield, Mr. Horace St. J. K. Donisthorpe, Mr. H. E. Freeman, Dr. Norman H. Joy, Mr. R. T. Lewis, Mr. C. Oldham, Mr. C. D. Soar, Mr. T. Stainforth, and Mr. G. Aird Whyte; and to many correspondents who have obligingly contributed specimens. To all I tender my sincere thanks.

#### PSEUDOSCORPIONES.

Pseudoscorpiones Latreille 1825 (14). Chernetes Simon 1879 (27). Chelonethi Thorell 1883 (31). Chernetidea Cambridge 1892 (42).

ARACHNIDA with 2-jointed completely chelate chelicerae, provided with structures called serrula and lamina interior (often also with lamina exterior), and bearing openings of spinning-ducts often produced into a "galea." Maxillae movable in small degree, with laminae forming part of mouth, pars palpigera very large with enormously developed completely chelate palp. Remaining 4 pairs of appendages all ambulatory, 2-clawed. Cephalothorax

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with sternal elements obliterated or almost obliterated,<sup>1</sup> maxillae and coxae meeting or almost meeting in median line. Abdomen joined to cephalothorax without constriction; somites 12, the first (prae-genital) with full-sized tergite; sterna of somites II. and III. comprising the genital-area; those of III. and IV. carrying the tracheal spiracles (2 pairs); somite XII. greatly reduced, forming when extended a minute prae-anal "tail." Coitus unobserved.

 1. Serrula fixed throughout
 .
 .
 .
 Panctenodactyli.

 2. Serrula free distally
 .
 .
 .
 .
 .

#### I. Panctenodactyli.

Chelicerae small; serrula fixed throughout; lamina exterior and galea always present. Cephalothorax without anterior median process or marginal serration; frequently with a groove marking off head from thorax, and often another limiting the two thoracic somites. Abdominal somite XI. usually with separate tergite and sternite.

(Head marked off from thorax, and tergite-sternite XI. separate in all Britannic forms; in these the lamina interior is in most part plate-like; maxillae and coxae with ventral face in same plane; cephalothorax always rounded or narrowed in front; most or all abdominal tergites with median division; body more or less flattened, with dermo-skeleton somewhat solid, generally dull and heavily sculptured, rarely polished; bristles never all

th well-separated with longer pars

#### ERRATUM.

Page 50, line 14. For "tergites" read "sternites".

. Chelifer. Cheiridium.

ephalothorax with

or without grooves marking off head and thoracic somites. Abdominal somite XI. with tergite always visible from above; somite XII. terminal. Bristles a little curved or straight, clavate, toothed or nearly simple. Eyes 0 or 2, near

<sup>&</sup>lt;sup>1</sup> Cf. Lankester (61), p. 255.

<sup>&</sup>lt;sup>2</sup> Panctenodactyli and Hemictenodactyli, Balzan 1891 (41), are well-marked divisions in a small fauna like ours; less so when Garypidae are considered; they are scarcely sub-orders. Cf. Hansen (43), p. 230; With (66), p. 54; Hirst (97), p. 106.

<sup>&</sup>lt;sup>3</sup> The remaining families of Panctenodactyli, Garypidae and Feaellidae are 4-eyed; femur of legs I. generally with longer pars basalis and shorter pars tibialis; in Garypidae all tarsi 2-jointed, in Feaellidae 1-jointed.

anterior margin of head. (Britannic species always with groove marking off head, and generally with another limiting the two thoracic somites.)

Species numerous; formerly divided into Atemnus, Chernes, and Chelifer s.s., artificial genera now usually abandoned; With (66, 82) has recently shown, however, that four natural divisions are distinguishable—(1) group of C. Birmanieus, (2) group of C. cimicoides, (3) group of C. cancroides, (4) group of C. subruber; and these groups which are at least sub-genera are here adopted as (1) Atemnus, (2) Chernes, (3) Chelifer s.s., redefined; and (4) Withius, sub-gen. nov.

- 1. Fingers of palps with accessory teeth
   .
   .
   .
   Chernes.

   Fingers of palps without accessory teeth
   .
   .
   .
   .
   .

## I. Chernes Menge 1855 (20).<sup>2</sup>

Legs I. with articulation between trochantin and femur wide, oblique; fingers of palps with accessory teeth;  $\mathcal{S}$  without coxal sac, genital-area with plate II. not longer, usually shorter than plate I., without ram's-horn organs. Eyes 0 (in Britannic species).

(Britannic species 9: abdomen with tergite I. incompletely or more often completely divided, the rest divided, except XI. which is incompletely divided or more often entire; main tergites generally with four bristles in front of the posterior marginal row; palps more or less robust, femur usually increasing abruptly from its stalk and attaining its full breadth near base, tibia usually with marked anterio-proximal convexity, hand sometimes both broad and obliquely high, posterior margin of fingers with a series of accessory teeth, anterior margin with a series or with an isolated tooth;  $\mathcal{S}$  with genitalarea and secondary characters moderately conspicuous, and with coxae IV. straight or nearly so posteriorly, moderately or but little modified.)

1. Body polished; tibia IV. with tactile hair												
Body unpolished; tibia IV. without tactile hair												
2. Trochanter of palps with upper protuberance broad, showing on												
posterior margin												
Trochanter of palps with upper protuberance narrower, not												
showing on posterior margin	3											

**4**0

<sup>&</sup>lt;sup>1</sup> Atemnus is unrepresented in our fauna.

Chelunops Gervais 1849 (18) has sometimes been used in place of Chernes; but its type is not known to pertain to the present sub-genus.
3. Tarsus IV. with tactile hair $\frac{1}{3}$ remo	ved from base . nodosus.
Tarsus IV. with tactile hair near m	iddle <i>Godfreyi</i> .
4. Anterior margin of fingers with isol	ated accessory tooth; ventral
face of maxillae granulate	5
Anterior margin of fingers with a ser	ies of accessory teeth ; ventral
face of maxillae smooth or nearly	yso7
5. Tactile hairs of abdominal somite X	I. present 6
Tactile hairs of abdominal somite X	I. absent Wideri.
6. Tarsus IV. with tactile hair .	scorpioides.
Tarsus IV. without tactile hair	<i>dubius</i> .
7. Cephalothorax and palps with hone	y-comb sculpture; tarsus IV.
without tactile hair	cimicoides.
Cephalothorax granulate; tarsus IV	with tactile hair 8
8. Palps dull or nearly so	<i>Panzeri</i> .
9. Palps brilliantly glossy	Cyrneus. <sup>1</sup>

# C. nodosus Schr.<sup>2</sup>

Chelifer nodosus Schr. 1803 (7)? C. inaequalis Curtis 1849 (19)? Chernes Reussii (C. L. Koch) L. Koch 1873 (24). Chelifer nodosus (Schr.) Simon 1879 (27).

Palps and cephalothorax reddish-brown, abdominal tergites olive-horny; glossy, with nearly simple bristles. Cephalothorax weakly granulate at sides, dorsum non-granulate, second groove scarcely perceptible or absent; abdominal tergites non-granulate reticulate, scar-spots indistinct, main

<sup>&</sup>lt;sup>1</sup> Chelifer (Chernes) sp.  $\mathcal{S}$  (mature?), a single specimen from Bloxworth, has been recorded as C. meridianus L. Koch (42); name used by mistake; Mr. Ellingsen was inclined to refer the animal, in spite of some differences, to C. cimicoides (Fabr.). Chelifer (Chernes) insuetus Camb. (42), based on two examples found in 1880 at Dover in an oil-mill (since destroyed), belongs with C. nodosus, C. Godfreyi, and C. Chyzeri to a group with polished integuments, almost simple bristles, nongranulate tergites, and with a tactile hair near extremity of tibia IV.; the animal is closely allied to C. nodosus, but is much larger and well-distinguished by its short, excessively robust, palps (a comparison of which with fig. 1 would at once disclose a want of identity); as suggested by Mr. Cambridge (33)—the writer is indebted to him for an opportunity of examining one of the specimens—it is likely to have been imported with material used in the mill; it is certainly foreign to our fauna.

<sup>&</sup>lt;sup>2</sup> With regard to the characters given throughout for the species, it should be mentioned that the coloration indicated is that of the mature animal during life seen in a strong light against an opaque background; the colours, more especially of Hemictenodactyli, are soon altered in spirit. The length of the body, from the anterior margin of the head to the posterior extremity of the abdomen, is given in millimetres and tenths; but, from the extensible character of the abdomen, these measurements are valueless in themselves; they are intended to give an idea of the relative size of the animals. This character of the abdomen must be borne in mind also when comparing the drawings which are intended primarily to illustrate the general shape of the palp; they are made from spirit-specimens, and while some of the tactile or pseudo-tacticle hairs are shown, all the bristles are omitted. As regards the indications of distribution, specimens have been seen by the writer from all the districts named, except in the few cases in which italic type is used.

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sclerites near inner margin with 1-3 bristles in front of row, tergite-sternite XI. each with two pairs of tactile hairs, tergite with inner pair considerably shorter than outer; galea (?) well-developed, branching from short base, branches simple rather long; palps (fig. 1) trochanter with upper protuberance distinctly dorsal, lower protuberance alone projecting posteriorly, its proximoposterior corner moderately prominent but distinctly rounded, tibia strongly convex in front, hand (9) moderately broad obliquely high, anterior margin of fingers with an isolated accessory tooth; the palp is granulate, at least in front, with small part of femur and great part of tibia and hand smooth; lower face of maxillae smooth; coxae IV. ( 2 ) short and broad, inner margin longer than posterior; legs IV. tibia with tactile hair near extremity (shorter than that of tarsus), tactile hair of tarsus about  $\frac{1}{3}$  removed from base. J with galea poorly developed, hand somewhat narrower with less oblique height, coxae IV. differing little from 2. L. 1.7.

Among vegetable refuse; in cucumber-frames, manure-heaps, &c.; widely distributed and common in Britain; probably also in Ireland, but not yet recorded; seizes flies and often comes to notice on their legs in autumn; a mysterious animal of which males are seldom seen.

(26, 33, 42, 49, 84-5.)

### C. Godfreyi sp. nov.

Palps and cephalothorax reddish-brown, abdominal tergites olive-horny; glossy, with nearly simple bristles. Cephalothorax weakly granulate at sides and over part of dorsum of thorax, dorsum of head non-granulate, second groove scarcely perceptible or absent; abdominal tergites non-granulate reticulate, scar-spots indistinct, main sclerites near inner margin with 1 bristle in front of row, tergite-sternite XI. each with two pairs of tactile hairs, tergite with inner pair not greatly shorter than outer; galea (?) welldeveloped, branching from short base, branches simple rather long; palps (fig. 2) trochanter as in preceding species, tibia less strongly convex in front, hand (?) with somewhat less oblique height, anterior margin of fingers with an isolated accessory tooth; the palp is granulate, at least in front, with small part of femur and great part of tibia and hand smooth; lower face of maxillae smooth; coxae IV. (?) short and broad, inner margin longer than posterior; legs IV. tibia with tactile hair near extremity (as long or almost as long as that of tarsus), tactile hair of tarsus further from base than in preceding species : taking only dorsal margin about in middle. J with galea poorly developed, hand somewhat narrower with less oblique height (?), coxae IV. differing little from 2. L. 1.6.

In manure-heaps: Petersham; Newport, Isle of Wight (E. A. Butler); among moss: Oban (C. D. Soar); on flies' legs: South Norwood 1 (H. Hill); Hatfield (F. G. Pitts); Rathmines, Co. Dublin (N. E. Stephens).

<sup>1</sup> Recorded as C. nodosus (75, 87).

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# C. Chyzeri (Töm.).

Chernes Chyzeri Töm. 1882 (29). Chelifer Chyzeri (Töm.). Ell. 1907 (75).

Palps and cephalothorax reddish-brown, abdominal tergites olive-horny; glossy, with nearly simple bristles. Cephalothorax granulate at sides and weakly so over dorsum of thorax, dorsum of head scarcely granulate, second groove perceptibly indicated; abdominal tergites non-granulate, rather strongly reticulate, scar-spots indistinct, tergite-sternite XI. each with 2 pairs of tactile hairs; galea ( $\mathfrak{P}$ )?; palps (fig. 3) trochanter with both upper and lower protuberances much developed, both projecting posteriorly, and both with marked proximo-posterior corner, which in lower protuberance is little if at all rounded; anterior margin of fingers with an isolated accessory tooth; the palp is granulate, with small part of femur and part of tibia and hand smooth or nearly so; lower face of maxillae smooth; coxae IV. ( $\mathfrak{P}$ ) moderately short and broad; legs IV. tibia with tactile hair near extremity, tactile hair of tarsus about  $\frac{1}{3}$  removed from base.  $\mathfrak{F}$  with galea moderately developed, hand somewhat narrower and lower(?), coxae IV. differing little from  $\mathfrak{P}$ . L 1%.

Under bark of an old stump of beech: Burnham Beeches, 1905. (75.)

# C. scorpioides Herm.

Chelifer scorpioides Herm. 1804 (8)?. Chernes phaleratus (Simon) Camb. 1892 (42); by mistake. Chernes minutus Ell. 1896 (45). Chelifer scorpioides (Herm.-Töm.) Ell. 1907 (75).

Palps and cephalothorax reddish-brown, abdominal tergites horny-brown; dull or nearly so, with clavate and toothed bristles. Cephalothorax granulate, both grooves distinct; abdominal tergites granulate with moderately long distinctly clavate bristles, scar-spots indistinct, interstitial membrane of dorsum wrinkled, sternites with bristles simple or nearly so, tergite XI. with 1 pair sternite XI. with 2 pairs of tactile hairs; galea ( $\mathfrak{P}$ ) well-developed, stagshornlike, branching from short broad base, branches re-dividing; palps (fig. 4) rather stout, tibia strongly convex in front, anterior margin of fingers with an isolated accessory tooth; the palp is granulate all round, including hand, fingers granulate; bristles of front of femur moderately long, a little clavate; lower face of maxillae weakly granulate; coxae IV. ( $\mathfrak{P}$ ) short and broad, inner margin as long as or longer than posterior; legs IV. tibia without tactile hair, tactile hair of tarsus near middle.  $\mathfrak{F}$  with galea poorly developed, hand a little narrower, coxae IV. differing little from  $\mathfrak{P}$ . L. 1.7.

Among vegetable refuse, in rubbish-heaps, etc.; sometimes abundant; probably widely distributed: Essex, Kent, Surrey, Sussex; also about decaying trees: New Forest (W. F. Blandford and the writer); in nests of *Formica rufa*: Buddon Wood and Weybridge (H. Donisthorpe); in nest of *Bombus muscorum*: one (W. H. Tuck, Bury St. Edmund's).

<sup>(42, 72, 75, 79, 95.)</sup> 

#### C. dubius (Camb.).

Chernes dubius Camb. 1892 (42).<sup>1</sup> Chelifer Tullgreni Strand 1900 (47). Chelifer dubius (Camb.) Ell. 1907 (75).

Palps reddish-brown, cephalothorax and abdominal tergites rather pale horny, the former more or less reddish; dull or nearly so, with clavate and toothed bristles. Cephalothorax granulate, second groove indistinct; abdominal tergites granulate with short distinctly clavate bristles, scar-spots indistinct, interstitial membrane of dorsum wrinkled, sternites with bristles simple or nearly so, tergite XI. with 1 pair sternite XI. with 2 pairs of tactile hairs; galea ( $\mathfrak{P}$ ) branching from short base (branches sometimes re-dividing), less robust and smaller than in last species; palps (fig. 5) rather slender, femur rising but little and obliquely from its stalk, tibia moderately convex in front, anterior margin of fingers with an isolated accessory tooth; the palp is granulate nearly all round, hand weakly so (fingers not granulate); bristles of front of femur rather short, moderately clavate; lower face of maxillae weakly granulate; coxae IV. ( $\mathfrak{P}$ ) short and broad, inner margin as long as posterior; legs IV. tibia and tarsus without tactile hairs.  $\mathfrak{F}$  with galea poorly developed, hand a little narrower, coxae IV. differing little from  $\mathfrak{P}$ . L. 1.6.

Under embedded stones in unbroken country and near the sea; less commonly under loose stones and among débris; widely distributed: Ross-shire, Fifeshire, East and West Lothian, Cumberland, Berkshire, Dorsetshire. Also in Sussex and in many places in Kent and Surrey, e.g. on wooded chalky hill-sides, under firmly-placed flints. Mr. Godfrey found it in numbers on the shores of the Forth almost within reach of the tides. Ireland: Co. Wicklow (?) (92).

(42, 55, 57, 70, 75, 85.)

### C. Wideri C. L. Koch.

Chelifer Wideri C. L. Koch 1843 (17). Chernes Wideri (C. L. Koch) L. Koch 1873 (24). Chelifer phaleratus Simon 1879 (27)?

Palps and cephalothorax red-brown, abdominal tergites yellowish-brown; dull or nearly so, with clavate and toothed bristles. Cephalothorax strongly granulate, both grooves distinct; abdominal tergites granulate with short strongly clavate bristles, scar-spots moderately distinct, interstitial membrane of dorsum wrinkled almost granulate, bristles of sternites VII.-XI. clavate, tergite-sternite XI. without tactile hairs; galea ( $\mathfrak{P}$ ) moderately long, distally with small processes; palps (fig. 6) femur rather robust, tibia rising gently from stalk and only a little convex in front, hand rather narrow nearly parallel descending rapidly to fingers, anterior margin of fingers with an isolated accessory tooth; the palp is strongly granulate (hand a triffe less so); bristles of palp short, for most part rather strongly clavate; lower face of maxillae granulate; coxae IV. ( $\mathfrak{P}$ ) broad, posterior margin longer than inner; legs IV.

<sup>&</sup>lt;sup>1</sup> Mr. Cambridge has permitted me to examine the type from Glanville's Wootton.

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tibia and tarsus without tactile hairs.  $\sigma$  with galea poorly developed; palps (particularly femur) more robust, hand slightly broader and higher and slightly shorter, fingers closing with wider gape; coxae IV. somewhat less broad at base, posterior margin longer in proportion to inner. L. 2.3.

Under bark of old oak-trees: Sherwood Forest; West Wickham Common, Kent; Richmond Park, Surrey; found also at Ewhurst, Surrey, under a stone in the floor of a cow-shed (Aird Whyte). (75, 87.)

### C. Panzeri C. L. Koch.

Chelifer Panzeri C. L. Koch 1836 (15). Chelifer cimicoides (Fabr.) Hansen 1884-5 (34, 35).<sup>1</sup> Chernes rufeolus (Simon) Camb. 1905 (64).

Palps and cephalothorax red-brown, abdominal tergites horny-brown: dull or nearly so, with clavate and toothed bristles. Cephalothorax granulate. broadly rounded in front, a little broader in middle than behind, both grooves distinct; abdominal tergites granulate, with rather strongly clavate bristles, scar-spots distinct, interstitial membrane of dorsum granulate, sternites with bristles mostly simple, in part weakly clavate, tergite XI. with 1 pair sternite XI. with 2 pairs of tactile hairs; galea (?) rather long and stout, its distal <sup>2</sup>/<sub>3</sub>rds with small processes; palps (fig. 7) robust, femur rising almost perpendicularly from stalk with an abrupt corner, tibia with moderate anterio-proximal convexity, hand rising very abruptly from stalk, rather broad and obliquely high, but with rather gradual descent to fingers, anterior margin of fingers with a series of accessory teeth; granulation of palp not strong, evident in front and over part of upper surface, elsewhere including most of hand obscured, the surface with a roughened encrusted appearance; bristles of palp of moderate length, in great part distinctly clavate; lower face of maxillæ nearly smooth; coxae IV. ( ? ) broad, posterior margin longer than inner; legs IV. tibia without tactile hair, tactile hair of tarsus short about  $\frac{3}{4}$  $\mathcal{F}$  with galea a little smaller; palps altogether more removed from base. robust, hand broader with greater oblique height, fingers closing with wider gape; coxae IV. widening from narrower base, posterior margin somewhat more than twice as long as inner. L. 2.6.

In old stables, cow-sheds, barns, etc., under bricks and stones in the floors, beneath accumulated refuse of old hay, etc.; also in old breweries,<sup>2</sup> granaries, etc.; widely distributed and common in Britain; probably also in Ireland, but not yet recorded; researches of Dr. Joy showed this species to live also in hollow trees about old nests of owls, starlings, etc.

<sup>(64, 70, 75, 77-9, 85.)</sup> 

<sup>&</sup>lt;sup>1</sup> An examination of Hansen's specimens, made by Mr. With, showed them to belong to the present species.

<sup>&</sup>lt;sup>2</sup> This animal, which has only recently figured in our lists, was the subject of interesting observations by S. J. McIntire (21-3) published as long ago as 1868-1871; he obtained specimens from a brewery at Theale, and deposited one of them with the Quekett Microscopical Club.

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# C. Cyrneus (L. Koch).

Chernes Cyrneus L. Koch 1873 (24). Chelifer cyrneus (L. Koch) Simon 1879 (27).

Palps deep rich red-brown, stalks and extremities distinctly reddish, otherwise very dark, hand often almost or quite black; cephalothorax and abdominal tergites dark reddish- or olive-brown approaching black; interstitial membrane greyish-white; legs brownish-yellow; dull or nearly so, except greater part of palp which is brilliantly glossy; bristles somewhat clavate and toothed. Cephalothorax granulate, broadest in middle, posteriorly with membrane exposed on either side, both grooves distinct; abdominal tergites granulate, bristles not strongly clavate, scar-spots distinct, interstitial membrane of dorsum granulate, sternites with bristles simple or nearly so, tergite XI. with 1 pair sternite XI. with 2 pairs of tactile hairs; galea ( 2 ) with long stout shaft and small distally placed processes; palps (fig. 8) exceedingly robust, hand of great size, broad and obliquely high, with stout rather short fingers. anterior margin of fingers with a series of accessory teeth; trochanter, front and upper surface of femur, front of tibia and part of front of hand granulate, elsewhere with obsolete granulation or smooth; bristles of palp non-clavate, minutely toothed; lower face of maxillae nearly smooth; coxae IV. ( 2 ) broad, posterior margin longer than inner; legs IV. tibia without tactile hair, tactile hair of tarsus about  $\frac{3}{4}$  removed from base. 3 with galea scarcely differing from **9**; hand somewhat higher; coxae IV. somewhat narrower at base, posterior margin a little more than  $\frac{1}{2}$  as long again as inner. L. 3.6.

Under rather close-fitting bark or dead or partly dead oak-trees: Sherwood Forest; Richmond Park, Surrey; Windsor Forest? (16).

(64, 68, 76, 80).

#### C. cimicoides (Fabr.)

Scorpio cimicoides Fabr. 1793 (5)? Chelifer Olfersii Leach 1817 (13)? Chelifer Geoffroyi Leach 1817 (13). Chernes cimicoides (Fabr.) Camb. 1892 (42). Chelifer cimicoides (Fabr.) Ell. 1907 (75).<sup>1</sup>

Palps dark red-brown, cephalothorax reddish- or horny-brown, abdominal tergites horny-brown; dull or nearly so, with conspicuous clavate and toothed bristles. Cephalothorax broadest behind, head and first thoracic tergite with honey-comb sculpture, second thoracic tergite granulate, both grooves distinct; abdominal tergites granulate, with rather long very strongly clavate bristles, scar-spots distinct, interstitial membrane of dorsum 'granulate, sternites with bristles simple or nearly so, tergite XI. with 1 pair sternite XI. with 2 pairs

<sup>&</sup>lt;sup>1</sup> C. cimicoides (Fabr.) Menge 1855 (20) and C. cimicoides (Fabr.) Simon 1879 (27) are doubtful; that of Canestrini 1883 (32) = C. scorpioides?; that of Hansen 1884-5 (34, 35) = C. Panzeri,

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of tactile hairs; galea ( $\mathfrak{P}$ ) rather stout, moderately long, its distal  $\frac{1}{2}$  with small processes; palps (fig. 9) moderately robust, hand broad with moderate oblique height, anterior margin of fingers with a series of accessory teeth; sculpture of palp honey-comb-like, bristles rather long, in great part very strongly clavate; lower face of maxillae nearly smooth; coxae IV. ( $\mathfrak{P}$ ) broad, posterior margin longer than inner; legs IV. tibia and tarsus without tactile hairs.  $\mathfrak{F}$  with galea a little smaller; hand more robust, slightly shorter; coxae IV. widening from narrower base, posterior margin about  $2\frac{1}{3}$  as long as inner. L. 2.5.

Under rather close-fitting bark of dead or partly dead trees, oak, beech, hornbeam, etc.; abundant in the south-east: Epping Forest, Windsor Forest, Burnham Beeches, Richmond Park, West Wickham Common (Kent), Ashtead Forest, Dallington Forest, New Forest, etc.; under bark of old willows by river-sides: Thames, Lea, etc.; also in *Devonshire*, *Dorsetshire*, *Wiltshire*, Cambridgeshire, Cheshire, Lincolnshire, and in Sherwood Forest; but not recorded from north of the Mersey and Humber.

(42, 58, 80, 84, 87-8.)

### II. Chelifer s.s.

Legs I. with articulation between trochantin and femur wide, oblique; fingers of palps without accessory teeth;  $\mathcal{J}$  with coxal sac, genital-area complex, with plate II. much longer than plate I., and with long ram's-horn organs. Eyes 2.

(Britannic species 2: abdomen with tergite XI. divided like those in front of it, main tergites generally with 6 bristles in front of the posterior marginal row; palps only moderately robust or long and slender, femur increasing gradually from stalk and not attaining full breadth till near extremity, tibia without marked anterio-proximal convexity, hand more or less oval;  $\mathcal{J}$  with genital-area and secondary characters conspicuous,<sup>1</sup> the ram's-horn organs protrusible in forward lateral direction far beyond trochanters of palps, coxae IV. strongly concave posteriorly, much modified.)

1.	Claws simple		•	•	•	•	Latreillii.
2.	Claws with a to	oth				•	cancroides.

# C. Latreillii Leach.

# C. Latreillii Leach 1817 (13). C. DeGeeri (C. L. Koch) Simon 1879 (27).

**?** Palps dark reddish-brown, stalks and extremities distinctly reddish, otherwise darkened with olive, hand nearly black with dark reddish fingers; cephalothorax dark reddish-brown, anteriorly obscured with olive nearly black; abdominal tergites horny-brown, with large dark brown scar-spots; dull or nearly so, with short obtuse non-clavate bristles. Cephalothorax strongly granulate, not surcharged with bristle-tubercles, first

<sup>&</sup>lt;sup>1</sup> Lophochernes Simon 1878 (25) = Chelifer s.s.  $\mathcal{J}$  with secondary characters much pronounced.

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groove narrow with deep suture, second moderately impressed without distinct suture; eyes convex, smooth, well-limited; abdominal tergites rather strongly granulate, all divided, tergite-sternite XI. each with 1 pair of tactile hairs; galea rather short, distal  $\frac{1}{2}$  with rather short processes; palps (fig. 10) only moderately slender, tibia distinctly convex in front, fingers rather strongly curved; the palp is granulate all round including hand; coxae IV. with posterior margin nearly straight, somewhat more than  $\frac{1}{2}$  as long again as inner; legs IV. tarsus without tactile hair; claws simple. L. 2.9.

♂ Abdominal sternites much more developed, that of somite IV. strong; galea smaller, processes minute or absent; palps with hand somewhat smaller, fingers closing with wider gape; coxae IV. with posterior margin strongly concave, twice as long as inner; legs I. greatly strengthened, with humpbacked tarsus and greatly enlarged claws, posterior claw of peculiar shape with oddly turned extremity and with a process along its anterior margin.

(28, 30, 37, 48-9, 58, 63, 75, 79, 85, 89.)

#### C. cancroides (Linn.)

Acarus cancroides Linn. 1758 (2).<sup>1</sup> C. Hermanni Leach 1817 (13). C. cancroides (Linn.) Simon 1879 (27). C. granulatus (C. L. Koch) Hansen 1884-5 (34, 35).

Palps somewhat reddish- or tawny-brown sometimes faintly tinged with olive, cephalothorax darker reddish- or olive-brown, abdominal tergites paler brownish- or olive-horny with moderately conspicuous scar-spots; dull or nearly so, with short, clavate bristles. Cephalothorax strongly granulate surcharged with bristle-tubercles at least towards sides, second groove more impressed than first both with distinct suture; eyes convex, not quite free from granulation towards margin; abdominal tergites rather strongly granulate, all divided, tergite XI. without tactile hairs, sternite XI. with 1 pair; galea rather short, distally with short processes; palps (fig. 11) long and slender, tibia almost straight in front, fingers long gently curved; the palp is granulate all round as far as extremity of tibia, hand with peculiar minute sculpture, dorso-posteriorly trochanter has a few bristle-tubercles and femur a few inconspicuous ones in similar position

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Always maritime in Britain, and as far as known at present confined to the east and south. Fifeshire and East Lothian: plentiful along the shores of the Forth in rock-crevices and under stones. Yorkshire, Lincolnshire, Norfolk, Kent, and Sussex: plentiful on the coast saud-hills, making its home for the most part in old sheathing bases of marram-grass (*Ammophila arenaria*), sometimes under bark of old stumps of sea-buckthorn and elder, and often found sheltering under pieces of wood, etc., on the sand. Dorsetshire? (42).

<sup>&</sup>lt;sup>1</sup> Acarus cancroides Linn. 1758, Phalangium cancroides Linn. 1767, Scorpio cancroides (Linn.) Fabr. 1775, Chelifer cancroides (Linn.) Fourcroy 1785, Obisium cancroides (Linn.) Illiger 1798, Opisium cancroides (Linn.) Illiger 1807.

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along basal half; coxae IV. with posterior margin nearly straight, twice as long as inner; legs IV. tarsus with tactile hair near extremity; claws with a tooth. L. 3.2.

 $\mathcal{S}$  Abdominal sternites more developed, that of somite IV. strong; cephalothorax with bristle-tubercles a little more marked; anterior abdominal tergites strengthened, I.-III. almost without median division, resembling those of thorax; posterior thoracic tergite and anterior abdominal tergites with strong lateral keels produced posteriorly into a stout spinelike tubercle, and below with margin deflected perpendicularly; these features strongly marked as far as abdominal tergite V. or VI. thence decreasing towards IX. or X.; galea smaller; palps with hand slightly smaller, fingers closing with wider gape; coxae IV. with stout anterio-dorsal tubercle, posterior margin strongly concave, four times as long as inner; legs I. with tarsus a little strengthened, its claws slightly enlarged, posterior claw of peculiar shape with strong basal part and with slender distal part running off at an angle, at extremity of basal part a sharp tooth.

In old buildings, corn-stores, bakeries, stables, lofts, etc.; long established, but doubtfully indigenous: London and Westminster, Manchester, Glasgow, Edmonton, Grays, Polegate; Limerick.

(42, 74-5, 83, 85, 92.)

#### III. Withius sub-gen. nov.

Legs I. with articulation between trochantin and femur rather narrow almost perpendicular; fingers of palps without accessory teeth;  $\mathcal{J}$  without coxal sac, genital-area simple, with plate II. generally a little longer than plate I., without ram's-horn organs. Eyes 2 (in Britannic species).

(Britannic species 1: abdomen with tergites all divided, I. and XI. sometimes incompletely; main tergites generally with 6 bristles in front of the posterior marginal row; palps of distinctive shape, elongated in  $\mathcal{J}$ ;  $\mathcal{J}$  with genital-area inconspicuous, with secondary characters including remarkable bristle-areas of sternites well-marked, and with coxae IV. nearly straight posteriorly, but little modified.)<sup>1</sup>

#### C. subruber Sim.

#### C. subruber Sim. 1879 (27).

**?** Palps clear reddish-brown, cephalothorax reddish horny-brown, abdominal tergites horny-brown with darker scar-spots and paler bristle-

<sup>&</sup>lt;sup>1</sup> Sub-gen. Withius (of which our species is the type) is widely distributed and has many species, mostly distinguishable at a glance by their general appearance; sternal bristle-areas in  $\mathcal{S}$ , though subject to modification, are probably common to all; elongation of the palp of the  $\mathcal{S}$  is also general, and may, e.g. in *C. longichelifer* Balz., be strikingly marked. Cf. With (66, 82).

bases; mostly dull or nearly so, part of hand glossy; bristles moderately long more or less clavate. Cephalothorax strongly granulate, both grooves distinct; eyes convex, well-limited, nearly smooth; abdominal tergites rather strongly granulate, tergite XI. with 1 pair sternite XI. with 2 pairs of tactile hairs; galea of moderate length, distally with short processes; palps (fig. 12) trochanter with upper protuberance high inclining backwards, femur increasing obliquely but rather rapidly from stalk and soon attaining full breadth, tibia without marked anterio-proximal convexity, becoming broad towards middle and beyond, hand relatively only moderately broad, fingers shorter than hand; the palp is granulate all round, hand and lower surface less distinctly so, lower surface of hand nearly smooth; coxae IV. with posterior margin almost straight, not twice as long as inner; legs IV. tarsus with tactile hair some way beyond middle. L. 2.5.

3 Abdominal tergites somewhat more developed; sternites (IV.) V.-IX. with well-defined inner-posterior areas furnished with a great number of closely placed minute bristles, occupying at median line posterior two-thirds and extending to about middle of posterior margin of each sclerite; galea much smaller; palps somewhat longer, trochanter with protuberance more developed, tibia noticeably elongated with more evident concavity beyond stalk behind, hand narrower and a little longer, fingers a little longer, with scarcely wider gape; coxae IV. somewhat narrower at base, posterior margin scarcely if at all concave.

Among refuse, in buildings and in the open, in the south of England; almost certainly imported; Mr. Cambridge received it in 1880 from an oil-mill at Dover and from near Plymouth, in 1886 from an old building at Hyde, Dorsetshire,<sup>1</sup> and in 1905 from Sheppey, where Mr. Donisthorpe found it in a heap of refuse of sugar- and rice-gunnies, etc., and in this place the writer saw it two years later in great plenty; Hendon (1908), in a manure-heap (E. A. Butler).<sup>2</sup>

(33, 42, 67.)

### Cheiridium.

### Cheiridium Menge 1855 (20).

Legs I. with femur entire or with indistinct trochantin, never with wellseparated trochantin and femur; legs IV. with femur entire. Cephalothorax with head distinctly marked off; thorax without groove. Abdominal somite XI. with tergite visible or invisible from above, its sternite with semi-circular incision for somite XII. which is almost or quite ventral. Bristles sickleshaped, one-toothed. Eyes 2, well removed from anterior margin of head.

<sup>&</sup>lt;sup>1</sup> Recorded as C. peculiaris L. Koch; by mistake (38).

 $<sup>^2</sup>$  Our specimens are identical, as Mr. With has ascertained, with those of Hansen found in Denmark in rice-warehouses and in ships with sugar and rice from the East (34, 35, 66).

#### C. museorum (Leach).

Chelifer museorum Leach 1817 (13). Cheiridium museorum (Leach) Menge 1855 (20).

Palps and cephalothorax rather richly reddish-brown, thorax a little less dark, abdominal tergites becoming rather richly amber-brown; dull or nearly so, with small whitish bristles. Head narrow in front, broadened out and raised towards base with two lateral and two dorso-lateral elevations, closely granulate; eyes convex, smooth, well-limited, far removed from anterior and some distance from lateral margin; thoracic tergite much broader behind than in front, with median circular depression; abdomen broad, tergites I.-X. divided, XI. invisible from above, undivided; thoracic tergite, abdominal tergites, and interstitial membrane of dorsum strongly granulate, with large remote granules, in great part with low ridges running from one to another; galea (?) moderately long, distally with minute processes; palps (fig. 13) trochanter abruptly broadened from stalk, its lower protuberance basal much produced posteriorly, femur increasing obliquely from stalk, not broader near base than near extremity; the palp is granulate, tibia and hand rather weakly so; coxae IV. (?) long, slightly concave behind and a little widened to a moderate corner towards extremity. J with galea much smaller; coxae IV. more concave behind and widened to a prominent corner towards extremity; genital plates and sternites behind them strongly developed. L. 1.1.<sup>1</sup>

In old stables, cow-sheds, barns, hay-lofts, meal- and flour-mills, etc., behind the boards, under stones on the floors, and among débris; in old houses in crevices of wood-work, behind wall-paper, in cases of stuffed birds, etc.; also in old nests of birds in walls and hollow trees; and sometimes under close-fitting bark of dead trees; generally distributed and abundant in Britain. Ireland: Co. Dublin (R. F. Scharff).

(1, 11, 13, 42, 69, 70, 75, 79, 81, 85, 87, 92.)

# II. Hemictenodactyli.

Chelicerae large; serrula free distally; lamina exterior only exceptionally present; often without galea. Cephalothorax with anterior median process or marginal serration; never with grooves limiting head and thoracic somites. Abdominal somite XI. with tergite and sternite fused.

(Galea absent in all but one and lamina exterior absent in all Britannic forms; in these, and generally, lamina interior serrula-like; maxillae with ventral face in higher plane than that of coxae; cephalothorax broadly truncate in front; abdominal tergites without median division; body more

<sup>&</sup>lt;sup>1</sup> C. ferum Sim. (found as near to us as northern Brittany) has the head only slightly broadened out and raised towards base, abdominal tergite XI. visible from above, femur of palps increasing abruptly from stalk and broader near base than elsewhere;  $\varphi$  with remarkable triple galea,

or less cylindrical, with dermo-skeleton less solid than in Panctenodactyli, polished, largely free from heavy sculpture; bristles simple.)

1.	Legs I. with tarsi 2-jointed			Obisiidae.
2.	Legs I. with tarsi 1-jointed	•	•	Chthoniidae.

### OBISIIDAE.

All legs with tarsi 2-jointed; femur of legs I, with longer pars basalis and shorter pars tibialis; legs IV, with articulation between trochantin and femur alike on anterior and posterior faces. Cephalothorax with anterior median process; not serrated. Eyes 4, 2 or 0.

#### Obisium.

#### Obisium (Illiger) Leach 1815 (12).<sup>1</sup>

Cephalothorax broad in front, not broader in front than behind. Palps with fingers always more or less curved, hand without dorsal tactile hairs or with one or several, tibia never caliciform. Galea present or absent. Eyes 4, 2, or 0.

Britannic species with eyes 4 or 2, never with dorsal tactile hairs on hand. All intensely glossy, with bristles long slender and unequal; granulation may occur on palps, but not on cephalothorax or abdomen; abdomen with lateral membrane sharply papillate; fused tergite-sternite of somite XI, with perforation for somite XII, terminal or sub-ventral, well-removed from anterior ventral margin; somite XII. with separate tergite and sternite each with 2 bristles; chelicerae moderately large; hand of palps with abruptly limited stalk ; teeth of both fingers in close-set row, of movable finger for most part truncate or broadly rounded off, of fixed finger generally acute; femora of legs III. and IV. deep or moderately deep; in legs III. posterior face of femur, at least in 4-eyed species, with low papillation; coxae I, with outer anterior corner prolonged into a point and with a more or less obsolete point of different character at inner anterior corner; 3 with genital-area inconspicuous; compared with 9 generally with hand less voluminous, fingers a little longer in proportion to hand, and sometimes with tibia a little longer-stalked and narrower.)

1.	Chelicerae	with	galea		•				Ide	orono	us.	
	Chelicerae	with	but ga	lea		•						2
2.	Eyes 2		•	•			•	•		Rone	eus.	
3,	Eyes 4	•	•	•	٠	•	•		Obis	ium s	8.S. <sup>2</sup>	

<sup>1</sup> Obisium Illiger (6, was a synonym of *Chelifer*; but was adopted by Leach (12) for the present genus; = *Opisium* misprinted (10).

<sup>2</sup> Sub-gen. Ideobisium with galea and 4 eyes is unrepresented in our fauna: as also are the eyeless sub-gen. Blothrus and Ideoblothrus.

#### I. Ideoroncus Balzan 1890 (40).

Chelicerae with galea; eyes 2.

### 0. Cambridgii (L. Koch).

Roncus Cambridgii L. Koch 1873 (24). O. Cambridgei (L. Koch) Simon 1879 (27).<sup>1</sup> Ideoroneus Cambridgei (L. Koch) With 1907 (73). Ideobisium Cambridgii (L. Koch) Ell. 1907 (75).

Palps reddish-brown, cephalothorax reddish-brown tinged with olive, abdominal tergites olive-horny. Cephalothorax with median process obtuse only a little produced, dorsum smooth or in part slightly reticulate; abdominal tergites slightly reticulate; galea with stout stem divided distally into several short branches; palps (fig. 14) with femur short and stout distinctly stalked and slightly broader near base than near extremity, tibia rather long-stalked afterwards convex anterio-ventrally and very moderately so dorsally, fingers about as long as hand; femur tibia and hand in part granulate more especially in front and to somewhat less extent above, the granules on femur and part of hand well-pronounced. L.  $2\cdot3$ .

Under stones and among débris, in the open and in woods, on and near the coast and a little distance inland; western in distribution, but plentiful where it occurs: Ross-shire, Argyllshire, Arran, Ayrshire, Kirkcudbrightshire; Cornwall, Devonshire, Dorsetshire; Isle of Wight. (42, 50, 56, 59, 69, 71, 85-6.)

# II. Roncus L. Koch 1873 (24).

Chelicerae without galea; eyes 2.

### 0. lubricum (L. Koch).

Roncus lubricus L. Koch 1873 (24). O. lubricum (L. Koch) Simon 1879 (27).

Palps reddish-horny, cephalothorax olive-horny somewhat reddish, abdominal tergites olive-horny. Cephalothorax with median process acute well-produced, dorsun smooth; abdominal tergites smooth or laterally slightly reticulate; chelicerae with tubercle of movable finger small; palps (fig. 15) with femur longer and less robust than in last species with only moderately differentiated stalk and only slightly or not broader near base than near extremity, tibia rather long-stalked afterwards convex anterio-ventrally and nearly flat dorsally, fingers longer than hand; femur granulate in front and to less extent above, hand granulate in part, tibia smooth. L. 2.5.

Under stones, bricks, etc.; at the roots of grass, among moss, etc.; perhaps only in the southeast and south: Kent, Sussex, Surrey, Berkshire, Middlesex, Essex; *Cambridgeshire; Dorsetshire*, Devonshire; not recorded from north-west of the Severn and Wash.

(42, 60, 79, 87.)

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<sup>&</sup>lt;sup>1</sup> Simon by accident gives under this name the description of *O. lubricum* and vice versa; the localities and other particulars, however, do not appear to be transposed.

### III. Obisium s.s.

Chelicerae without galea; eyes 4.

(Britannic species 3: dorsum of cephalothorax, abdominal tergites, femur and tibia of palps smooth; hand in part smooth in part obsolete-granulate. Eyes well-developed, near together and somewhat tilted on common raised base; between them and partly round the first a blackish patch; chelicerae with tubercle of movable finger well-developed, differing according to species, and generally larger in  $\mathfrak{P}$  than in  $\mathfrak{F}$ ; femur of palps with scarcely differentiated stalk.)

1.	Cephalothorax with median proce	ess o	bsolete	9	. muscorum.	
	Cephalothorax with median proce	ess p	$\operatorname{romin}$	${}^{\mathrm{ent}}$		2
2.	Fingers longer than hand .	•			. Carpenteri.	
3,	Fingers scarcely as long as hand				maritimum.1	

## 0. muscorum Leach.

O. museorum Leach 1817 (13). O. simile (L. Koch) Simon 1879 (27); in part.<sup>2</sup>

Palps clear reddish-horny, cephalothorax and abdominal tergites deep olive, the former with reddish tinge, legs horny. Cephalothorax with median process obsolete; chelicerae with tubercle of movable finger ( $\mathfrak{q}$ ) high almost semi-circular, teeth of fixed finger small; palps (fig. 16) with femur almost equally broad near base and near extremity, towards middle distinctly concave behind with corresponding convexity in front, tibia scarcely or not broader than femur, membranous opening about  $\frac{1}{2}$  front margin (stalk excluded), hand variable more or less tumid and of only moderate length (in  $\mathfrak{q}$  more voluminous than in  $\mathfrak{F}$ ), fingers much longer than hand, teeth of fixed finger slightly tapering and rounded at tip with broader higher sharply pointed ones at intervals, teeth of movable finger distinct; legs IV, with tarsus<sup>2</sup> much longer than tarsus<sup>1</sup> (at least 1·3). L. 2·8.

Under stones, among dead leaves, moss, etc., in the open and in woods, from sea-level to 3,500 ft.; generally distributed and abundant in Britain and Ireland.

(13, 42, 44, 51, 58, 65, 70-1, 75, 79, 85, 87, 91-2, 94.)

<sup>&</sup>lt;sup>1</sup> O. sylvaticum C. L. Koch has by mistake been recorded as British (42); the specimen, disfigured in preparation for the microscope, was in reality O. lubricum. Records of O. simile L. Koch in Britain (30, 36) are also erroneous; they relate to O. muscorum.

<sup>&</sup>lt;sup>2</sup> That the present species is *O. muscorum* Leach is sure from the type which is preserved in the British Museum, where it has been examined by Cambridge (42) and by the writer (94). Simon confused this animal with *O. simile* L. Koch; and has unfortunately applied Leach's name to another species, i.e. *O. Carpenteri*. In spite of this fact, however, the *O. muscorum* Leach of most writers appears to be correctly named; and this is certainly the case with Hansen (34), Tullgren (46), With (66), and Ellingsen (75). The writer is indebted to M. Simon for specimens from his collection of "*O. simile*" (*O. simile* L. Koch and *O. muscorum* Leach) and "*O. muscorum*" (*O. Carpenteri*).

### 0. Carpenteri nom. nov.

O. muscorum (Leach) Simon 1879 (27); by mistake. O. Carpenteri nom. nov. 1910 (94).

Palps reddish-horny, perhaps tinged with olive, cephalothorax and abdominal tergites deep olive, the former with reddish tinge, legs horny. Cephalothorax with median process prominent; chelicerae with tubercle of movable finger moderately high convex, teeth of fixed finger rather small; palps (fig. 17) with femur increasing slightly in breadth from near base to near extremity, towards middle slightly concave behind and with corresponding slight convexity in front, tibia distinctly but not greatly broader than distal part of femur, membranous opening about  $\frac{1}{2}$  front margin (stalk excluded), hand rather long and broad (in  $\mathfrak{P}$  distinctly voluminous), fingers longer than hand, teeth of fixed finger abruptly pointed uniform (without larger ones at intervals), teeth of movable finger in most part almost obsolete; legs IV. with tarsus<sup>2</sup> scarcely longer than tarsus<sup>1</sup>. L. 3<sup>.3</sup>.

Ireland: Glengariff, Co. Cork, 1909-10; on a rocky wooded hill-side, under the flaking outer-bark of Arbutus-trees, in rock-crevices, and among dead leaves. Unknown in Britain.

(93-4.)

# 0. maritimum Leach.

O. maritimum Leach 1817 (13). O. littorale Moniez 1890 (39).

Palps rich horny-brown (not reddish), cephalothorax and abdominal tergites deep olive-horny, legs greenish. Cephalothorax with median process prominent; chelicerae with tubercle of movable finger long and rather low sub-angular, teeth of fixed finger large; palps (fig. 18) with femur gradually increasing from near base to near extremity, in front and behind nearly straight, tibia distinctly but not greatly broader than distal part of femur, membranous opening about  $\frac{1}{3}$  of front (stalk excluded), hand rather long and relatively narrow, fingers scarcely as long as hand, teeth of fixed finger like those of last species but smaller, teeth of movable finger distinct; legs IV. with tarsus<sup>1</sup> and tarsus<sup>2</sup> about equal. L. 3<sup>.2</sup>.

On the sea-shore between tide-marks, in old deep-seated rock-crevices and under stones lying more or less embedded in permanent resting-places; plentiful where it occurs; Britain, western and south-western shores: Ross-shire, Argyllshire, Cornwall, Devonshire; Isle of Man: Port Erin Bay; Ireland: Clare Island (Clew Bay), Kenmare Bay, Bantry Bay.

(11, 13, 22, 42, 62, 69, 71, 75, 85, 92-4.)

#### CHTHONIIDAE.

Legs I: with tarsi 1-jointed; legs IV. with tarsi 2-jointed; femur of legs I. with longer pars basalis and shorter pars tibialis; legs IV. with articulation between trochantin and femur different in character on anterior and posterior faces. Cephalothorax with anterior marginal serration, sometimes also with pronounced median tooth. Eyes 4, 2, or 0.

[H 2]

## Chthonius.

# Chthonius C. L. Koch 1843 (17).

Cephalothorax usually broader in front than behind. Palps with fingers long, in dorsal view straight or nearly so, hand with 2 dorsal tactile hairs, tibia caliciform. Galea present or absent. Eyes 4, 2, or 0.

(Britannic species with eyes 4, cephalothorax always broader in front than behind, galea absent. All glossy, with large blackish bristles; without granulation, more or less distinctly reticulate; fused tergite-sternite of abdominal somite XI. with perforation for somite XII. sub-ventral rather near anterior ventral margin; somite XII. with tergite and sternite separate, sternite with 2, tergite without bristles; chelicerae very large; palps with femur with an anterior row of 3 and an anterio-dorsal row of 5-6 bristles, tibia with large dorsal fissure; hand without stalk, increasing from broad base with more or less abrupt anterior elbow; the two dorsal tactile hairs median<sup>1</sup>; teeth of fingers large, those of fixed finger ·always widely separated; femur of legs IV. exceedingly deep; coxae II. and III. each with a bristle-group.;  $\mathcal{J}$  with genital-area conspicuous, plate II. with large V-shaped opening with close-set marginal bristles and bounded anteriorly by concave posterior margin of plate I.; compared with  $\mathfrak{P}$ , hand narrower, eyeinterval a little less, tubercle of movable finger of chelicerae smaller.)

1.	Hand with dorsal depression				•	tetra	chela	tus.	
	Hand without dorsal depression	on							2
2.	Posterior margin of cephalotho	orax w	$\operatorname{vith} 2$	large	brist	les			3
	Posterior margin of cephaloth	orax	with 4	4 larg	ge bri	stles	. <i>Re</i>	ayi.	
3.	Eye I. removed from front nea	rly o	r quit	e 1 d	iamet	ter; h	and	not	
	darkened					or tho	dacty	lus.	
4.	Eye I. removed from front sca	rcely	more	than	1 dia	imete	r; ha	and	
	darkened	•		•	•		ten	uis.	

C. Rayi L. Koch.

C. Rayi L. Koch 1873 (24).<sup>2</sup> Obisium orthodactylum Leach 1817 (13); in part.

Palps reddish-horny; chelicerae rich reddish-brown, cephalothorax deep

<sup>1</sup> The position of these tactile hairs, whether median, sub-median, basal or apical, and of the large tibial fissure which tends to move in correlation, also the presence or absence of bristle-groups on coxae I.-III., provide useful specific characters in *Chthonius*.

<sup>2</sup> This common species was certainly not unknown when named C. Rayi by L. Koch in 1873. Chelifer ischnochelus Herm. 1804 (8) and Chelifer trombiduoides Latr. 1804 (9) probably represent it, but these species cannot be certainly identified. Obisium orthodactylum Leach 1817 (13), in part at least, represents it, three of Leach's specimens in spite of their bad condition being clearly recognizable; but as the one indicated as the type is perhaps doubtful, I have followed Cambridge (42), who has identified it with the next species; and as the present species is now universally known as C. Rayi L. Koch, that name is here retained.

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olive-horny, abdominal tergites brownish-horny. Bristles robust; cephalothorax much broader in front than behind, with 20 full-sized bristles 4 on posterior margin, anterior margin towards middle irregularly serrated produced into a depressed median point; eyes moderately large, about 2 diameters apart, eye I. fully 1 diameter from front; chelicerae exceedingly robust; palps (fig. 19) femur with 6 bristles in anterio-dorsal row, hand without dorsal depression, fingers much longer than hand (about 1.7), teeth of fixed finger well-separated large triangular slightly inclined backwards, those of movable finger less separated and lower. L. 2.0.

Under stones, bricks, etc.; among dead leaves and débris, in the open and in woods: often about margins of cultivated fields, by road-sides in villages, in old quarries and chalk-pits, under pieces of wood, etc., on the floors of farm-buildings, and even in the cellars of houses; widely distributed and abundant in Britain and Ireland.

(13, 42, 54, 58, 79, 85, 90, 92-3.)

### C. orthodactylus (Leach).

Obisium orthodactylum Leach 1817 (13); in part. C. orthodactylus (Leach) Cambridge 1892 (42).<sup>1</sup>

Palps pale horny more or less reddish, chelicerae reddish-horny, cephalothorax and abdominal tergites yellowish-horny. Bristles somewhat longer and less stout than in last species; cephalothorax moderately broader in front than behind, with 18 full-sized bristles 2 on posterior margin, anterior margin towards middle sub-regularly serrated not produced into a point; eyes a little larger than in last species, considerably more than 1 diameter apart, in  $\mathfrak{P}$ sometimes about 1.5, eye I. nearly or quite 1 diameter from front; chelicerae moderately robust; palps (fig. 20) femur with 5 bristles in anterio-dorsal row, hand without dorsal depression, fingers much longer than hand (about 1.9), teeth of fixed finger well-separated large triangular slightly inclined backwards, those of movable finger less separated much lower. L. 1.5.

Among dead leaves, under stones, etc., in woods, old parks, church-yards, etc.; not uncommon in the Thames valley and elsewhere in the south-east: Oxfordshire, Buckinghamshire, Berkshire, Surrey, Kent; also in Hertfordshire, Sussex, Hampshire, Dorsetshire; *Cambridgeshire*? (60). Recorded for Scotland and Ireland by mistake (47a, 53, 85, 91).

(42, 92, 96.)

### C. tenuis L. Koch.

# C. tenuis L. Koch 1873 (24).

Hand deep olive, rest of palp and chelicerae reddish-horny, cephalothorax and abdominal tergites deep olive, legs pinkish. Cephalothorax moderately broader in front than behind, with 18 full-sized bristles 2 on posterior margin, anterior margin towards middle sub-regularly serrated not produced

<sup>&</sup>lt;sup>1</sup> Mr. Cambridge has permitted me to examine one of his specimens from Bloxworth.

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into a point; eyes larger than in last 2 species, not greatly exceeding 1 diameter apart, eye I. scarcely more than  $\frac{1}{2}$  diameter from front; chelicerae moderately robust (the two large teeth of fixed finger less uniform and not so close together as in last species); palps (fig. 21) femur with 5 bristles in anterio-dorsal row, hand without dorsal depression (somewhat narrower more parallel-sided and with anterior basal elbow less pronounced than in last species, the fingers in dorsal view perceptibly very slightly curved), fingers much longer than hand (about 1.9), teeth of fixed finger well-separated large triangular slightly inclined backwards, those of movable finger less separated much lower. L. 1.8.

Among dead leaves, under stones, etc., in sandy, gravelly, and chalky districts in the south-east; plentiful on the sands and sandstones of the Weald; New Forest and elsewhere in Hampshire; also in Surrey, Berkshire, Dorsetshire; but not recorded from north of the Thames.

(33, 42, 75, 79, 87, 90.)

## C. tetrachelatus (Preys.).

Scorpio tetrachelatus Preys. 1790 (4). C. trombidioides (Latr.) L. Koch 1873 (24). C. tetrachelatus (Preys.) Simon 1879 (27).

Palps and chelicerae horny faintly or distinctly reddish, cephalothorax and abdominal tergites horny olive-horny or deep olive. Cephalothorax a little wider in front than behind, with 18 full-sized bristles 2 on posterior margin, anterior margin towards middle sub-regularly serrated not produced into a point; eyes large about 1 diameter apart; chelicerae moderately robust; palps (fig. 22) femur with 6 bristles in anterio-dorsal row, hand long with distal third dorsally depressed to plane of dorsum of fixed finger, fingers longer than hand (about 1.3), teeth of fixed finger widely separated large triangular erect, those of movable finger similar in character and as widely separated. L. 1.5.

Under stones, etc., from sea-level to 1600 ft.; widely distributed in Britain and Ireland; abundant near the sea and some distance inland; elsewhere less common and generally confined to old gardens, etc.

(21-2, 42, 52, 54, 71, 84-5, 87, 89, 92-3.)

#### LIST OF BOOKS AND PAPERS REFERRED TO IN THE TEXT.

- 1. HOOKE, R.—Micrographia: or some Physiological Descriptions of minute Bodies made by Magnifying Glasses. London, 1665.
- 2. LINNAEUS, C.-Systema Naturae, ed. 10, i. Holmiae, 1758.
- 3. GEOFFROY, É. L.—Histoire abrégée des Insectes qui se trouvent aux environs de Paris, ii. Paris, 1762.
- 4. PREYSSLER, J. D.-Verzeichniss böhmischer Insekten. Prag, 1790.
- FABRICIUS, J. C.—Entomologia Systematica emendata et aucta, ii. Hafniae, 1793.

KEW—A Synopsis of the False-Scorpions of Britain and Ireland. 59

- 7. SCHRANK, F. v. P.-Fauna Boica, iii. Landshut, 1803.
- 8. HERMANN, J. F.-Mémoire Aptérologique. Strasbourg, 1804.
- 9. LATREILLE, P. A.—Histoire naturelle générale et particulière des Crustacés et des Insectes, vii. Paris, 1804.
- 10. ILLIGER, J. K. W.—In Rossius, Fauna Etrusca, ii. Helmstadii, 1807.
- MONTAGU, G.—Descriptions of several new or rare Animals principally marine discovered on the South Coast of Devonshire. Trans. Linnean Society, London, xi. (1815), 1–26.
- 12. LEACH, W. E.—A tabular View of the external Characters of Four Classes of Animals which Linné arranged under Insecta. Id., 306–400.
- LEACH, W. E.—On the Characters of the Genera of the Family Scorpionidea with Descriptions of the British Species of Chelifer and Obisium. Zoological Miscellany, iii. (1817), 48–53.
- 14. LATREILLE, P. A.-Familles Naturelles du Règne Animal. Paris, 1825.
- KOCH, C. L.—Deutschlands Crustaceen Myriapoden und Arachniden. Regensburg, 1835–44.
- 16. WESTWOOD, J. O.- The Entomologist's Text-Book. London, 1838.
- 17. KOCH, C. L.—Die Arachniden, x. Nürnberg, 1843.
- 18. GERVAIS, P.-In Gay, Historia física y política de Chile, iv. Paris, 1849.
- CURTIS, J.—Observations on the Natural History and Economy of various Insects affecting the Potato-crops. Journ. Royal Agricultural Society of England, x. (1849), 70–118.
- MENGE, A.—Ueber die Scheerenspinnen, Chernetidae. Neueste Schriften d. Naturforschenden Gesellschaft Danzig, v. (1855), 1-43.
- MCINTIRE, S. J.—On Pseudo-Scorpiones. Journ. Quekett Microscopical Club, i. (1868), 8–15.
- MCINTIRE, S. J.—Pseudoscorpions. Hardwicke's Science Gossip, v. (1869), 243–247.
- MCINTIRE, S. J.—An Incident in the Life of a Chelifer. Monthly Microscopical Journal, vi. (1871), 209–10.
- 24. KOCH, L.—-Uebersichtliche Darstellung der europäischen Chernetiden (Pseudoscorpione). Nürnberg, 1873.
- SIMON, E.—Description d'un genre nouveau de la famille des Cheliferidae. Bull. Société Zoologique de France, iii. (1878), 66-7.
- 26. DALE, C. W.-History of Glanville's Wootton. London, 1878.
- 27. SIMON, E.—Les Arachnides de France, vii. Paris, 1879.
- CROWTHER, H.—Chelifer De Geerii (C. Koch) a species new to Britain. Hardwicke's Science Gossip, xviii. (1882), 277; Zoologist (3), vi, (1882), 465.

- TÖMÖSVÁRY, Ö.-Pseudoscorpiones Faunae Hungaricae. Magyar Tudományos Akad. Math. és Természettud. Közlemények, xviii. (1882), 135-256.
- BLOOMFIELD, E. N.; BUTLER, E. A.—Natural History of Hastings and St. Leonards and the vicinity: first supplement. Hastings, 1883.
- 31. THORELL, T.—Descrizione di alcuni Aracnidi inferiori dell'Arcipelago Malese. Ann. Museo civico di Storia Naturale Genova, xviii. (1883), 21-69.
- 32. CANESTRINI, G.—Chernetides Italici. In Berlese, Acari Myriopoda et Scorpiones hucusque in Italia reperta. Padova, 1883-5.
- CAMBRIDGE, O. P.—Pseudoscorpions new to Britain. Naturalist, 1884, p. 103.
- HANSEN, H. J.—Arthrogastra Danica. Naturhistorisk Tidsskrift (3), xiv. (1884), 491-554.
- 35. HANSEN, H. J.-Zoologica Danica, iv. Copenhagen, 1885.
- 36. CAMBRIDGE, O. P.—A Contribution towards the knowledge of the Arachnida of Epping Forest. Trans. Essex Field Club, iv. (1886), 41–45.
- 37. KEW, H. W.—Chelifer De Geerii Koch near the Lincolnshire Coast. Naturalist, 1886, p. 339.
- CAMBRIDGE, O. P.-On New and Rare British Spiders. Proc. Dorset Natural History, etc., Field Club, x. (1889), 107-138.
- 39. MONIEZ, R.—Sur un Pseudo-Scorpion marin (Obisium littorale nov. sp.). Revue biologique du Nord de la France, ii. (1890), 102-9.
- BALZAN, L.—Revisione dei Pseudoscorpioni del bacino dei fiumi Paranà e Paraguay. Ann. Museo civico di Storia Naturale Genova (2), ix. (1890), 401-54.
- BALZAN, L.-Voyage de M. E. Simon au Venezuela: Chernetes (Pseudoscorpiones). Ann. Société entomologique de France, lx. (1891-2), 497-552.
- CAMBRIDGE, O. P.-On the British Species of False-Scorpions. Proc. Dorset Natural History, etc., Field Club, xiii. (1892), 199-231.
- HANSEN, H. J.—Organs and Characters in different Orders of Arachnids. Entomologiske Meddelelser udg. Entomologisk Forening Kjöbenhavn, iv. (1893–4), 137–251.
- 44. CARPENTER, G. H.; EVANS, W.—A list of Phalangidea (Harvestmen) and Chernetidea (False-Scorpions) collected in the Neighbourhood of Edinburgh. Proc. Royal Physical Society Edinburgh, xiii. (1895), 114-23.
- ELLINGSEN, E.—Norske Pseudoscorpioner. Christiania Videnskabs-Selskabs Forhandlinger 1896, No. 5, pp. 1-21.

KEW-A Synopsis of the False-Scorpions of Britain and Ireland. 61

- TULLGREN, A.—Bidrag till kännedomen om Sveriges Pseudoscorpioner. Entomologisk Tidskrift, xx. (1899), 161–182.
- 47. STRAND, E.—Arachnologisches. Nyt Magazin for Naturvidenskaberne, xxxviii. (1900), 95-102.
- 47A. CARPENTER, G. H.; EVANS, W.—Additional Records of Spiders and other Arachuids from the Edinburgh District. Proc. Royal Physical Society Edinburgh, xiv. (1900), 168-181.
- JOHNSON, H. E.-East Riding Pseudoscorpions. Trans. Hull Scientific and Field Naturalists' Club, i. (1901), 228.
- KEW, H. W.—Lincolnshire Pseudoscorpions; with an account of the association of such animals with other Arthropods. Naturalist, 1901, pp. 193-215.
- 50. EVANS, W.-Roncus cambridgii L. K. and other Chernetids in Scotland. Annals of Scottish Natural History, x. (1901), 53.
- 51. GODFREY, R.—Chernetidea or False-Scorpions of West Lothian. Id., 214-7.
- EVANS, W.—Chthonius tetrachelatus Preyss. and other Chernetids in Scotland. Id., 241-2.
- CARPENTER, G. H.—In British Association Guide to Belfast and Counties of Down and Antrim. Belfast, 1902.
- CARR, J. W.—Nottinghamshire Crustacea and Arachnida. Trans. Nottingham Naturalists' Society, 1903, pp. 1–7.
- EVANS, W.—Chelifer (Chernes) tullgreni Strand in Scotland. Annals of Scottish Natural History, xii. (1903), 120-1.
- 56. WATERSTON, J.-Roncus Cambridgii L. K. in Argyllshire. Id., 187.
- 57. Evans, W.—Chernes dubius Cambr. (= C. tullgreni Strand) in Scotland. Id., 249-50.
- KEW, H. W.-North of England Pseudoscorpions. Naturalist, 1903, pp. 293-300.
- 59. GODFREY, R.—Chernetidea in Ayrshire. Annals of Scottish Natural History, xiii. (1904), 195.
- 60. WARBURTON, C.—In Marr and Shipley, Handbook to the Natural History of Cambridgeshire. Cambridge, 1904.
- LANKESTER, E. R.—The Structure and Classification of the Arachnida. Quarterly Journal of Microscopical Science (n. s.), xlviii. (1904), 161-269.
- IMMS, A. D.—On a Marine Pseudoscorpion from the Isle of Man. Annals and Magazine of Natural History (7), xv. (1905), 231-2.
- EVANS, W.—Chelifer latreillii Leach in Fife. Annals of Scottish Natural History, xiv. (1905), 247.

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[2]

- 64. CAMBRIDGE, O. P.—On New and Rare British Arachnida. Proc. Dorset Natural History, etc., Field Club, xxvi. (1905), 40-74.
- 65. JACKSON, A. R.—The Spiders of the Tyne Valley. Trans. Natural History Society of Northumberland Durham and Newcastle-upon-Tyne (n. s.), i. (1906), 337-405.
- 66. WITH, C. J.—The Danish Expedition to Siam, 1899-1900. Chelonethi: an account of the Indian false-scorpions together with studies on the anatomy and classification of the order. Kgl. Danske Videnskabernes Selskabs Skrifter (7), iii. (1906), 1-214.
- 67. CAMBRIDGE, O. P.—On some New and Rare British Arachnida. Proc. Dorset Natural History, etc., Field Club, xxvii. (1906), 72–92.<sup>\*\*</sup>
- KEW, H. W.—Chernes cyrneus in Nottinghamshire; a recent addition to the known False-Scorpions of Britain. Trans. Nottingham Naturalists' Society, 1906, pp. 41–6.
- JACKSON, A. R.—Rare Arachnids captured during 1906. Proc. Chester Society of Natural History, etc., vi. (1907), 1–7.
- WHYTE, G. A.; WHYTE, R. B.—The False-Scorpions of Cumberland. Naturalist, 1907, pp. 203-4.
- GODFREY, R.—The False-Scorpions of the West of Scotland. Annals of Scottish Natural History, xvi. (1907), 162-3.
- 72. DONISTHORPE, H. St. J. K.— Myrmecophilous notes for 1907. Entomologist's Record, xix. (1907), 254-6.
- 7.3. WITH, C. J.—On some New Species of Cheliferidae in the British Museum. Journ. Linnean Society London : Zoology, xxx. (1907), 49-85.
- 74. WHYTE, G. A.—Chelifer cancroides (Linn.) in Manchester. Zoologist . (4), xi. (1907), 388–9.
- 75. ELLINGSEN, E.—Notes on Pseudoscorpions, British and Foreign. Journ. Quekett Microscopical Club (2), x. (1907), 155–172.
- CAMBRIDGE, O. P.—On New and Rare British Arachnida. Proc. Dorset Natural History, etc., Field Club, xxviii. (1907), 121-148.
- 77. FALCONER, W.—A Pseudo-scorpion new to Northumberland. Naturalist, 1907, p. 388.
- 78. FALCONER, W.-A Pseudo-scorpion new to Yorkshire. Id., p. 432.
- BUTTERFIELD, W. R.—A Preliminary List of the False-Scorpions (Chernetidea) of the Hastings District. Hastings and East Sussex Naturalist, i. (1908), 111-4.
- BENNETT, W. H.—Occurrence of Chernes cyrneus L. Koch and C. cimicoides (Fabr.) in Richmond Park Surrey. Id., 114.
- FALCONER, W.—Chiridium museorum Leach at Huddersfield. Naturalist, 1908, p. 110.

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- WITH, C. J.-- An Account of the South American Cheliferinae in the Collections of the British and Copenhagen Museums. Trans. Zoological Society London, xviii. (1908), 217-340.
- CAMBRIDGE, O. P.—On New and Rare British Arachnida. Proc. Dorset Natural History, etc., Field Club, xxix. (1908), 161–94.
- JACKSON, A. R.—On some Rare Arachnids captured during 1907. Trans. Natural History Society of Northumberland Durham and Newcastle-upon-Tyne (n.s.), iii. (1908), 49–78.
- GODFREY, R.—The False-Scorpions of Scotland. Annals of Scottish Natural History, xvii. (1908), 90-100, 155-61; xviii. (1909), 22-6, 153-63; xix. (1910), 23-33.
- SMITH, F. P.—In Morey, Guide to the Natural History of the Isle of Wight. Newport, 1909.
- 87. KEW, H. W.—Arachnida-Pseudoscorpiones. In Grinling, Survey and Record of Woolwich and West Kent. Woolwich, 1909.
- BUTTERFIELD, W. R.—Occurrence of the False-Scorpion Chernes cimicoides (Fabr.) in Dallington Forest. Hastings and East Sussex Naturalist, i. (1909), 195–6.
- 89. STAINFORTH, T.—List of East Yorkshire Spiders Harvest-men and Pseudoscorpions added to the Hull Municipal Museum Collection in 1908. Trans. Hull Scientific and Field Naturalists' Club, iv. (1909), 87–102.
- 90. JACKSON, A. R.—On some Rare Arachnids observed during 1908. Trans. Natural History Society of Northumberland Durham and Newcastle-upon-Tyne (n. s.), iii. (1909), 418–439.
- 91. Evans, W.—Our Present Knowledge of the Fauna of the Forth Area. Proc. Royal Physical Society Edinburgh, xvii. (1909), 1-64.
- 92. KEW, H. W.—Notes on the Irish False-Scorpions in the National Museum of Ireland. Irish Naturalist, xviii. (1909), 249–50.
- 93. KEW, H. W.—A Holiday in South-Western Ireland. Notes on some False-Scorpions' and other Animals observed in the Counties of Kerry and Cork. Id., xix. (1910), 64-73.
- 94. KEW, H. W.—On the Irish Species of Obisium with special reference to one from Glengariff new to the Britannic fauna. Id., 108–12.
- DONISTHORPE, H. St. J. K.—On the Founding of Nests by Ants; and a few notes on Myrmecophiles. Entomologist's Record, xxii. (1910).
- 96. JACKSON, A. R.—On some Arthropods observed in 1909. Lancashire Naturalist, 1910, pp. 17-22, 46-51.
- 97. HIRST, A. S.—In Guide to the Crustacea Arachnida Onychophora and Myriopoda exhibited in the British Museum (Natural History). London, 1910.

DESCRIPTION OF PLATES IV.-VI.

#### FIG.

- 1. Chelifer nodosus Schr., §.
- 2. Chelifer Godfreyi sp. nov., 2.
- 3. Chelifer Chyzeri (Töm.), 3.
- 4. Chelifer scorpioides Herm.,  $\mathfrak{P}$ .
- 5. Chelifer dubius (Camb.),
- 6. Chelifer Wideri C. L. Koch, 9.
- 7. Chelifer Panzeri C. L. Koch, &.
- 8. Chelifer Cyrneus (L. Koch), 9.

9. Chelifer cimicoides (Fabr.), 3.

- 10. Chelifer Latreillii Leach, 3.
- 11. Chelifer cancroides (Linn.), 3.
- 12. Chelifer subruber Sim., 3.
- 13. Cheiridium museorum (Leach), 9.
- 14. Obisium Cambridgii (L. Koch), 2.
- 15. Obisium lubricum (L. Koch), 3.
- 16. Obisium muscorum Leach,  $\mathcal{J}$ .
- 17. Obisium Carpenteri nom. nov., 9.
- 18. Obisium maritimum Leach,  $\mathcal{J}$ .
- 19. Chthonius Rayi L. Koch, 2.
- 20. Chthonius orthodactylus (Leach), 2.
- 21. Chthonius tenuis L. Koch, 9.
- 22. Chthonius tetrachelatus (Preys.), 3.





KEW .--- FALSE-SCORPIONS OF BRITAIN AND IRELAND.

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PLATE V.



Kew. - False-Scorpions of Britain and Ireland.

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PLATE VI.



Kew.--False-Scorpions of Britain and Ireland.

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# III.

# A LIST OF THE LAND AND FRESHWATER MOLLUSKS OF IRELAND.

### BY ARTHUR WILSON STELFOX, A.R.I.B.A.

(BEING THE NINTH REPORT FROM THE FAUNA AND FLORA COMMITTEE.)

COMMUNICATED BY R. F. SCHARFF, PH.D., M.R.I.A.

#### PLATE VII.

Read DECEMBER 12, 1910. Published MARCH 4, 1911.

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1.	Introduction,			65	4.	Introduce	d Spe	cies,		. 131
2.	List of Species with Distri	bution,		71	5.	Bibliograp	ohy,			. 136
3.	Erroneous and doubtful Re	cords,	. 1	27	6.	Index,				. 158

#### 1. INTRODUCTION.

THE first work of any importance published on the Land and Freshwater Mollusca of Ireland was that of Capt. Brown [31],<sup>1</sup> who, in his *Irish Testacca*, recorded fifty-six species. Of these fifty-six, nine have now been omitted from the Irish list for various reasons.

In William Thompson's report [280], which is still our most valuable work on the subject, ninety-nine species are to be found; and if we add his *Helix pulchella* var. *crenella*, to which we now give specific rank, his list includes an even hundred. Unfortunately seven of these must be put down as erroneous records, not through any fault of Thompson's, but owing to the carelessness of a few of his correspondents.

From the death of Thompson in 1851 until the advent of Dr. Scharff no serious work was attempted in this branch of natural history in Ireland, except that for which the late Prof. Ralph Tate was responsible during his only too short residence in Belfast, and the commencement of a verified census by Messrs. Taylor and Roebuck on the lines of that of the Conchological Society [278].

In the year in which the *Irish Naturalist* first made its appearance (1892) Dr. Scharff gave us a valuable annotated list [214], embodying not only the

<sup>&</sup>lt;sup>1</sup> The numbers in brackets refer to the bibliography at the end of the paper. R.I.A. PROC., VOL. XXIX., SECT. B.

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previous work of men such as Brown, Templeton, Thompson, Hyndman, Warren, Waller, Harvey, Clarke, Andrews, Ball, Humphreys, Hogan, and Tate, but a great deal of his own work, the result of many excursions and much careful research. His attention was directed chiefly to the south-west corner of Ireland, the haunt of Geomalacus maculosus and Limnaea involuta. The result of his work in that quarter was the addition to our fauna of Pisidium hibernicum (which, like Limnaca involuta, is apparently an endemic species) and a series of interesting notes on some of the other and commoner species found there. In his paper Dr. Scharff recorded 120 species, of which four were given as doubtful and have since been withdrawn; three others are not now included in the Irish list-viz., Sphacrium rivicola, Paludina vivipara, and Limnaca glabra : while Hyalinia contracta is now regarded as a variety of *H. crystallina*. The shells recorded by Dr. Scharff as *Helix sericea*, Drap., and Vertigo moulinsiana, Dupuy, were in reality Hygromia granulata, Alder, and Vertigo lilljeborgi, Westerlund; while the specimens from Lough Drin, near Mullingar, recorded as Pisidium globulare (= P. steenbuchi) are now considered by Mr. B. B. Woodward to be a form of Pisidium pasillum.

The following table shows the number of species recorded for each division up till the close of the years 1900 and 1910 respectively:—

#### NUMBER OF SPECIES RECORDED FROM EACH DIVISION.

		In	1900	In 1910						In 1900	In 1910
1.	South Kerry,		60	85		21.	Dublin,			55	96
2.	North Kerry,		53	75		22.	Meath.			1	87
3.	West Cork, .		13	80		<u>2</u> 3.	Westmeath	1, .		57	70
4.	Mid Cork, .		16	80		24.	Longford.			2	51
5.	East Cork, .		23	83		25.	Roscommo	п,		4	67
6.	Waterford, .		24	83		26.	East Mayo	3 *		12	42
$\overline{\ell}$ .	South Tipperary,	-	52	81		27.	West May	0,	-	53	88
8.	Limerick, .		28	85		28.	Sligo, .			22	85
9,	Clare, .		40	103		29	Leitrim,			25	71
10.	North Tipperary,		69	85		30,	Cavan,			35	68
11.	Kilkenny, .		0	88		31.	Louth,			5	87
12.	Wexford, .		6	80		32.	Monaghan,			15	73
13.	Carlow, .		1	87		33.	Fermanagh	1.		32	78
14.	Queen's Co.,		28	84		34.	East Done,	gal,		33	83
15.	South-east Galwa	ιy,	1	79		35.	West Done	gal,		71	87
16.	West Galway,		52	82		36.	Tyrone,			11	62
17.	North-east Galwa	iу,	52	81		37.	Armagh,			20	75
18.	King's Co., .		35	80	Ŧ	38.	Down,			49	87
19.	Kildare, .		31	81		39.	Antrim,			77	96
20.	Wicklow, .		42	73	,	40.	Derry,			37	88

# STELFOX-List of Land and Freshwater Mollusks of Ireland. 67

Since the publication of his list in 1892 Dr. Scharff's duties have most unfortunately left him little spare time. He has, however, induced a small band of Irish conchologists to continue the work which he had begun, and, at the present time, our knowledge of this branch of our fauna compares very favourably with that in most other parts of Europe. The home conchologists have also received great assistance from some of their English fellow-workers in exploring parts of the least frequented districts. The Triennial Field Club Conferences, and above all the several Island Surveys, organized by Mr. R. Ll. Praeger, have each added materially to our knowledge of the distribution of the various species. There are few if any districts which have not now been at least roughly surveyed; but still a great deal of filling-in work remains to be done, and particularly in the centre, east, and west are areas which it will take some years to explore fully. The divisions which most require further work are East Mayo, Longford, Tyrone, East Donegal, Roscommon, Cavan, Leitrim, and Fermanagh. The absence of many species from these areas is therefore only apparent, as they are known to be generally distributed.



Fig. 1.

 $[\mathbf{2}K]$ 

It will be seen by the above lists that Praeger's sub-division of Ireland<sup>1</sup> has been used in the present paper. For exhibiting the distribution of each species in the country I have employed the device proposed by Praeger,<sup>2</sup> in which symbols representing the names of the forty divisions are printed in an order corresponding to their relative geographical positions, so that a glance shows whether the range of a species is northern, southern, &c. The accompanying map (fig. 1) shows the forty divisions into which Ireland is divided, and the letter—or number—symbols which may be employed to express them.

The following species are additions to the list of Irish mollusca as recorded by Dr. Scharff in 1892; the dates of their discovery and the names of their recorders are added :---

- 1894. Hyalinia helvetica Blum, Irish Nat., iii, 45, R. A. Phillips. Since withdrawn from the Irish list; see Irish Nat., xix, 210, 242 and 254, 1910.
- 1895. Pisidium hibernicum Westerlund, Irish Nat., iv, 335, R. F. Scharff.
- 1897. Paludestrina jenkinsi Smith, Irish Nat., vi, 234, L. E. Adams.
- 1907. Vitrina hibernica Taylor, Irish Nat., xiv, 225, J. W. Taylor.
- 1908. Bithynia leachi Sheppard, Irish Nat., xvii, 1, R. Welch. Limnaea praetenuis Bowell, Irish Nat., xvii, 45, Rev. E. W. Bowell. Vertigo moulinsiana Dupuy, Irish Nat., xvii, 89, R. A. Phillips. Pisidium personatum Malm, Proceedings of the Malacological Society, viii, 124, B. B. Woodward.
- 1909. Paludestrina confusa Frauenfeld, Irish Nat., xviii, 143, R. A. Phillips.
- 1910. *Pisidium steenbuchi* Möller, Proceedings of the Malacological Society, ix, 5, B. B. Woodward.
  - P. lilljeborgi Clessin, B. B. Woodward. Ibid.

Another supposed species has been added to the Irish list—namely Vallonia excentrica Sterki; but for the present I am content to include this shell under the name of Vallonia pulchella, although Sterki's species has been adopted by most conchologists in Great Britain. Mr. A. S. Kennard has also described two new species of Hyalinia from material sent him from Ireland H. hibernica [136] and H. scharffi [137]; but as some of us in Ireland regard all the shells so named by Mr. Kennard to be racial forms of Hyalinia cellaria Müller, they are likewise omitted from the list of species. Of the above list, Paludestrina jenkinsi, P. confusa, Vertigo moulinsiana, and Bithynia leachi are well-known and easily recognizable species. The great majority of the others belong to critical groups. Vitrina hibernica is, of course, readily distinguished from our only other Britannic member of

<sup>&</sup>lt;sup>1</sup> Irish Topographical Botany, 1901. <sup>2</sup> Irish Nat., xv, pp. 88-94. 1906.

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the genus (V. pellucida); but it appears to have several close allies on the Continent, and after being first referred to the Vitrina elongata of Draparnaud by Mr. Taylor, it was afterwards referred to V. pyrenäica Fér. by the Rev. E. W. Bowell. In describing his Hyalinia hibernica Mr. Kennard gave the following reason for making a new species : "that the Irish shell was certainly not H. cellaria of Müller." That is the point, of course, on which I do not altogether agree with Mr. Kennard, He has, however, certainly drawn the attention of conchologists in general to the fact that, in this island, there exists a form of Hyalinia cellaria which differs materially from the type of Müller and the form which is usually met with in the south-east of England. Had Mr. Kennard described the shell as a mere variety of such a variable species as H. cellaria, none would have more than glanced at his words, as unfortunately the term "variety" has been used to describe such trifling variation that there is now little meaning attached to it.

Fourteen land and fifteen freshwater species which are known to live in Britain are still unrecorded for Ireland. Of these, twelve of the former and all the latter (except the two endemic species—Limnaea burnetti and Paludestrina taylori) have mainly a central range in Europe, and therefore belong to that group in which Ireland is known to be poor. The two exceptions in the list of land-species are Limax tenellus and Hygromia revelata. The latter belongs to the Cornish branch of the Lusitanian group. There seems therefore, in my opinion, yet a chance that this species may occur somewhere along the east coast of Ireland, the head-quarters in this country of Helix pisana, Vitrina hibernica, and several terrestrial isopods which appear to belong to this same group. Limax tenellus, if in Ireland, is more likely to occur in the north or north-west.

In the preparation of this list I have received great help from Dr. Scharff, who has handed over to me all the notes which he had been collecting for many years for the purpose of a similar paper, which he had unfortunately to abandon to take up other work. The bibliography, which will be found to be very full, was also commenced by Dr. Scharff, but has been completed by Mr. Welch after much arduous work. Had it not been for the assistance of the latter, upon which I could always count, I should not have dared to undertake the completion of this paper; and, although I alone am to blame for any erroneous opinions which have been expressed in the text, Mr. Welch must be given a large share of the credit of the compilation of it. To Mr. R. A. Phillips I owe also my greatest thanks for notes and records, at least half of those from the southern counties being due to his careful work; Mr. P. H. Grierson has contributed a great deal of information on the

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central districts; and Mr. J. N. Milne's notes on the counties of Donegal, Derry, and Tyrone have proved most valuable. To the English conchologists who have often spent their holidays in this country, helping us to explore some unworked areas, we also owe a great deal, but particularly to the late Dr. G. W. Chaster, Messrs. L. E. Adams, E. Collier, R. Standen, and C. E. Wright; while great assistance has been given to the Irish workers by the Rev. E. W. Bowell, Messrs. A. S. Kennard, C. Oldham, W. Denišon Roebuck, J. W. Taylor, and B. B. Woodward, in identifying some of the more critical species. The following naturalists, while not confining themselves to conchology, have also considerably added to our material :—Miss A. L. Massy, Miss Amy Warren, Rev. A. and Miss Delap, Messrs. Harry Fogerty, G. P. Farran, W. A. Green, J. Ray Hardy, W. F. de V. Kane, B. R. Lucas, H. Wallis Kew, J. G. Milne, H. L. Orr, R. Ll. Praeger, J. R. le B. Tomlin, Major Trevelyan, the late A. G. More and S. A. Stewart, and many others.

In addition to the collections of many conchologists, that in the National' Museum—including Dr. Scharff's private collection—and those of Thompson and Hyndman in Belfast, have been looked through.

The nomenclature in the paper is founded on that of the Conchological Society's List; but I have followed Mr. J. W. Taylor in retaining the old name Hyalinia instead of Vitrea. In a few other cases I have departed from the Society's nomenclature for reasons stated in the text.

The synonyms given are those used in the principal Irish lists, viz., those of Brown, Thompson,<sup>1</sup> and Scharff; but where more than one of these writers employ the same name, I have given only the earlier reference.

Many records for such shells as *Vertigo pusilla* and *V. angustior* are based on specimens found in sand-dune deposits; but, as the chief object of a census is as an aid to the study of geographical distribution, I consider it quite justifiable to include these records.

The only records of Pisidia included in section 2 of the paper are those founded on specimens verified by Mr. B. B. Woodward, who has made a special study of this genus, except those of *Pisidium amnicum*, *P. henslowanum*, and *P. milium*, in which cases there is little likelihood of mistakes having been made. Therefore, although the common species, such as *P. pusillum*, *P. personatum*, *P. casertanum*, and *P. subtruncatum*, are known to be generally distributed, we have only a few verified records. All records, other than those verified by Mr. Woodward, are included among the doubtful records in the third section of the paper.

<sup>&</sup>lt;sup>1</sup> I must here state that the paging given in the case of Thompson's work is that of the reprint and not of the original.
2. LIST OF SPECIES WITH DISTRIBUTION.

GASTROPODA.

## TESTACELLIDAE.

Testacella maugei Férussac.

WD ED LD AN FE TY AR DO WM SL LE MO EM RO CV LH WG NG LF WH ME SG KC KD DU CL NT QC CW WI NK LK ST KK WX SK MC EC WA

From their common habit of living in gardens, rather than in the open country, none of the three species of this genus is likely to be met with during an ordinary natural history ramble. It is perhaps for this reason, rather than scarcity, that we have so few records of these interesting slugs. But, although their presence in several of the southern divisions has in all probability been passed over, it seems unlikely that their range in Ireland will be much widened by future work, for they appear to belong to a group of animals which has entered this country from the south or south-east; some of them never having spread beyond the southern and eastern counties. The distribution of our three species of Testacella and that of Hyalinia lucida is very similar, and should a report of "a slug with a shell on its tail," received by Mr. Phillips from a gardener

in Clare, prove trustworthy, their distributions will in this country be almost identical.

Testacella haliotidea Draparnaud.

												C	W		
								γA	,	C	E	IC	M	SK	S
						Χ	W	Κ		T	S	Κ	L	ΙK	У
			ľ	W]	Į	V	CV	С	(	$\mathbf{T}$	N	L	$\mathbf{C}$		
			J	DU		D	KI	С	]	βG	S				
			E	MI	[]	Η	W	$\mathbf{F}$	]	IG	N	G	W		
			ł	LE	I	7	Сĭ	0	]	ΞM	E				
						0	Μ	$\mathbf{E}$		$^{\rm bL}$	5	M	W		
00	D	I	ł	4B	1	Y	$\mathbf{T}$	Έ							
			V	AN	1	D	$\mathbf{L}$	D	)]	٧D	Ţ				
			J	۸N		D	тл	D	1	VD	T				

Has a southern and eastern range, and its distribution is similar to that of the other two species of the genus. The record from Strabane in Tyrone, <sup>1</sup> I regard for the present as due to an introduction, though future investigation may prove the species to be a native there.

## Testacella scutulum Sowerby.

Has a distribution similar to the two preceding species. All three inhabit gardens, and the neighbourhood of towns, and are seldom, if ever, found in the open country in Ireland. Although living under suspicious circumstances, and often appearing to have been naturalized, their distribution, I think, proves them to be native. Messrs. Taylor and Roebuck, when recording *T. maugei* var.

<sup>&</sup>lt;sup>1</sup> Scharff, Irish Naturalist, p. 163, 1908.

viridans,1 add the following note :--" It is noteworthy that these-the only

		WD	ED	$\mathbf{L}\mathbf{D}$	AN	
			$\mathbf{FE}$	$\mathbf{T}\mathbf{Y}$	$\mathbf{AR}$	DO
	WM	$\mathbf{SL}$	$\mathbf{LE}$	MO		
		$\mathbf{E}\mathbf{M}$	RO	$\mathbf{CV}$	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		$\mathbf{SG}$	KC	KD	DU	
	$\mathbf{CL}$	$\mathbf{NT}$	QC	$\mathbf{CW}$	WI	
NK	$\mathbf{L}\mathbf{K}$	$\mathbf{ST}$	KK	WX		
SK	$\mathbf{MC}$	EC	WA			
	WC					

Irish specimens of T. maugei that we have seen-should differ completely in colour from the English examples, and should resemble the common form, which, according to Morelet, occurs in Portugal." This seems in favour of the view that at any rate they have not been introduced from England.

## LIMACIDAE.

Limax maximus Linné.

		WD	ED	LD	AN	
			FE	TΥ	AR	DO
	WM	SL	LE	MO		
		$\mathbf{E}\mathbf{M}$	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SG	KC	KD	DU	
	CL	NT	QC	CW	WI	
NK	LK	ST	ŇΚ	WX		
SK	MC	EC	WA			
	WC					

Generally distributed, but only locally common. Usually occurs most abundantly in the vicinity of human habitations,

<sup>1</sup> Proc. R.I.A. (2), iv. 673, 1888.

but is also to be met with in the open country, and lives in most of our old native woods. Seems absent from, or very rare in, some districts in the western counties, and the only islands from which it has been reported are Achill, in West Mayo, and Inishbofin, in West Galway. On Clare Island, and on the adjoining mainland of West Mayo, there is a striped form of Limax arborum. which is almost indistinguishable from a half grown specimen of the present slug, but all the shells taken from these striped specimens of L. arborum have been quite typical of that species. The supposed Inishbofin examples of L. maximus are more likely to have been the above form of L. arborum.

## Limax cinereo-niger Wolf.

Limax maximus var. ?, Thompson, Cat. L. and F. W. Moll. of Ireland, p. 47, 1840; var. cinereo-niger, Scharff, Irish Nat., p. 88, 1892.

		WD	$\mathbf{E}\mathbf{D}$	LD	AN	
			$\mathbf{FE}$	ΤY	AR	DO
	WM	SL	$\mathbf{LE}$	MO		
		EM	$\mathbf{RO}$	$\mathbf{CV}$	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		SG	KC	KD	DU	
	$\mathbf{CL}$	NT	QC	CW	WI	
NK	LK	$\mathbf{ST}$	КK	WX		
SK	MC	EC	WA			
	WC					

Generally distributed, but must be considered a rare and local slug in Ireland. The type is particularly scarce, and the forms usually met with are striped or spotted, resembling the vars. vera and maura. Unlike the last, this species never deserts the open country, and occurs most frequently in districts which contain old native woods or rough ground that has never been under cultivation.

It has recently been collected on Clare Island (West Mayo), by Mr. H. Wallis Kew, this being the first record outside the mainland.

Limax flavus Linné.

		WD	ED	LD	AN	
			$\mathbf{FE}$	TY	AR	DO
	WM	SL	LE	MO		
		$\mathbf{E}\mathbf{M}$	RO	CV	LH	•
	WG	NG	$\mathbf{LF}$	WH	ME	
		SG	KC	KD	DU	
	CL	NT	QC	CW	WI	
NK	LK	ST	ŘΚ	WX		
SK	MC	EC	WA			
	WC					

Generally distributed throughout the mainland, and found on Lambay, in Dublin, and on Rathlin, in Antrim. There are no records, however, for any of the western islands; and along the west coast it is exceedingly local. Usually inhabits gardens, hot-houses, churchyards, cellars, and even larders and sculleries, where it hides in crevices during the day, and only makes its appearance after dark. It is, however, also known to occur in some of the old native woods. The cracks into which this slug can erawl are amazingly small. No variation of any real importance has been noted, but occasionally lighter or darker specimens are met with.

Limax arborum Bouchard-Chantereaux.

Limax marginatus, Scharff, Irish Nat., p. 89, 1892.

		WD	ED	LD	AN	
			FE	ΤY	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		SC	KC	KD	DU	
	CL	NT	<b>0</b> 0	CW	WI	
NK	LK	ST	ŇΚ	WX		
SK	MC	EC	WA			
	WC					

Generally distributed and usually common, but perhaps most abundant in the mountainous districts of the west coast and on the western islands, from nearly all of which it has been recorded, as well as from Lambay in Dublin, and Rathlin in Antrim. As its name implies, it is regarded generally as a tree-slug, and in many cases this is undoubtedly correct; but the wholesale destruction of our woodland areas has in no way diminished its distribution. Great variation is shown in the colour and marking of this slug, and many beautifully striped and spotted forms are to be found: these are particularly common in the west. A unicolourous mountain form, almost black, has been recorded from high altitudes (over 2000 feet) in Kerry, Mayo, and Down. The altitudinal range of Limax arborum is very great; and from sea-level it occurs up to a height of 3000 feet in the Reeks, South Kerry, at which altitude uniformly black specimens were first

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collected by Dr. Scharff and Professor Carpenter in 1898.1

## Agriolimax agrestis (Linné).

Limax agrestis, Thompson, Cat. L. F. W. Moll. of Ireland, p. 5, 1840.

## WD ED LD AN FE TY AR DO WMSL LE MO EM RO CV LH WG NG LF WH ME SG KC KD DU CL NT OC CW WI NK LK ST KK WX SK MC EC WA WC

An ubiquitous species, being, I think, almost uniformly distributed throughout the mainland and islands, and common from sea-level to an altitude of 2500 feet. Shows great variation in colour, particularly in the south and west; and specimens from milk-white to almost jet-black are generally to be found in these districts. In some places, usually in the maritime counties, the beautiful var. lilacina occurs commonly, and more often than not, in colonies: while the mountain form is almost invariably of a dusky brown colour. Specimens which I have collected on Tory Island, West Donegal, were all of this "mountain" form, with the addition of two darker brown stripes, one on each side of the shield.

Agriolimax laevis (Müller).

		WD	ED	LD	AN	
			FE	TΥ	AR	ĐO
	WM	SL	LE	MO		
		$\mathbf{E}\mathbf{M}$	RO	$\mathbf{C}\mathbf{V}$	LH	
	WG	NG	LF	WH	ME	
		SG	KC	KD	DÜ	
	CL	NT	OC	CW	WI	
NK	LK	ST	KK	WX		
SK	MC	EC	WA			
	WC					

This was formerly regarded as a rare species in Ireland, and appears to have been unknown to Thompson or his correspondents. In reality it is quite common, and is generally distributed, being found in moist woods and wherever suitable marshy ground exists. From the comparative dryness of parts of the eastern and central areas, it is perhaps more abundant in the southern. western, and northern counties. It lives on most of the western islands, whose moist climate is eminently suitable for its existence. In the Botanic Gardens, Glasnevin, and in some nurseries, a rather peculiar form, apparently of this species, has been introduced with foreign plants into the hot-houses. It differs from our native examples in being of a deep slate-purple colour instead of the usual brown.

## Milax sowerbyi (Férussac).

Amalia carinata, Scharff, Slugs of Ireland, Sci. Trans. R. D. S. (2), iv., 531, 1891. Amalia Sowerbyi, Scharff, Irish Nat., p. 89, 1892.

Though widely distributed, this slug

<sup>1</sup> Irish Nat., viii, 214. L. marginatus, var. nov. niger Scharff.

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is much more common in the southern and eastern counties than in other parts

```
WD EDLDANFETYARDOWMSLLEMOEMROCVLHWGNGLFWHWGNGLFUHCLNTQCCWNKLKSTKKWXSKMCECWAWCWCWA
```

of the country, especially in gardens and near the coast. It is absent from most of our islands, but has been noted on Inishmore, one of the Aran Islands, in Clare; Achill Island, in West Mayo; and Rathlin Island, in Antrim.

During the Irish Field Club Conference at Cork in 1907, a spotted form of this slug was taken at Blarney, Mid Cork, and at Aghada, in East Cork, resembling, in the opinion of Mr. J. W. Taylor, the Continental *Milax marginatus* of Draparnaud.

## Milax gagates (Draparnaud).

## Amalia gagates, Scharff, Irish Nat., p. 90, 1892.

It is very strange that neither this nor the last species was known to the late W. Thompson in the north, as in many gardens in Belfast, where these do great damage to bulbous plants, they are onlytoo common. Unlike *M. sowerbyi* this slug is found on most of our western islands, and occurs with that species on Rathlin Island in Antrim.

On the mainland it is widely distri-

buted, but rare or absent from many parts of the central plain, and to a

		WD	ED	LD	AN	
			FE	TY	AR	DO
	WM	SL	$\mathbf{LE}$	MO		
		EM	RO	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		SG	KC	KD	DU	
	CL	NT	QC	CW	WI	
NK	LK	$\mathbf{ST}$	KK	WX		
SK	MC	EC	WA			
	WC					

certain extent is replaced by M. sowerbyi in parts of the southern and eastern counties.

As Dr. Scharff has pointed out there are two well-marked colour-forms of this species, a tan-coloured and a dark lead-coloured one. On Achill Island in West Mayo I have taken an almost black specimen at an altitude of between 800 and 1,000 feet on the slopes of Croaghaun; and during September, 1910. I took a similar one on the summit of Brandon Mt.-3127 feetin South Kerry. In the last station it was associated with Arion ater and Hyalinia alliaria, while Saxifraga groenlandica grew in the crevices of the adjoining wall.

## ZONITIDAE.

## Vitrina pellucida (Müller).

Helix elliptica, Brown, Mem. Werner. Soc., vol. ii, p. 525, 1818.

Generally distributed, but particularly common on the sandy warrens of the north coast, where it can be collected in

[L 2]

large numbers during the winter months round the mouths of rabbit burrows.

		WD	ED	LD	AN	
			FE	TY	AR	DO
	WM	SL	LE	MO		
		$\mathbf{E}\mathbf{M}$	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SC	KC	KD	DU	
	CL	NT	QC	CW	WL	
NK	LK	ST	KK	WX		
SK	MC	EC	WA			
	WC					

It is decidedly rare in some parts of the west, and very rare on the Dingle peninsula. Mr. Phillips tells me that " in the southern half of Ireland, though widespread, it is never abundant, and a day's general shell-collecting seldom produces more than half a dozen specimens." It is a shell that varies considerably in shape; and in colour it ranges from amber-yellow to bright green. I have noticed the yellowcoloured shells more often in the late autumn months than in the spring; and they usually seem smaller and more rounded than the green ones. This species lives, though apparently rare, on the majority of the western islands, and is also recorded from Lambay in Dublin, and Rathlin in Antrim.

## **Vitrina hibernica** Taylor.

#### (? = V. pyrenäica Fér.)

## Vitrina elongata, Taylor, Irish Nat., xvi, p. 225, 1907. V. pyrenaica, Bowell, id., vol. xvii., p. 94, pl. 4, 1908.

This interesting shell has now been taken in four localities on the Silurian area of Louth. As will be seen by the above synonymy it has, in the short

		WD	$\mathbf{ED}$	$\mathrm{LD}$	AN	
			$\mathbf{FE}$	ΤY	$\mathbf{AR}$	DO
	$\mathbb{W}M$	SL	$\mathbf{LE}$	MO		
		$\mathbf{E}\mathbf{M}$	RO	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		$\mathbf{SG}$	$\mathbf{KC}$	KD	$\mathrm{DU}$	
	$\mathbf{CL}$	$\mathbf{NT}$	QC	CW	WI	
NK	$\mathbf{L}\mathbf{K}$	$\mathbf{ST}$	$\mathbf{K}\mathbf{K}$	WX		
SK	$\mathbf{MC}$	EC	WA			
	WC					

space of time since its discovery by Mr. Grierson, given rise to much controversy. Mr. Taylor in 1907, described it as Vitrina elongata Drap., after it had been recorded by Mr. Grierson as Vitrina pellucida, var. depressiuscula : the Rev. E. W. Bowell, having dissected the animal, pronounced it to be identical with Férussac's Vitrina pyrenäica, and finally in his Monograph<sup>1</sup> Mr. Taylor has accorded it new specific rank. That it is closely allied to, if not identical with, the Pyrenean shell, there can be little doubt; but, until further confirmatory evidence comes to hand, I prefer to use Mr. Taylor's name rather than that of Férussac.

If specifically distinct from V. pyrenäica, this shell is unknown outside Ireland. Férussac's species is recorded by Jordan from the Pyrenees, in both France and Spain, as being found in his Mountain, Sub-alpine, and Alpine regions, which lie between the altitudes of 500-1000, 1000-2000, and over 2000 mètres respectively.

<sup>&</sup>lt;sup>1</sup> Since Mr. Taylor has thrown doubt on the existence of any such species as V. pyrenäica

## Hyalinia crystallina (Müller).

Helix crystallina, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 20, 1840.

```
WD ED LD AN
FE TY AR DO
WMSL LE MO
Em Ro CV LH
WG NG LF WH ME
SG KC KD DU
CL NT QC GW WI
NK LK ST KK WX
SK MC EC WA
WC
```

Generally distributed and usually common in damp and shady places. The typical form, as known to most English authors, is, I think, found more often than elsewhere in the south and midlands. Specimens from Carrigrohane. Mid Cork, seem to be identical with the Hyalinia subterranea of Bourguignat. The smaller and more contracted form, Hyalinia contracta of Westerlund, is perhaps more widely distributed; but as it is difficult to separate these two forms, except in the case of wellmarked specimens, their distribution cannot at present be clearly shown. Generally found on the western and other islands, but not common on any.

## Hyalinia lucida (Draparnaud).

## Hyalinia Draparnaudi, Scharff, Irish Nat., p. 65, 1892.

From its distribution in Ireland, which is similar to that of the Testacellidae, this is a most interesting species. It is, moreover, the only one

	WC					
SK	MC	EC	WA			
NK	LK	ST	KK	WX		
	CL	NT	QC	$\mathbf{CW}$	WI	
		$\mathbf{SG}$	KC	KD	DU	
	WG	NG	$\mathbf{LF}$	WH	ME	
		$\mathbf{E}\mathbf{M}$	$\mathbf{RO}$	$\mathbf{C}\mathbf{V}$	LH	
	WM	$\operatorname{SL}$	$\mathbf{LE}$	MO		
			$\mathbf{FE}$	$\mathbf{T}\mathbf{Y}$	AR	DO
		WD	ED	LD	AN	

of its genus that is not generally distributed in this country. In many places in Munster and in parts of Leinster it sometimes outnumbers all the other Hyaliniae, especially in towns and in the neighbourhood of habitations. Outside these areas we have no authentic records. Large specimens of our Irish Hyalinia cellaria (Vitrea hibernica Kennard) have frequently been mistaken for this species; and we have therefore many false records to contend with. Thus, H. lucida has been recorded from the Aran Islands in Clare, South Kerry, West Cork, West Galway, N.E. Galway, Leitrim, Cavan, West Donegal, East Donegal, Antrim, and Down; but the majority of these areas have been since visited by conchologists who found nothing but the large race of H. cellaria mentioned above. Therefore until refound, it would be unwise to record it for any of the divisions mentioned. H. lucida has been introduced with plants into hot-houses in Cork, Dublin, Antrim, Down, and Fermanagh, &c.

<sup>(</sup>Mon. L. and F. W. Moll. of the Brit. Isles, Vol. III, appendix), it may be of interest to mention that there are specimens of this shell in the Dublin Museum, collected by Dr. Scharff

some years ago at Eaux Bonnes, Férussac's original habitat for the species. These appear to be almost identical with specimens of the Irish shell from Co. Louth.

Hyalinia cellaria (Müller).

Plate VII, figs. 51, 52.

Helix cellaria, Thompson, Cat. L. & F.W. Moll. of Ireland, p. 18, 1840.

		WD	ED	LD	AN	
			FE	TΥ	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SC	KC	KD	DU	
	CL	NT	QC	CW	WI	
NK	LK	ST	KK	WX		
SK	MC	EC	WA			
	WC					

Generally distributed and usually common in all parts of the country and on most of the western and other islands. Practically all the full-grown Irish specimens I have seen could be referred to the Vitrea hibernica of Kennard ; but in several localities in the eastern counties this shell does not appear to grow beyond the usual size of English specimens. A variety with more globular shell, smaller umbilicus, rounder aperture, more polished surface, and usually more delicate texture, is found locally in the south and west. It is this latter shell that has been described by Mr. Kennard as Vitrea scharff; and it is also, I think, that which has been often mistaken for and recorded as Hyalinia helvetica Blum or H. glabra Studer, from which it is at once distinguished by its possessing the sutural striation of the H. cellaria All these conical, highly group.1 polished specimens are, in my opinion, voung shells of a woodland form of Hyalinia cellaria; and until further

evidence on the matter is forthcoming I must regard all these as variations of one species. The whitish form of Hyalinia cellaria is found in several districts, principally in the south and west: and in some areas, as, for instance, near Kilkenny and the districts around Abbeyleix and Durrow in Queen's Co., it is the prevailing form. Personally I have never taken this white form except in churchvards in West Mavo: in all of these which I have visited in that division it has been the only form observed. Perhaps the most remarkable shells of this species I have seen are those taken by Mr. Welch in the old woods at Glencar, in Sligo,1 and similar ones collected by Mr. Phillips in woods at Woodford, S.E. Galway. (Plate VII, figs. 51-52.) These are large and verv high-spired, and have less rapidly increasing whorls than most of our Irish examples usually have; the last whorl is also greatly depressed towards the aperture.

## Hyalinia alliaria (Miller).

Helix alliaria, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 18, 1840.

		WD	ED	LD	AN	
			FE	TY	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		SG	KC	KD	DU	
	CL	NT	QC	CW	WL	
NK	LK	ST	KK	WX		
SK	MC	EC	WA			
	WC					

<sup>1</sup> These shells have been recorded by Mr. Taylor in his monograph (vol. iii, p. 55) as *Hyalinia helvetica* Bium.

<sup>&</sup>lt;sup>1</sup> Irish Nat., Oct., Nov., and Dec., 1910.

Generally distributed, but most abundant in the western and northern maritime counties, and extremely common on the western islands, where the greenish form usually predominates. A white or cream-coloured form is also frequently met with in the west or on the islands, and resembles a gigantic **H.** pura. In some old woods, especially in the south-western districts, a smaller, more narrowly umbilicated and more conical shell is often found, which contrasts greatly with the larger and flatter shells living in more exposed situations. The case of these two forms seems analogous to the scharffi and hibernica forms of Hyalinia cellaria. In the Dingle peninsula Hyalinia alliaria occurs from sea-level to the summit of Brandon Mt., 3127 feet; and its altitudinal distribution exceeds that of any of our other Hyaliniae.

## Hyalinia nitidula (Draparnaud).<sup>1</sup>

Helix nitidula, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 18, 1840.

		WD	ED	LD	AN	
			FE	TY	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SC	KC	KD	DU	
	CL	NT	0C	CW	WI	
NK	LK	ST	ŇК	WX		
SK	MC	EC	WA			
	WC					

Distributed throughout the four pro-

vinces, but seldom met with in real abundance. The prevailing form seems to resemble the Hyalinia nitens of Michaud. The var, helmi is occasionally met with in colonies, and on the great talus of Fair Head in Antrim, and in a similar position at the base of the north cliffs of Achill Island, West Mayo, it occurs without the type. This species is often found on the western islands; but it is usually rare, and appears to be losing ground both on the islands and on the mainland, perhaps owing to the increase of cultivation and the consequent diminution of sheltered habitats.

#### Hyalinia pura (Alder).

Helix pura, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 18, 1840.

		WD	ËD	LD	AN	
			FE	TY	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SC	KC	KD	DU	
	CL	NT	0.C	CW	WI	
NK	LK	ST	ŇК	WY		
SK	MC	EC	WA			
	WC					

Generally distributed, and may be found wherever suitable mossy and

<sup>&</sup>lt;sup>1</sup> It has always been the custom in England and elsewhere to regard the species here in-

tended as the Hyalinia nitidula of Draparnaud; but the figure given by this authority in his Hist. Nat. Moll. terr. et fluv. de la France, p. 117, pl. viii., more resembles H. pura Alder. The belief that Draparnaud intended to describe H. pura is strengthened by his distinctly including H. radiatula Alder as a variety under his nitidula. This belief is still further strengthened by the fact that Wm. Thompson

shaded habitats occur. It lives on several of the western islands, and is also recorded from Rathlin Island in Antrim and Lambay in Dublin. In most parts of the country the type is commoner than the var. *nitidosa*, which, according to Mr. J. W. Taylor,<sup>1</sup> is most prevalent in the central districts.

#### Hyalinia radiatula (Alder).

Helix radiatula, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 19, 1840.

		WD	ED	LD	AN	
			FE	ΤY	AR	DO
	WM	SL	LE	MO		
		$\mathrm{E}\mathrm{M}$	RO	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		SG	KC	KD	DU	
	CL	NT	QC	CW	WE	
NK	LK	ST	KK	WX		
SK	MC	EC	WA			
	WC					

One of the most ubiquitous species of the genus in Ireland, having a wide distribution in all four provinces. The green form and the type occur probably in about equal numbers; but in particular districts one of these may often predominate. Recorded from Lambay, in Dublin, and usually found on the western islands.

Westerlund has recorded Hyalinia petronella

<sup>1</sup> Mon. L. & F. W. Moll. of the Brit. Isles, Vol. iii, p. 85. Charpentier as found in "Ireland." This would appear to be an erroneous record, Westerlund, like the late Dr. Gwyn Jeffreys, probably mistaking *Zonitoides excavatus* for *H. petronella*. Mr. Taylor, in his monograph, classes the latter shell as an alpine race of *H. radiatula*.]

## Zonitoides nitidus (Müller).

Helix lucida, Thompson, Cat. L. & F. W.
Moll. of Ireland, p. 19, 1840. Hyalinia nitida, Scharff, Irish Nat., p. 67, 1892.

WD ED LD AN FE TY AR DO Wmsl Le Mo Em Ro CV LH Wg Ng Lf Wh Me Sg Kc Kd Du Cl Nt QC CW Wi NK LK St KK WX Sk Mc EC WA

Generally distributed, but only locally Found on two of the common. western islands, namely, Clare Island, West Mayo, and Inishmore, Aran Islands, Clare. Around the stony edges of lakes in the limestone areas it is perhaps most abundant; but it can be obtained by careful search in almost all marshy places throughout the country. Its principal variation is in colour. The darkest specimens I have seen are from Clare Island, which are of a rich red-mahogany colour; and the palest are from Queen's County. A rather strongly striated form, with narrower whorls, closely resembling some specimens of Zonitoides excavatus, I have seen in several localities in the west.

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mentions (Cat. L. & F. W. Moll. of Ireland, p. 18) that M. Michaud identified Irish specimens of *H. pura* and *H. radiatula* as two forms of *H. nitidula* Drap. Michaud must surely at this time have been fully qualified to recognize Draparnaud's species.

## Zonitoides excavatus (Bean).

Helix excavata, Thompson, Cat. L. &
F. W. Moll. of Ireland, p. 20, 1840.
Hyalinia excavata, Scharff, Irish Nat.,
p. 67, 1892.

		WD	ED	LD	AN	
			FE	ΤY	$\mathbf{AR}$	DO
	WM	$\operatorname{SL}$	$\mathbf{LE}$	MO		
		$\mathbf{E}\mathbf{M}$	RO	$\mathbf{CV}$	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		SG	$\mathbf{KC}$	KD	$\mathrm{DU}$	
	CL	$\mathbf{NT}$	QC	CW	WI	
NK	LK	ST	KK	WX		
SK	MC	EC	WA			
	WC					

This is the only terrestrial species which in Ireland we could term calcifuge; all the localities from which it has been recorded lie outside the Carboniferous limestone areas, with the possible exception of the Limerick station. It has a wide range in the southern, western and north-western counties, but seems absent from the north-east and the central plain, and is rare or absent in all the eastern counties. Old records from Dublin and Down have not been verified in recent years. As this species, however, is found in parts of Kilkenny and Wexford, there seems no reason why it should not also occur in Carlow, Wicklow, and Dublin, the greater part of this area being formed of non-calcareous rocks. As a general rule the type and the var. vitrina are equally common; but in many cases, though found in the same district, each form lives in separate colonies, and in some districts only one of them may occur. Mr. Phillips tells me that this

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is his experience in the south-east, where he has never seen the type. The presence of this shell on our islands has only been noted in two cases, viz., Clare and Achill, both in West Mayo.

## Euconulus fulvus (Müller).

Helix fulva, Thompson, Cat. L. & F. W.
Moll. of Ireland, p. 11, 1840.
Hyalinia fulva, Scharff, Irish Nat., p. 67, 1892.

		WD	ED	LD	AN	
			FE	ΤY	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SC	KC	KD	DU	
	CL	NT	QC	CW	WL	
NK	LK	ST	ŇΚ	WX		
SK	MC	EC	WA			
	WC					

A very hardy little mollusk and found almost everywhere, though seldom met with in large numbers. Commonly found on the western and other islands. It is one of the few land-shells which live in the neighbourhood of our peatbogs. Shows little variation.

#### ARIONIDAE.

#### Arion ater (Linné).

Generally distributed over the mainland and islands. It shows much variation in colour and many examples, even when practically full-grown, are distinctly banded. In the mountainous districts, as well as on the west coast and the western islands, it is usual to find only jet-black specimens. The vars.

		WD	ED	LD	AN	
			FE	TY	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SG	KC	KD	DU	
	CL	NT	0C	CW	WL	
NK	LK	ST	ŇК	WX		
SK	MC	EC	WA			
	WC					

castanea and plumbea, which are more prevalent in the eastern parts of the country, are nevertheless generally distributed on the mainland, and have also been noted as occurring on several of the islands. The vars. succinea and albolateralis have been found in many districts, but show no particular geographical distribution. The altitudinal distribution of Arion ater extends from sea-level to over 3000 feet, at which high altitudes the var. aterrima only has been noticed.

Arion subfuscus (Draparnaud).

		WD	ED	LD	AN	
			FE	TΥ	AR	DO
	WM	SL	LE	MO		
		$\mathbf{E}\mathbf{M}$	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SG	KC	KD	DU	
	CL	NT	QC	CW	WE	
NK	LK	ST	KK	WX		
SK	MC	EC	WA			
	WC					

Common throughout the entire main-

land and usually met with on the islands. Like *Arion ater*, this slug is found from sea-level to the summits of the highest mountains. In the western and south-western districts specimens are frequently more distinctly banded. Its colouring is fairly constant in other parts of the country.

Arion intermedius Normand.

		WD	ED	LD	AN	
			FE	ΤY	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		SG	KC	KD	DU	
	CL	NT	<b>0</b> C	CW	WI	
NK	LK	ST	ŇК	WX		
SK	MC	EC	WA			
	WC					

Very generally distributed, but more local than any of the other species, especially in the central, and in parts of the eastern counties. In the west and on the western islands it is often the most abundant of all the Arionidae, usually living in great profusion at the roots of plants on the damper parts of the cliffs and in similar situations. Western specimens are generally more distinctly banded than those found in the east, and are often of an almost uniform grey colour above, sometimes nearly black, the head and tentacles being generally darker than the rest of the animal. The vellowish and less viscid mucus will usually distinguish these western specimens from Arion hortensis, even if the servated dorsal line is not visible.

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A beautiful bright golden-yellow form with brilliant orange foot-sole was recently taken by Mr. Welch and myself on Brandon mountain in South Kerry, the most highly coloured specimen being taken at an altitude of about 2700 feet. On Croaghpatrick, West Mayo, a similar yellow form has occurred to me at an altitude of 1525 feet.

Arion hortensis Férussac.

		WD	ED	LD	AN	
			FE	TY	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SG	KC	KD	DU	
	CL	NT	<b>0</b> C	CW	WI	
NK	LK	ST	ŇК	WX		
SK	MC	EC	WA			
	WC					

Generally distributed, but much more plentiful in the east; it is often rare and local in the west. On the Dingle peninsula it is exceptionally rare; and on the islands off the west coast it is not always to be found. The western form of *Arion intermedius* closely resembles pale specimens of this slug, and, during moist weather, when the serrated outline of that species is not always visible, there is little externally to separate the species, except the mucus, which in this species is more tenacious.<sup>1</sup>

## Arion circumscriptus Johnston.<sup>2</sup>

Arion bourguignati, Scharff, Slugs of Ireland, Sci. Trans. Royal Dublin Society (2), iv, 547, 1891.

		WD	ED	LD	AN	
			FE	ΤY	AR	DO
	WM	SL	LE	MO		
		$\mathbf{E}\mathbf{M}$	RO	CV	LH	
	WG	NC	$\mathbf{LF}$	WH	ME	
		SG	KC	KD	DU	
	CL	NT	0.C	CW	WI	
NK	LK	ST	ŇК	WX		
SK	MC	EC	WA			
	WC					

Widely distributed, but never as plentiful as the other species of the genus. More common in the west than *Arion hortensis*. It inhabits the majority of the western islands, where a greyishbrown form prevails. This "western" form, which also occurs in the Dublin and Wicklow hills, is similar to one I have collected in the Orkneys and in western Norway.

## Geomalacus maculosus Allman.

The "Kerry Slug" may be collected in large numbers during damp weather on lichen-covered rocks in some portions of West Cork and South Kerry, on which its protective markings render it scarcely visible. It has also been taken in woods by Dr. Scharff, who discovered it near Glengarriff in the mossy forks of trees, where it had retired during dry

<sup>&</sup>lt;sup>1</sup> It may be worth noting that in the districts where the grey form of *A. intermedius* occurs, this slug is generally almost black, with dark orange footsole, thus making the separation of the two species a comparatively easy task.

<sup>&</sup>lt;sup>2</sup> The name A. circumscriptus of Johnston is adopted here, because the older A. fasciatus, which was thought to be this species, is probably Arion intermedius Normand.

weather. Near the tunnel above this village I once observed it very common

```
      WD ED LD AN

      FE
      TY AR
      DO

      WM SL
      LE MO
      H

      EM RO CV LH
      H
      H

      WG NG LF WH ME
      G
      DU

      CL NT QC CW WI
      H

      NK LK ST KK WX
      H

      SK MC EC WA
      W
```

on the grassy edges of the road at an altitude of about 1000 feet. There is a considerable amount of variation in its colouring and marking, some specimens being of greenish-yellow and others white, while the markings vary also in intensity and in their disposition on the animal, sometimes being placed so as to show distinct bands. In dry weather it is impossible to find it in its usual habitats.<sup>1</sup>

## ENDODONTIDAE.

Punctum pygmaeum (Draparnaud).

Helix pygmaea, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 17, 1840.

This primitive species is generally distributed throughout the mainland. It is also found on most of the western islands, and is a frequent ingredient of siftings from flood-debris and sand-duneshell-pockets.

<sup>1</sup> Irish Nat., vii., 220, 1898.

		WD	ED	LD	AN	
			FE	TΥ	AR	DC
	WM	SL	LE	MO		
		$\mathbf{E}\mathbf{M}$	RO	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		SG	KC	KD	DU	
	CL	NT	0,C	CW	WI	
NK	LK	ST	ŇК	WX		
SK	MC	EC	WA			
	WC					

# Sphyradium edentulum (Draparnaud).

Vertigo edentula, Thompson, Cat. L. & F. W. Moll. of Ireland, p 25, 1840.

		WD	ED	LD	AN	
			FE	TY	AR	DO
	WM	SL	LE	MO		
		$\mathrm{E}\mathrm{M}$	RO	CV	LH	
	WG	NC	$\mathbf{LF}$	WΗ	ME	
		SG	KC	KD	DU	
	CL	NT	QC	CW	WI	
NK	LK	ST	ŇК	WX		
SK	MC	EC	WA			
	WC					

Very generally distributed and exceedingly abundant in all the old native woods. Particularly common in the rough, uncultivated parts of the glens of Antrim, and in damp meadows and woods of parts of the west and southwest. The var. columella, which has often been regarded as a distinct species on the Continent, also occurs frequently; but it is at present impossible to give its exact distribution. S. edentulum is generally found on the western islands.

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#### Pyramidula rupestris (Draparnaud).

Helix umbilicata, Thompson, Cat. L.
and F. W. Moll. of Ireland, p. 17, 1840. H. rupestris, Scharff, Irish Nat., p. 105, 1892.

WD ED LD AN FE TY AR DO WMSL LE MO EM RO CV LH WG NG LF WH ME SG KC KD DU CL NT QC CW WI NK LK ST KK WY SK MC EC WA

Widely distributed over the Carboniferous limestone of the central plain, and also occurs in several isolated colonies on the Chalk in Antrim. Between the Antrim Chalk and the nearest habitat of this species on the Carboniferous formation lie many miles of country from which the shell has never been recorded. In the south P. rupestris is often found on old mortared walls and other buildings many miles from the nearest limestone area. On the Antrim coast in one spot it has certainly spread from the Chalk on to the adjoining basalt; its distribution is therefore not altogether governed by the presence or absence of a pure limestone. It, however, seems to prefer districts where limestone predominates, and the only island on which it has yet been found is composed of this rock: this is Inismore, in the Aran Islands, where the beautiful var. viridescenti-alba occurs sparingly with the type. On the bleak summits of the Leitrim mountains which protrude from the peat-covered areas this shell sometimes occurs in great profusion. On one of these hilltops not many feet in circumference, completely isolated by the surrounding peat, and at an altitude of over 1400 feet, I have taken this species, associated with Agriolimax agrestis, Hyalinia alliaria, Euconulus fulvus, Arion subfuscus, Hygromia hispida, and Pupa cylindracea. Thompson's old record for "Scrabo, Co. Down," has never been verified, though often searched for. As there are no specimens in the Thompson collection from this division, it is not included in the present list.

#### Pyramidula rotundata (Müller).

Helix radiata, Brown, Mem. Werner.
Soc., vol. ii., p. 525, 1818. H.
rotundata, Thompson, Cat. L. & F.
W. Moll. of Ireland, p. 16, 1840.

```
WD ED LD AN
FE TY AR DO
WM SL LE MO
EM RO CV LH
WG NG LF WH ME
SG KC KD DU
CL NT QC CW WI
NK LK ST KK WX
SK MC EC WA
WC
```

Common and usually abundant throughout the entire mainland and islands. The principal variation is an almost unicolorous form which lives in the old native woods in all districts. As in the case of several other species, the shells found on the western islands are mostly of the woodland type, although no woods now remain there. In many districts round the coast the greenish-white form is sometimes found, but seldom met with in numbers. Variation in the spire is also considerable; but no importance from a distributional point of view is attached to such variation.

#### HELICIDAE.

#### Helicella virgata (Da Costa).

Helix virgata, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 14, 1840.

		WD	ED	LD	AN	
			$\mathbf{FE}$	$\mathbf{T}\mathbf{Y}$	AR	DO
	WM	$\mathbf{SL}$	$\mathbf{LE}$	MO		
		$\mathbf{E}\mathbf{M}$	RO	CV	LH	
	WC	NG	LF	WH	ME	
		SG	KC	KD	DU	
	CL	NT	0C	CW	WI	
NK	LK	ST	ŇК	WX		
SK	MC	EC	WA			
	WC					

Of our four Irish Helicellae this is the only one with a restricted distribution, though abundant in places where it does occur. It is common throughout the central and eastern, and many of the southern counties, decreasing in abundance towards the north-west and north. From Ulster it is almost absent, being found only in the south-east and in three localities in northern Antrim, one of which is on Rathlin Island. Like *Pyramidula rupestris*, the only western island on which it has been so far observed is Inishmore, one of the Aran Islands. Throughout the greater part of its range in Ireland, this species shows the usual variation; but in the Antrim habitats the type is never seen, and all specimens are referable to the vars. *alba* or *submaritima*, the former being found on Rathlin only, while the latter occurs in all three localities.<sup>1</sup>

#### Helicella itala (Linné).

Helix ericetorum, Thompson, Cat. L. and F. W. Moll. of Ireland, p. 16, 1840.

		WD	ED	LD	AN	
			$\mathbf{FE}$	$\mathbf{T}\mathbf{Y}$	AR	DO
	WM	SL	$\mathbf{LE}$	MO		
		EM	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SC	KC	KD	DU	
	CL	NT	QC	CW	WL	
NK	LK	ST	KK	WX		
SK	MC	EC	WA			
	WC					

Occurs on practically all the sanddune areas round the coast, but is noticeably absent from those of Louth and Down, and some of those in Sligo. Over the limestone districts, with the exception of those of Sligo, Monaghan, Cavan, Fermanagh, and Tyrone, it is also generally distributed; and on the western islands where suitable conditions prevail, it is not often absent. The form which lives in the eastern counties and on the central plain is, as a rule, larger and flatter than that met

<sup>&</sup>lt;sup>1</sup> A peculiarly high-spired and apparently foreign form has been introduced with ballast on the railway embankment at Magheramorne, in the south of Antrim.—Irish Nat., xv, 76.

with on the west coast; and I have little doubt that several other continental "species" are included in our *H. itala.* Specimens from the Aran Islands (Clare) have been described by Dr. Westerlund as *Helix lampra*. I do not, however, think their characters are sufficiently marked to deserve specific distinction.

#### Helicella intersecta (Poiret).

Helix caperata, Thompson, Cat. L. and
F. W. Moll. of Ireland, p. 15, 1840.
H. intersecta, Scharff, Irish Nat., p. 107, 1892.

WD ED LD AN FE TY AR DO WM SL LE MO EM RO CV LH WG NG LF WH ME SG KC KD DU CL NT QC CW WI NK LK ST KK WX SK MC EC WA WC

The distribution of this xerophile is very similar to that of *Helicella itala*; yet it is a rarer and more local shell, and seldom occurs in the enormous quantities of the other members of the genus. It is absent from the greater part of Ulster, being found only very locally on the coasts of Antrim, Derry, and Donegal; but it reappears on the limestone area in the south of Armagh. Specimens from the west and northwest are generally extremely large, and are identical with specimens in the Westerlund collection, Dublin Museum, from the coast of Portugal. The prevailing form in the central and castern counties is more akin to that found on the Chalk downs of the south of England.<sup>1</sup> In the Dingle Peninsula (South Kerry) I have recently taken both these forms, and what I had formerly regarded as the "eastern" one occurred in four stations, while the large "western" form was only taken in one locality.

#### Helicella barbara (Linné).

Helix bifasciata, Brown, Mem. Werner Soc., vol. ii., p. 529, 1818. Bulimus acutus, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 22, 1840. Helix acuta, Scharff, Irish Nat., p. 108, 1892.

		WD	ED	LD	AN	
			$\mathbf{FE}$	$\mathbf{T}\mathbf{Y}$	AR	DO
	WM	SL	$\mathbf{LE}$	MO		
		$\mathbf{E}\mathbf{M}$	RO	$\mathbf{CV}$	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		SG	KC	KD	DU	
	CL	NT	QC	CW	WI	
NK	$\mathbf{L}\mathbf{K}$	ST	KK	WX		
SK	MC	EC	WA			
	WC					

Like *Helicella itala*, this shell has an extremely wide distribution on coastal sand-dunes and over the central plain, though sometimes absent from large areas of both. It is a remarkable fact that this essentially maritime species is found right in the heart of Ireland, and can be collected in great quantities right across the central plain from

<sup>&</sup>lt;sup>1</sup> This form would appear to be Montagu's *Helix caperata*.

Dublin to Galway; and while it seems to be absent from the coast of North Kerry and Clare-sand-dunes included -it is found inland at Ennis, in the latter division. Though absent from Clare Island in West Mavo, it is as a general rule found on the western islands, and is also recorded from Lambay in Dublin, and Rathlin in Antrim. Its variation is considerable, both in size and markings; but nowhere is such great variation observed as on the east coast from Dublin to Down, where specimens can be found from almost white to black. In the central districts and on the west coast the prevailing forms are the type and var. strigata, while examples from many of the western islands are of a much more tumid shape than is usual on the mainland.

## Hygromia fusca (Montagu).

Helix fusea, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 10, 1840.

		WD	ΕD	LD	AN	
			FE	TY	AR	DO
	WM	SL	LE	MO		
		EM	$\mathbf{RO}$	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	ΜE	
		$\mathbf{SG}$	KC	KD	DU	
	CL	NT	<b>00</b>	CW	WI	
NK	LK	ST	ŇК	WX		
SK	MC	EC	WA			
	WC					

Fairly common throughout the nativewooded areas and in similar uncultivated parts of the country, but especially abundant in the damp northern and western glens; and its almost constant association with the Wood Rush (Luzula maxima) is remarkable. It is absent from many districts in the central counties, and is always rare outside the coastal or mountainous parts of the country, but shows no preference for any geological formation. Its presence on the sea-cliffs of Achill and Clare Islands in West Mayo is particularly interesting; but since this shell is known to be a very ancient species, the fact is not so surprising. In the Dingle peninsula, in South Kerry, it occurs on Luzula to at least 1400 feet altitude near Connor Hill, closely associated with such local plants as Saxifraga umbrosa, S. Geum, S. stellaris, Oxyria digyna, and Pinguicula grandiflora.

## Hygromia granulata Alder.

Helix granulata, Thompson, Cat. L. &
F. W. Moll. of Ireland, p. 12, 1840.
H. sericea, Scharff, Irish Nat., p. 106, 1892.

		WD	ED	LD	AN	
			$\mathbf{FE}$	$\mathbf{T}\mathbf{Y}$	$\mathbf{AR}$	DO
	WM	SL	$\mathbf{LE}$	MO		
		ЕM	RO	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		$\operatorname{SG}$	$\mathbf{KC}$	$\mathrm{KD}$	DU	
	CL	$\mathbf{NT}$	$\rm QC$	CW	WI	
NK	LΚ	ST	$\mathbf{K}\mathbf{K}$	WX		
SK	MC	EC	WA			
	WC					

Has mainly a south-western range, and, though local, is generally plentiful where found. Mr. Phillips sends me the following notes on its habits:— "It is particularly abundant along the

upper tidal reaches of the Shannon and its tributaries, and its empty shells are to be found in enormous quantities among the debris along their banks after high winter floods. In Limerick it occurs in woods with Acanthinula lamellata and Pupa anglica." Though often inhabiting damp situations, this shell will also thrive in very dry places, as it has recently occurred to me at Ardfert, in North Kerry, living on the upper storeys of the old abbey, among nettles and brambles. As I have noticed in Cornwall, Hygromia hispida is seldom found associated with the present species, though probably living in its neighbourhood. Miss Warren's record from Killanley marsh, in Sligo, shows that its range may possibly be extended in the future, and there are old records for "Helix sericea" from Dublin and Kildare. These latter may possibly, however, only refer to a variety of H. hispida, and I regard them as doubtfnl.

## Hygromia hispida (Linné).

Helix hispida and H. concinna, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 13, 1840.

WD ED LD AN FE TY AR DO WM SL LE MO EM RO CV LH WG NG LF WH ME SG KC KD DU CL NT QC CW WI NK LK ST KK WX SK MC EC WA WC

A most variable shell, and one which R.I.A. PROC., VOL. XXIX., SECT. B. is found in all parts of the four provinces, though somewhat scarce in some districts, and seldom common on peaty areas. Three fairly distinct forms of variation can be observed; but in certain districts connecting forms may be obtained : —

(a.) The small, contracted form of the drier parts of the central and eastern counties. This shows a strongly calcicole distribution. In appearance it sometimes resembles superficially the *Hygromia plebeia* Drap. of the Continent, but is at once distinguished from that shell by its less conoid shape, its more strongly marked suture, and thicker peristome.

(b.) The large, flat, and very openly umbilicated form which prevails in parts of the north-eastern, eastern, and south-eastern counties. This is particularly common around the edges of the basaltic plateau of Antrim and Derry and in the valleys and tidal marshes of the Barrow, Nore, and Suir, in Wexford and Kilkenny.

(c.) This, which appears referable to Clessin's var. *septentrionalis*, is found in many parts of the north and west, and is the only form that I have ever found on the western islands. In appearance it is usually hairy, thin, high-spired and therefore with a narrow umbilicus, and, though sometimes girdled with a white peripheral band, it is more often of a unicolorous walnut-brown. Outside Ireland I have taken specimens of this form in the Orkneys and in western Norway.

In the north-east one seldom finds fully grown shells, as this species breeds and often dies long before the lip of the shell is formed.

[N]

## Hygromia rufescens (Pennant).

Helix rufescens, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 14, 1840.

		WD	ED	LD	AN	
			FE	TΥ	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SG	KC	KD	DU	
	CL	NT	QC	CW	WI	
NK	LK	ST	ŇК	WX		
SK	MC	EC	WA			
	WC					

Though found in all divisions and on the Aran Islands, this must be looked upon as distinctly an eastern and central species, and one which has all the appearance of being among the latest arrivals in this country. In the north and west it is seldom native, as far as one can judge, and usually appears naturalized. It is one of our few shells which is clearly extending the range of its distribution at the present day; and it is constantly turning up in fresh localities, especially gardens, where it is easily introduced with plants, and seldom fails to establish itself.<sup>1</sup> Being to a certain extent a "hedgerow" species, the present cultivated condition of the country is admirably suited to its requirements: and it occurs in great quantities in such habitats in the central and eastern counties. It varies greatly, from white to a rich dark-brown in colour, and in shape from almost flat to a high-spired and conical shell.

Sometimes it is keeled obtusely; but more often this is absent when the shell is full-grown. Probably at least three continental "species" are included in our Irish Hygromia rufescens.

## Acanthinula aculeata (Müller).

Helix aculeata, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 11, 1840.

		WD	ED	LD	AN	
			FE	TY	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		SC	KC	KD	DU	
	CL	NT	QC	CW	WI	
NK	LK	ST	KK	WX		
SK	MC	EC	WA			
	WC					

Generally distributed, but never met with in such quantities as the next species. From the number of dead shells found in our sand-dunes this would appear to have formerly been a more abundant species. White specimens frequently occur, and spineless ones have been recorded from several localities. This latter form, the var, *sublaevis* of Westerlund, is never common; and it has, so far as my experience goes, only been taken occasionally on the stony margins of lakes, and never in company with the type.

Acanthinula aculeata is frequent but by no means common on the western islands. Juvenile specimens of the western form of *Pupa cylindracea* closely resemble *A. aculeata* var. sublaevis, but the latter can be distinguished by its deeper suture.

<sup>&</sup>lt;sup>1</sup> Its liking for *Arabis albida* has often been noted by me, and few gardens where this plant grows do not also shelter *H. rufescens*.

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## Acanthinula lamellata (Jeffreys).

Helix lamellata, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 12, 1840.

		WD	ED	LD	AN	
			FE	ΤY	AR	DO
	WM	SL	LE	MO		
		$\mathbf{E}\mathbf{M}$	$\mathbf{RO}$	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	$\mathbf{ME}$	
		SG	$\mathbf{KC}$	KD	ÐU	
	CL	NT	QC	CW	WI	
NK	LK	ST	KK	WX		
SK	MC	EC	WA			
	WC					

A typical old-woodland species; and though very local, it is often extremely abundant. Mr. Phillips writes that in the south it seldom, if ever, occurs except in old Oak-woods or in glens containing Oak. This is not our experience, however, in the north; and at least a third of the habitats known to me contain at the present time no Oaks; but its association with Hazel, Beech (where this has been planted), and especially with Holly, has often been remarked on by my friend Mr. Welch. Like Hygromia fusca, this shell is neither attracted by, nor shuns, the limestone areas, and in this respect differs from Zonitoides excavatus, with which species it is frequently associated in the non-calcareous districts. Its distribution may be termed "anti-central," as it is only in the maritime and mountainous districts that it can be looked upon as anything but a rare shell. It is as yet unknown from any of the western islands, with the exception of Clare Island and Achill in West Mayo.

Yallonia pulchella (Müller).

(? = V. excentrica Sterki).

Helix paludosa, Brown, Mem. Werner. Soc., vol. ii., p. 524, 1818. H. pulchella, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 9, 1840.

		WD	ED	LD	AN	
			FE	$\mathbf{T}\mathbf{Y}$	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SG	KC	KD	DU	
	CL	NT	0 <u>C</u>	CW	WI	
NK	LK	ST	ŇК	WX		
SK	MC	EC	WA			
	WC					

Generally distributed both in the maritime counties and those districts formed of Carboniferous limestone, but seldom met with inland in the noncalcareous areas, and absent from many inland districts in Ulster.

It is common in most of the western counties and on the islands.

I am unable to discriminate clearly between *Vallonia excentrica* and the typical *V. pulchella*, and have therefore united the two forms.

#### Vallonia costata (Müller).

Helix pulchella, var. crenella, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 9, 1840. *H. pulchella*, var. costata, Scharff, Irish Nat., p. 105, 1892.

This shell has a much more central and eastern range than Vallonia pulchella and, although it occurs on the Dingle [N 2] and Belmullet peninsulas in South Kerry and West Mayo respectively,

		WD	ED	LD	AN	
			FE ·	$\mathbf{T}\mathbf{Y}$	$\mathbf{AR}$	DO
	WM	SL	$\mathbf{LE}$	MO		
		EM	$\mathbf{RO}$	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		SG	KC	KD	DU	
	CL	NT	QC	CW	WI	
NK	LK	ST	KK	WX		
SK	$\mathbf{MC}$	EC	WA			
	WC					

it has never been reported as living on any of the western islands. It is also common on many of the dry coastal dunes of north Ulster. We may expect that in the future, if it has not already been done, this species will also be divided into two, as some specimens with a more excentric appearance are frequently met with. In many localities this and *V. pulchella* are found associated; but, as a general rule, they are found in separate colonies.

## Arianta arbustorum (Linné).

Helix arbustorum, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 9, 1840.

		WD	ED	LD	AN	
			FE	TY	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		$\mathbf{SG}$	KC	KD	$\mathrm{D}\mathrm{U}$	
	$\mathbf{CL}$	NT	QC	$\mathbf{CW}$	WI	
NK	$\mathbf{L}\mathbf{K}$	ST	KK	WX		
SK	$\mathbf{MC}$	EC	WA			
	WC					

From its wide range throughout Great Britain, it is surprising how local this shell is in Ireland; and its distribution should prove of great interest to students of the geographical distribution of animals and plants. It would appear that this species is one of a group of migrants which entered Ireland from the north. In the glens of Antrim Arianta arbustorum is closely associated with the other northern immigrants, which are mostly plants; but in no way does it depend on any of these for food, not actually living in contact with them, but in their neighbourhood. Its foodplants are apparently those which have a general distribution in this country, such as the Common Nettle (Urtica dioica). From Kenbane in north Antrim to the Belfast hills in the same county Arianta arbustorum is found locally in many of the glens; and in the mountain glens of Sligo and Leitrim it again appears in fair abundance. Between these two areas the shell is extremely local and rare, but the isolated habitats, such as that at Coagh in Derry, help us to trace its former range; and it is more than probable that many such habitats exist in the more mountainous districts of Derry, Tyrone, Fermanagh, and Cavan, which up to the present are quite a terra incognita to conchologists. The records for Armagh and Westmeath apparently mark the limits of its range in those directions; those from Dublin, Limerick, and North Kerry being seemingly erroneous. Thompson mentions that the species prevails throughout the county of Antrim, " as it likewise does in Down, but more sparingly." There are, however, no specimens of this shell from Down in the Thompson collection, nor has any other collector ever found the shell in that county; the record is therefore too doubtful to be admitted into the present list. This is one of the few records of Wm. Thompson's that have not been verified.

Most Irish specimens are of the rich brown form, but the var. *flavescens* also occurs frequently in Antrim and Leitrim. In shape our shells are generally rather large and often conical.

## Helix aspersa Müller.

		WD	ED	LD	AN	
			FE	TΥ	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SG	KC	KD	DU	
	CL	NT	0.C	CW	WI	
NK	LK	ST	KK	WX		
SK	MC	EC	WA			
	WC					

As the late Wm. Thompson has pointed out, and as might almost be expected from its distribution on the Continent, which is somewhat similar to that of our Irish Helicellae, this shell is much commoner round our coasts than in the inland areas. On the west coast it is especially abundant; and in many cases it literally covers every foot of the walls and tombstones of the old churchyards. It seems a pity that the poorer peasants of these districts have not developed the liking for these dainty morsels that they have in some parts of the Continent. Mr. J. G. Milne has stated that this shell is apparently losing ground in certain localities, and that it was seemingly extinct on Achill Island. The first statement is perhaps correct; but the latter is not, as the walls in the western portion of Achill are tenanted by large quantities of this snail. It has also been found on all of the larger western islands that so far have been visited, and is recorded from Lambay, in Dublin, and Rathlin, in Antrim. Its variation in most parts of the country is negligible; but on the west coast and on the Aran Islands it varies considerably in size, shape, colour, and texture; the prevailing form is rather high-spired, of medium size, and dark in colour. The var. exalbida occurs on Inishmore in the Aran Islands, and has also been recorded from Antrim and Carlow. One sinistral example has been taken at Raghly in Sligo.

## Helix nemoralis Müller.

		WD	ED	LD	AN	
			FE	ΤY	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SG	KC	KD	DU	
	CL	NT	QC	CW	WI	
NK	LK	ST	ŇК	WX		
SK	MC	EC	WA			
	WC					

The type and the unbanded forms of this ubiquitous species are generally distributed; but nearly all the other forms are confined to certain areas. The distribution of some of these scarcer forms is sometimes very similar to that

of other species, e.g. the unbanded form castanea has a distinctly central range, which corresponds closely with that of many of the "Central" group.1 On the coast of north-west Donegal the prevailing form is libellula albolabiata 00345, while the common band formula 00300 is seldom seen. On the coast of Kerry (Dingle area) the commonest form met with is libellula or rubella 00300, with a strong white line beneath the third band, the Donegal formula being exceptionally scarce. A common French and Pyrenean form is 00345, with a broad white line above the third band. In Ireland this form occurs in fair numbers on the island of Lambay, Dublin, and I have one example from West Donegal. The form albolabiata is frequently found in all parts of the country; but in some areas of the west and north it quite outnumbers the ordinary black-lipped form. A distinctly western form is citrinozonata, which lives in colonies on many of the sand-dunes from Clare to West Donegal, in several stations outnumbering all other forms in the centre of the colony. By far the most interesting form, however, is that which has been referred by Mr. Clessin to Helix tonnensis Sandberger, a German Pleistocene species. This is the large form from the deposits at Dog's Bay, West Galway. Interesting as it is to find this shell, which appears to have lived in Germany during Pleistocene times, turning up in these deposits in the west of Ireland, the fact that this same form, or a somewhat similar one, still lives in this country is

of far greater importance. On the Aran Islands and in the neighbouring Burren of Clare, as well as on the island of Inishmurray in Sligo, and on the great cliffs of Glenade in Leitrim, this is the prevailing form. Mr. Kennard has sent me a specimen of Helix tonnensis from Germany, which is almost identical with some of the Inishmurray shells. On the upland limestone plateau to the east of Ben Bulben in Sligo, there lives at an altitude of 1700 feet a large and rather heavy form of this species, which is perhaps nearer to the Dog's Bay fossil shells than any other living at present. These shells are completely isolated by the surrounding peat-covered areas, and are nearly all rubella albolabiata 00000. Shells from the deposits at Dog's Bay, var. hibernica West., sometimes weigh over 100 grains, i.e. five or six times the weight of average adult examples. Near Bundoran in East Donegal, large numreversed and scalariform bers of specimens have been discovered. A few of these have been taken alive, but the great majority have been brought to light by the women during the making of the shell necklaces which are sold in large numbers to summer visitors.

*Helix nemoralis* is known to have lived in this country with the Arctic Lemming and other animals, which have long ago vanished from Ireland.

## Helix hortensis Müller.

This species, which has a peculiar distribution in Ireland, like that of *Pyramidula rupestris*, *Helicella virgata*, and *Ena obscura*, has a wide range over the eastern and central counties, penetrat-

<sup>&</sup>lt;sup>1</sup> See Praeger, Types of Distribution in the Irish Flora, Proc. R.I.A., xxiv., sec. B., 35, 1902.

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ing as far west as Limerick, and Lisdoonvarna in Clare, and then re-

WDEDLDANFETYARDOWWSLMOHEMROCVLHWGNGLFWHMESGKCKDDUCLNTQCCWHNKLKSTKKWXSKMCECWA

appearing in Ulster, where it is found in six or seven isolated stations extending from Downpatrick in Down to Dunfanaghy in West Donegal. In two of the northern stations-Downhill in Derry and Newtownstewart in Tyronethe only form that has ever been observed is the var. lutea, and always In the remaining Ulster bandless. habitats this form and the type occur in about equal numbers; but no other variation is found, except the var. arenicola and specimens with a band formula of 10345. In most of the eastern and central localities where this shell is to be met with, we get all the variation usually associated with it in England; but in the Clare stations Mr. Phillips has observed only the type. Specimens of the small white-lipped sand-hill form of Helix nemoralis often met with on the west coast are quite indistinguishable from this species externally; and it is necessary to examine the darts in order to separate them, unless one is acquainted with the district, when their habitats will be alone sufficient.1 That of our present species is generally a glen, churchyard, or damp hedgerow with luxuriant vegetation; while the habitat of the dwarf white-lipped *Helix nemoralis* is always the open wind-swept sanddunes.

#### Helix pisana Müller.

		WD	$\mathbf{ED}$	$\mathbf{L}\mathbf{D}$	AN	
			$\mathbf{FE}$	$\mathbf{T}\mathbf{Y}$	$\mathbf{AR}$	DO
	WM	SL	$\mathbf{LE}$	MO		
		$\mathbf{E}\mathbf{M}$	$\mathbf{RO}$	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		$\mathbf{SG}$	KC	KÐ	DU	
	$\mathbf{CL}$	$\mathbf{NT}$	$\rm QC$	CW	WI	
NK	$\mathbf{L}\mathbf{K}$	ST	KK	WX		
SK	$\mathbf{MC}$	$\mathbf{EC}$	WA			
	WC					

Practically confined to the sand-dunes which fringe the coasts of Louth, Meath, and Dublin, where it has been known for almost a century. The old records for Galway and South Kerry seem both erroneous; but there is a specimen in the Dublin Museum from "La Bergerie," in Queen's Co., and another from Drumcondra, a suburb of Dublin, so that possibly the species may occur locally further inland.<sup>2</sup> In the places where it is to be found it is a common species, and shows considerable variation, the type as well as the white and chestnut-brown forms being generally met with. Our climate seldom gives this shell a long enough summer to complete the lip, and in some years the average size of specimens is smaller than in others.

<sup>&</sup>lt;sup>1</sup> For this reason I have placed the West

Mayo record in the list of " doubtfuls."

<sup>&</sup>lt;sup>2</sup> I have doubts as to the trustworthiness of the Queen's Co. record.

## ENIDAE.

## Ena obscura (Müller).

Helix obscura, Brown, Mem. Werner Soc., vol. ii, p. 529, 1818. Bulimus obscurus, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 21, 1840. Buliminus obscurus, Scharff, Irish Nat., p. 109, 1892.

		ШD	ΕD	$\mathbf{L}\mathbf{D}$	AN	
			FE	ТΥ	AR	DO
	WM	SL	LE	0M		
		EM	RO	CV	LH	
	WG	NG	$\mathbf{LF}$	WН	ME	
		SC	KC	KD	DU	
	CL	NT	QC	CW	WL	
NK	$\mathbf{L}\mathbf{K}$	ST	KK	WХ		
SK	MC	EC	WA			
	WC					

Has a distribution very similar to that of Helix hortensis, occurring more or less continuously from Louth to Kilkenny in the south, and S. E. Galway and Clare in the west, with two-at presentisolated habitats in Sligo and Leitrim, and three on the Chalk of the Antrim coast. Capt. Brown reports having found a shell in flood debris near the coast in the south of Co. Down, which he named Helix Lackhamensis ( = Ena montana Drap.) It is difficult to account for this find, as the present species, to which Thompson referred Brown's record, has never been seen by subsequent collectors in Co. Down.

The finding of *E. obscura* by Mr. Welch in the deposits of the Strandhill dunes in Sligo is noteworthy. This is the only fossil record so far of this species in Ireland.

## STENOGYRIDAE

## Cochlicopa lubrica (Müller).

Helix lubrica, Brown, Mem. Werner. Soc., vol. ii, p. 529, 1818. Bulimus lubricus, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 22, 1840.

		WD	ED	LD	AN	
			FE	TΥ	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NC	LF	WH	ME	
		SG	KC	KD	DU	
	CL	NT	0C	CW	WI	
NK	LK	ST	ŇК	WX		
SK	MC	EC	WA			
	WC					

Generally distributed over the mainland and islands. It varies considerably in size and colour. Mr. Phillips informs me that a smaller and more slender form of this species is very frequent in uncultivated places, and apparently agrees with the var. *maderensis* of Lowe, which is said to be the prevailing form in similar areas in Madeira and Cape Verde Islands.

## Caecilioides acicula (Müller).

Achatina acicula, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 23, 1840. *Coecilianella acicula*, Scharff, Irish Nat., p. 109, 1892.

One of our rarest land mollusks, but has a fairly continuous range from Monaghan to Mid Cork and from Dublin to West Galway, and is strictly calcicole in its distribution. We owe much to Mr. Grierson for our knowledge of its range and habits, as until his discoveries it had been regarded as

		WD	$\mathbf{ED}$	$\mathbf{L}\mathbf{D}$	AN	
			$\mathbf{FE}$	$\mathbf{T}\mathbf{Y}$	$\mathbf{AR}$	DO
	WM	SL	$\mathbf{LE}$	MO		
		$\mathbf{E}\mathbf{M}$	RO	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		$\mathbf{SG}$	KC	KD	DU	
	CL	NT	<b>0C</b>	CW	WI	
NK	LK	ST	ŇК	WX		
SK	MC	EC	WA			
	WC					

confined to a few isolated localities. From its underground habits it is just possible that it may yet be found in other divisions which lie on the central plain: but its range is not likely to be greatly enlarged. Bourguignat has described a variety from England as being "considerably more elongated than the type"; but Irish specimens sent by Dr. Scharff to Westerlund were pronounced by that authority to be typical.

#### PUPIDAE

Pupa anglica (Férussac).

		WD	ED	LD	AN	
			FE	TΥ	AR	DO
	WM	SL	LE	MO		
		$\mathbf{E}\mathbf{M}$	$\mathbf{RO}$	CV	LH	
	WG	NG	$\mathbf{LF}$	WΗ	ME	
		SC	$\mathbf{KC}$	KD	DU	
	CL	NT	<b>0</b> C	CW	WI	
NK	LK	ST	ŇК	WX		
SK	MC	EC	WA			
	WC	-				

In all the old wooded areas, and often associated with *Acanthinula lamellata*, but has a wider range than R.I.A. PROC., VOL. XXIX., SECT. B. that species, and also occurs in many marshes and on the margins of lakes, in company with Zonitoides nitidus, Vertigo antivertigo and Succinea pfeifferi. Specimens from the latter habitats are easily distinguished from those found in woods, by their more polished appearance, richer colouring, and larger size. The woodland specimens are mainly referable to the var. pallida Jeffreys, while occasionally pure white shells occur.

A large form, somewhat resembling *Pupa loweana* Woll. from Madeira, has been taken near Castletown-Berehaven in West Cork, by Dr. Scharff.

## Pupa cylindracea (Da Costa).

Pupa umbilicata, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 23, 1840.

Abundant in all parts of the mainland and common on all the islands. The prevailing western and insular form is usually unadorned with the denticle; or, if present, this is never strongly marked. This western variety seems to be identical with Pupa anconostoma Lowe, and has also been referred to the Pupa semproni of Charpentier by Messrs. Waterston and Taylor (Ann. Scottish Nat. Hist., January, 1906) The latter is supposed to be an alpine race of P. cylindracea, while the former would appear to be confined to the west coast of Europe from the Atlantic Islands<sup>1</sup> to Scandinavia.<sup>2</sup> In the drier parts of the limestone areas the normal

<sup>&</sup>lt;sup>1</sup> Wollaston, Testacea Atlantica, pp. 43, 210, 450, and 554.

<sup>&</sup>lt;sup>2</sup> Westerlund, Fauna Moll. Terr. et Fluy. Sveciae, Norvegiae et Daniae, p. 242.

form is the prevailing one; but nowhere in Ireland does this shell reach the size of the largest continental specimens.

		WD	ED	LD	AN	
			FE	TY	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SC	KC	KD	DU	
	CL	NT	QC	CW	WL	
NK	LK	ST	KK	WX		
SK	MC	EC	WA			
	WC					

## Pupa muscorum (Linné).

Pupa marginata, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 25, 1840.

		WD	ED	LD	AN	
			$\mathbf{FE}$	TY	$\mathbf{AR}$	DO
	WM	SL	$\mathbf{LE}$	MO		
		$\mathbf{E}\mathbf{M}$	$\mathbf{RO}$	$\mathbf{C}\mathbf{V}$	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		$\mathbf{SG}$	KC	KD	DU	
	CL	$\mathbf{NT}$	QC	CW	WI	
NK	LK	ST	ŇΚ	WX		
SK	MC	EC	WA			
	WC					

Widely distributed; but, except on the central limestone plain, it is purely a maritime species, and therefore absent from many inland districts of Ulster. Usually met with along the west coast, but very rare in West Galway, is seemingly absent from West Mayo, and has only been recorded for two of the western islands—Inishmore in the Aran Islands and Inishmacdara off the West Galway coast—in both of which it was taken by Mr. Standen in 1896, but has not been seen by recent collectors. The normal form with a denticle is that most commonly met with; but in Ulster this is very seldom seen, the great majority of shells being quite edentate. Dr. Scharff reports the var. *bigranata* Rossm. from the Aran Islands and Donegal.

## Vertigo minutissima (Hartmann).

		WD	$\mathbf{ED}$	$\mathbf{D}$	AN	
			$\mathbf{FE}$	$\mathbf{T}\mathbf{Y}$	AR	ĐO
	WM	$\mathbf{SL}$	$\mathbf{LE}$	MO		
		$\mathbf{E}\mathbf{M}$	RO	CV	$\mathbf{LH}$	
	WG	NG	$\mathbf{LF}$	WH	ME	
		$\mathbf{SG}$	KC	KD	DU	
	$\mathbf{CL}$	$\mathbf{NT}$	$\mathbf{QC}$	$\mathbf{CW}$	WI	
NK	$\mathbf{L}\mathbf{K}$	$\mathbf{ST}$	KK	WX		
SK	$\mathbf{MC}$	$\mathbf{EC}$	WA			
	WC					

Mr. J. R. Hardy's discovery of this shell at Killarney still remains our only record. He collected it under a log of wood in Muckross demesne. Conchologists who have visited this locality in recent years have failed to find specimens of this species.

## Vertigo antivertigo (Draparnaud).

Vertigo palustris, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 26, 1840.

Generally distributed and usually common in marshy places and around the stony edges of lakes. In the latter habitats it is commonly associated with Zonotoides nitidus, Agriolimax laevis, other Vertigoes, and Succinea pfeifferi. Particularly abundant in the west, and

98

recorded from most of the islands. It varies greatly in size, in the number of

```
WD ED LD AN
FE TY AR DO
WMSL LE MO
EM RO CV LH
WG NG LF WH ME
SG KC KD DU
CL NT QC CW WI
NK LK ST KK WX
SK MC EC WA
```

denticles, and in shape, some specimens being very short and stumpy. The most remarkable specimen I have seen is one which I took under stones on the edge of Glenade Lough in Leitrim; it is remarkably elongated, and wants the characteristic swollen body-whorl of this species; it is, moreover, of a rich claret colour, and in outline resembles slightly *Vertigo lilljeborgi*, with which shell it was associated.

Vertigo substriata (Jeffreys).

		WD	ED	LD	AN	
			FE	$\mathbf{T}\mathbf{Y}$	AR	DO
	WM	SL	LE	MO		
		$\mathbf{EM}$	$\mathbf{RO}$	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		SG	KC	KD	DU	
	CL	NT	ÔĈ	CW	WI	
NK	LK	$\mathbf{ST}$	KK	WX		
SK	MC	EC	WA			
	WC					

Generally distributed on most parts of the mainland, and frequently met with on the islands. It is common in all wooded areas, and generally found in marshy places, the edge of lakes or damp cliffs. Variation in size of the shell is often considerable, the marsh form being seemingly the largest.

Vertigo pygmaea (Draparnaud).

		WD	ED	LD	AN	
			FE	$\mathbf{T}\mathbf{Y}$	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		SG	KC	KD	DU	
	CL	NT	QC	CW	WI	
NK	LK	ST	ŇΚ	WX		
SK	MC	EC	WA			
	WC					

Shares with Vertigo antivertigo the distinction of being the commonest species of the genus, and is almost universally distributed over the mainland and on the islands. It is one of our most variable land-shells: three well-marked forms occur, viz.:--

(a) A small stumpy form, resembling somewhat in contour Vertigo substriata; has always five denticles, and is paler in colour than the other two forms described below. Common in woods.

(b) The very large robust form met with in marshy places, of a dark horncolour, and although often possessing a fifth denticle it is usual to find only four—one on the body-whorl, one on the columella, and two on the outer margin of the aperture. In shape it slightly resembles *Vertigo alpestris*, the last whorl being contracted, which gives the whole shell a slender appearance.

[0 2]

(e) A smaller and still more slender form than (b), and one which I have taken only in West Galway and West Mayo, on the Aran Islands, and on the Dingle promontory. Many of my specimens from the second locality have six denticles, viz., one on the body-whorl, two on the columella, and three on the outer margin of the lip.

Vertigo moulinsiana (Dupuy).

		WD	$\mathbf{ED}$	LD	AN	
			FE	$\mathbf{T}\mathbf{Y}$	AR	DO
	M.N	SL	LΕ	MO		
		ЕM	RO	CV	LH	
	WG	NG	$\mathbf{LF}$	WН	ME	
		SG	KC	КD	DU	
	CL	NT	QC	CW	WI	
NK	$\mathbf{L}\mathbf{K}$	ST	KK	M.Z		
$\mathbf{SK}$	$\mathbf{MC}$	EC	WA			
	WC					

This species, which has only recently been added to the Irish fauna by Mr. Phillips, is much the largest of the Britannic species of the genus, and is easily distinguished from the next, to which all previous records under the name of Vertigo moulinsiana in Ireland refer. The following notes on this shell have kindly been supplied by Mr. Phillips :- "So far its range is confined to the valley of the River Barrow; and it has been taken in one locality each in Carlow and Queen's County. It is a gregarious species, living in swampy marshes along the banks of the river, spending the spring and early summer months feeding low down among the marsh-vegetation; and in the autumn may be seen in great

numbers on the reeds and other tall plants, on which it breeds and finally hibernates. It does not appear to be particular as to the petrological nature of its habitats, that in Carlow being on granite, and the Queen's County one being on limestone."

## Vertigo lilljeborgi Westerlund.

Vertigo moulinsiana, Scharff, Irish Nat., p. 136, 1892.

WD ED LD AN FE TY AR DO WM SL **LE** MO EM RO CV LH WC NG LF WH ME SG KC KD DU CL NT QC CW WI SK LK ST KK WX SK MC EC WA

Although perhaps distributed sporadically over the western counties, it is only recently that this shell has been taken in any habitat other than that at Ballynahinch, in West Galway, where it was first discovered by the late Dr. Gwyn Jeffreys. Since the late Dr. Chaster and Mr. Tomlin rediscovered its habitat at Ballvnahinch, it has been found in several other localities in the same district and also in West Cork, on the shore of Lough Allua, and in a similar spot at the southern end of Glenade Lough, in Leitrim. In the former place, i.e. Lough Allua, I took only one shell; but, as I mistook it for Vertigo antivertigo, and recorded it as such, I

did not look for more specimens. At Glenade, however, it appeared common under stones near the outlet of the lake, associated with Vertigo pugmaea, V. antivertigo, V. substriata, Hyalinia radiatula, Carychium minimum, Succinea pfeifferi, Limnaea palustris, and L. trun-The great majority of the catula. specimens taken in this last habitat were small-smaller, in fact, than the accompanying specimens of V. pygmaea; but several were equal in size to those usually found in West Galway. Dr. Scharff's record from the Aran Islands has not been verified; and, as his specimen was unfortunately lost before the identity of the shell was definitely known, he considers it safer to omit the record from the present paper, though there can be little doubt that it was this shell that he found on Inishmore. Like Vertigo moulinsiana and the other members of the genus, this shows no preference for any particular geological formation: and its Irish habitats lie in Old Red Sandstone, Carboniferous limestone, and metamorphic areas.

Yertigo alpestris (Alder).

		WD	ED	LD	AN	
			$\mathbf{FE}$	$\mathbf{T}\mathbf{Y}$	$\mathbf{AR}$	DO
	$\mathbf{W}\mathbf{M}$	SL	$\mathbf{LE}$	MO		
		$\mathbf{E}\mathbf{M}$	RO	$\mathbf{CV}$	$\mathbf{LH}$	
	WG	NG	$\mathbf{LF}$	WН	$\mathbf{ME}$	
		$\mathbf{SG}$	KC	KD	$\mathbf{DU}$	
	$\mathbf{CL}$	$\mathbf{NT}$	$\mathbf{QC}$	$\mathbf{CW}$	WI	
NK	$\mathbf{L}\mathbf{K}$	$\mathbf{ST}$	KK	WX		
SK	$\mathbf{MC}$	EC	WA			
	WC					

Since Mr. Adams discovered this rare

species near Coleraine, in Derry, it has been taken in two other northern localities in the adjoining counties by Mr. Standen, namely, at Whitepark in Antrim, and Portsalon in West Donegal. Mr. Hogan's supposed discovery of this shell in Co. Dublin is known to be an error. Dr. Scharff is inclined to think that the shell collected at Ballintov, Antrim, by Mr. Tomlin, and recorded as Vertigo heldi Clessin,1 should really be considered a form of this species. It is just possible, however, that Mr. Tomlin's specimen may be an abnormal example of Vertigo pygmaea, as in the exact spot where the supposed V. heldi was taken I have since collected very large specimens of the former species.

## Yertigo pusilla Müller.

		WD	ED	LD	AN	
			$\mathbf{FE}$	$\mathbf{T}\mathbf{Y}$	$\mathbf{AR}$	DO
	WM	SL	$\mathbf{LE}$	$\mathbf{MO}$		
		$\mathbf{E}\mathbf{M}$	$\mathbf{RO}$	CV	$\mathbf{LH}$	
	WG	NG	$\mathbf{LF}$	WH	ME	
		SG	KC	KD	DU	
	CL	NT	$\mathbf{QC}$	CW	WI	
NK	$\mathbf{L}\mathbf{K}$	$\mathbf{ST}$	KK	WX		
SK	MC	$\mathbf{EC}$	WA			
	WC					

A very rare and local species in the living state, but, judging from the number of dead shells found in many of our sand-dunes, it must formerly have been much more common. It is, nevertheless, widely but discontinuously distributed throughout the mainland, but has not been reported from any of our islands. The very beautiful pure-

<sup>&</sup>lt;sup>1</sup> Irish Nat., xii. 110.

white form occurs sparingly in several of the northern deposits, but is fairly common in those round the north-west coast of Donegal. The old records for this species from Limerick, South Kerry and "Co. Cork" require verification.

#### Vertigo angustior Jeffreys.

		WD	ED	LD	AN	
			$\mathbf{FE}$	TY	$\mathbf{AR}$	DO
	WM	SL	$\mathbf{LE}$	MO		
		EM	RO	$\mathbf{C}\mathbf{V}$	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		$\mathbf{SG}$	$\mathbf{KC}$	KD	$\mathrm{DU}$	
	CL	$\mathbf{NT}$	QC	CW	WI	
NK	$\mathbf{L}\mathbf{K}$	ST	$\mathbf{K}\mathbf{K}$	WX		
SK	MC	$\mathbf{EC}$	WA			
	WC					

Like the last species, this appears to have become extinct in many of its former habitats, probably owing to blown sand filling and drying up its dwelling-places, which are as a rule coastal marshes. It is widely distributed over the southern, western, and northern districts, but seems to avoid the central plain and the eastern counties.<sup>1</sup> In the west it has recently turned up in great abundance in several isolated localities, similar to that in Sligo near Ballina, where Miss Warren has collected it for many years.

## CLAUSILIIDAE.

#### Balea perversa (Linné).

Like Limax arborum, this species

flourishes in the bare and open parts of the country, as well as in the old

		WD	ED	LD	AN	
			FE	TΥ	AR	DO
	WM	SL	LE	MO		
		$\mathbf{E}\mathbf{M}$	RO	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		SC	KC	KD	DU	
	CL	NT	<b>00</b>	CW	WI	
NK	LK	ST	ŇК	WX		
SK	MC	EC	WA			
	WC					

wooded areas, and shows no real preference for any geological formation, being almost as common on non-calcareous rocks as on the Chalk or Carboniferous limestone. The hardiness of this shell is remarkable, and perhaps none of our land mollusca is found under such variable conditions. It is a species which has constantly to withstand the hottest summer sun in many of its habitats, and yet I have often seen it on the crawl during frosty weather. In the central counties it is frequently associated with Pupa cylindracea and Pyramidula rupestris on the limestone walls; on the cliffs of Clare Island in West Mayo it is found with Hygromia fusca, Pupa anglica, Acicula lineata, and Limnaea truncatula; while in the wooded districts it has often other companions. Yet in spite of the remarkable adaptability of this shell, it shows no variation of any importance; and if the shells from several districts were thrown together, I doubt if anyone could separate them. Throughout the mainland it is generally distributed; and it is also usually met with on the adjoining islands.

<sup>&</sup>lt;sup>1</sup> Messrs. Taylor and Roebuck give a record for this species from Co. Cork, but it is impossible to say to which division this should be referred.

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## Clausilia laminata (Montagu).

Clausilia bidens, Thompson, Cat. L. and F. W. Moll. of Ireland, p. 28, 1840.

•		WD	ED	LD	AN	
			FE	$\mathbf{T}\mathbf{Y}$	$\mathbf{AR}$	DO
	WM	SL	$\mathbf{LE}$	MO		
		$\mathbf{E}\mathbf{M}$	$\mathbf{RO}$	CV	$\mathbf{LH}$	
	WG	NG	$\mathbf{LF}$	WH	$\mathbf{ME}$	
		$\mathbf{SG}$	KC	KD	$\mathrm{D}\mathrm{U}$	
	$\mathbf{CL}$	NT	$\mathbf{QC}$	$\mathbf{CW}$	WI	
NK	$\mathbf{L}\mathbf{K}$	$\mathbf{ST}$	KK	WX		
SK	$\mathbf{MC}$	$\mathbf{EC}$	WA			
	WC					

Has a remarkable distribution in this country, quite unlike that of any of our other mollusks, and is one of our rarest and most local land-shells, although its distribution in Europe is fairly extensive. Until December, 1910, when I took a single specimen at Enniskerry in Wicklow, it was known only from the districts lying around the great elevated mass of Cuilcagh in Cavan. In some of the glens, and in the woods which lie around the base of this mountainous area; it can be collected in fair abundance. The old record from Church Island in Lough Gill, Sligo, though seemingly authentic, has not been verified by conchologists who have recently visited that locality, and must therefore be regarded as doubtful for the present. The locality attached to the specimens in the Thompson Collection in Belfast-"The Giant's Causeway" --probably is due to the many hands through which the collection has passed, as all specimens in the collection were formerly kept in trays, and several other palpable mistakes occur in the

localities which are attached to shells. Mr. Welch's recent find of this shell at Carrickreagh on the southern shore of Lower Lough Erne in Fermanagh is a considerable extension of its range.

The white form has occurred sparingly in the Glen of the Marble Arch, and at Florencecourt, both in Fermanagh.

## Clausilia bidentata (Ström).

Clausilia nigricans, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 28, 1840.

		WD	ED	LD	AN	
			FE	TY	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NC	LF	WH	ME	
		SG	KC	KD	DU	
	CL	NT	00	CW	WI	
NK	LK	ST	KK	WX		
SK	MC	EC	WA			
	WC					

A ubiquitous species and found throughout the mainland and islands. Besides the type, which according to the late Prof. Boettger is generally known in England as var. everetti, two wellmarked forms are also known to occur. The first is the var. gracilior of Jeffreys, which is frequently met with in most parts of the country, but is particularly common in some of the wooded districts; examples from Torc Woods at Killarney probably mark the extreme variation in this direction.

The second form is the var. septentrionalis A. Schmidt : this occurs in parts of the west and on some of the western

islands; and it is also met with in other parts of the country.

Nothing, however, has ever been found which could be looked on even as a sub-species of this mollusk, with the possible exception of some shells taken by the late Dr. Chaster and Mr. J. R. Hardy on the shore of the Kenmare River, and mentioned by Mr. Standen in his report of the Field Club Conference (Irish Nat., September, 1898). From the habitat in which these specimens were living-under stones and seaweed below high-water markone could scarcely, however, expect them to have been normal. In one of the little glens of the north coast of Antrim a colony of this species occurs, in which a fair number of the beautiful white form may sometimes be found, associated with the white form of Pupa cylindracea and white-lipped Helix nemoralis. Specimens from Dunluce old church in Antrim have been referred by Westerlund to a new variety, var. variostriata West. (Irish Nat., ix, 131, 1900).

## SUCCINEIDAE.

## Succinea putris (Linné).

Plate VII, figs. 43, 44.

Helix succinea, Brown, Mem. Werner. Soc., vol. ii, p. 530, 1818.

A common shell in the central, southern, and eastern counties, and especially along the marshy banks of the larger rivers, such as the Shannon, Boyne, and Barrow. It becomes rare towards the west and north, and is quite absent from several districts, among which west Kerry, north-west Mayo, and north-west Donegal are the most important. A small obese form of *Succinea pfeifferi* (fig. 41) has often erroneously been recorded by visiting

		WD	ED	LD	AN	
			FE	TY	AR	DO
	WM	SL	LE	MO		
		$\mathbf{E}\mathbf{M}$	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SC	KC	KD	DU	
	CL	NT	00	CW	WI	
NK	LK	ST	KK	WX		
SK	MC	EC	WA			
	WC					

conchologists and English authorities as S. putris; but the opinion of some malacologists confirms that of the Irish workers, who regard this form of the next species as bearing no relationship to S. putris. Indeed, the Rev. E. W. Bowell, to whom I sent specimens from Donegal in 1908, replied that the radula and genitalia were not identical with any species known to him, and at any rate could not possibly be mistaken for those of S. putris. The habitat of these small forms of S. pfeifferi will, I think, at once separate them from the present species. They are invariably found on the ground or under stones around the edges of lakes or on the muddy sides of streams and drains, while S. putris, except during the winter months, which it often spends far away from its summer feeding-habitat, lives on the tall vegetation which fringes swamps, canals, and slow-running streams.

Succinea putris (fig. 44) varies considerably in size, colour—from dark mahogany to pale amber—and texture; but the most striking variation I have seen from this country is in Ń

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specimens collected by Mr. Phillips at Cloughjordan in North Tipperary (fig. 43). These examples are dark in colour and very much elongated, resembling to a certain extent some of the large continental forms of the next species.

This species has never been found on any of the western or other islands, although S. pfeifferi is common on nearly all of them, and S. oblonga has been recently taken by Mr. Phillips on the Aran Islands, the only large islands on which S. pfeifferi has not so far been discovered.

#### Succinea pfeifferi Rossmässler.<sup>1</sup>

Plate VII, figs. 38, 39, 41, 42, 45-47.

Succinea elegans, Scharff, Irish Nat., p. 137, 1892.

		WD	ED	LD	AN	
			FE	TΥ	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SG	KC	KD	DU	
	CL	NT	<b>0</b> C	CW	WI	
NK	LK	ST	ŇК	WX		
SK	MC	EC	WA			
	WC					

Succinea pfeifferi is abundant throughout the entire mainland, and on most of the larger islands; but what I take to be the type (figs. 38, 39) appears to be confined to the eastern counties. It varies greatly in all characters; and it is more than possible that under this name we have in Ireland at least three or four of what by some Continental authorities would be termed "good species." Forms of this shell occur which, to all appearances, closely resemble the following European species :—

- Succinea virescens Morelet. Frequent in brackish marshes and estuarics in the southern counties (fig. 45).
- Succinea contortula Baudon or Succinea schumacheri Andreae.<sup>2</sup> Found in marshes in many parts of the southern, central, and western counties. The only form I have ever found associated with S. putris (figs. 42, 46, 47).
- Succinea parvula Pascal. The form referred to under S. putris. Common in the western and northwestern counties and on the western islands. Considered a variety of S. putris by many English conchologists (fig. 41).

As intermediate forms would appear to connect all the above-mentioned varieties, even in our small island, it is impossible to consider them otherwise than as extreme forms of a somewhat polymorphic species. Specimens collected by Dr. Scharff at Clondalkin, near Dublin, have been considered by Dr. Westerlund worthy of varietal rank, and described by him under the name of var. reticulata West. This shell is frequently found in places that are dry during the greater part of some years; and Mr. Phillips has suggested that this fact may govern the variability of the species, as specimens taken in a marshy habitat are, as a general rule,

<sup>&</sup>lt;sup>1</sup> Nothing approaching the *Succinea elegans* of Risso having been ever found in Ireland, I follow Dr. Scharff (MS.) and the late William Thompson in employing Rossmässler's name.

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<sup>&</sup>lt;sup>2</sup> This form has been referred to both species by different authorities.

much less rugged than those which have lived in drier situations. On Cruit Island, in West Donegal, this shell lives on the short grass and under cow-dung on the western cliff-slopes, within easy reach of spray during westerly gales, and must depend entirely for its supply of water on dew and rain. Shells living in such a locality must vary greatly from year to year according to the amount of rain that falls during the season of their growth; and it is to he regretted that up to the present we have no data to tell us the amount or the direction of this variation.

## Succinea oblonga Draparnaud.

Plate VII, figs. 48-50.

		WD	ED	LD	AN	
			FE	$\mathbf{T}\mathbf{Y}$	$\mathbf{AR}$	DC
	WM	SL	$\mathbf{LE}$	$\mathbf{MO}$		
		$\mathbf{E}\mathbf{M}$	$\mathbf{RO}$	$\mathbf{C}\mathbf{V}$	LH	
	WG	NG	$\mathbf{LF}$	WΗ	ME	
		$\mathbf{SG}$	$\mathbf{KC}$	KD	$\mathrm{D}\mathrm{U}$	
	CL	NT	QC	CW	WI	
NK	$\mathbf{L}\mathbf{K}$	ST	KK	WX		
SK	MC	EC	WA			
	WC					

Habitats for this very local species are known in all four provinces; and in some of these it may be collected in large numbers. Its distribution, however, as at present known, is exceedingly discontinuous; but the majority of its stations lie in the southern or western counties. It shows no preference for any particular kind of habitat, nor is it apparently affected by the prevailing petrological conditions, as scarcely any two of these are in any way similar. Specimens from several

localities, but especially those from the Dooaghtry sand-dunes in West Mayo (fig. 49), are very similar to Moquin Tandon's conception of Succinea arenaria Bouch-Chant., i.e. small, deepred in colour, and with a deep suture, while the shells from the shore of Lough Neagh in Antrim are greenish in colour with large body whorl and less strongly marked suture (fig. 50). The larger and more elongated examples found along the southern shore of Lough Erne, at Carrickreagh, in Fermanagh (fig. 48), have been referred by the late Prof. Boettger to the var. agonostoma Küster. Mr. Phillips has taken this species on Inishmore, in the Aran Islands, this being the only record for the species other than from the mainland.

#### AURICULIDAE.

Carychium minimum Müller.

		WD	ED	LD	AN	
			FE	ΤY	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SG	KC	KD	DU	
	CL	NT	QC	CW	WI	
NK	LK	ST	KK	WX		
SK	MC	EC	WA			
	WC					

Is almost universally distributed throughout the mainland, and generally found on the western and other islands; but on a recent visit to Tory Island I was unable to find it. Varies greatly in size and in the proportion of width to height, specimens from some districts

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being much more slender than those met with in others. The largest specimens I have seen come from the Dublin and Wicklow Mountains, near the Scalp.

### Phytia myosotis (Draparnaud).<sup>1</sup>

Alexia denticulata, Scharff, Irish Nat., p. 149, 1892.

		WD	ED	LD	AN	
			$\mathbf{FE}$	$\mathbf{T}\mathbf{Y}$	$\mathbf{AR}$	DO
	WM	$\mathbf{SL}$	$\mathbf{LE}$	MO		
		$\mathbf{E}\mathbf{M}$	$\mathbf{RO}$	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		SG	KC	KD	DU	
	CL	NΤ	$\mathbf{QC}$	$\mathbf{CW}$	WI	
NK	LK	$\mathbf{ST}$	KK	WX		
SK	$\mathbf{MC}$	EC	WA			
	WC					

Recorded from many localities on the coasts of all four provinces, and almost always met with about high-water mark at the heads of estuaries where a certain amount of alluvial mud is deposited. The var. *denticulata* Montagu is rarer than the type, but the two forms often grade into one another.

### Ovatella bidentata (Montagu).

Melampus bidentatus, Scharff, Irish Nat., p. 149, 1892.

Very discontinuously scattered round

our coast-line; and though sometimes associated with *Phytia myosotis*, the

		WD	$\mathbf{ED}$	LD	AN	
			$\mathbf{FE}$	TΥ	$\mathbf{AR}$	DO
	WM	$\mathbf{SL}$	$\mathbf{LE}$	MO		
		$\mathbf{E}\mathbf{M}$	$\mathbf{RO}$	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	$\mathbf{ME}$	
		$\mathbf{SG}$	$\mathbf{KC}$	KD	DU	
	$\mathbf{CL}$	$\mathbf{NT}$	$\mathbf{QC}$	$\mathbf{CW}$	WI	
NK	$\mathbf{L}\mathbf{K}$	$\mathbf{ST}$	$\mathbf{K}\mathbf{K}$	WX		
SK	$\mathbf{MC}$	EC	WA			
	WC					

present species is much rarer and more local, and as a general rule prefers a more marine habitat, occurring under seaweed-covered stones in muddy creeks and estuaries.

#### OTINIDAE.

Otina otis (Turton).

		WD	ED	$\mathbf{L}\mathbf{D}$	AN	
			$\mathbf{FE}$	ТΥ	$\mathbf{AR}$	DO
	WM	SL	$\mathbf{LE}$	MO		
		$\mathbf{E}\mathbf{M}$	RO	$\mathbf{CV}$	LH	
	WC	NG	$\mathbf{LF}$	WH	ME	
		$\mathbf{SG}$	KC	KD	DU	
	CL	$\mathbf{NT}$	$\mathbf{QC}$	$\mathbf{CW}$	WI	
NK	$\mathbf{L}\mathbf{K}$	ST	$\mathbf{K}\mathbf{K}$	WX		
SK	$\mathbf{MC}$	EC	WA			
	WC					

Recorded from the coasts of Clare, West Galway, and West Donegal, and is probably generally distributed along the southern, western, and north-western coast-line. This species, like our other brackish and semi-marine shells, has not been specially searched for by conchologists.

<sup>&</sup>lt;sup>1</sup> This shell, as well as the two following (O. bidentata and O. otis), cannot truly be considered either land or freshwater species; but as Mr. Nichols does not include them in the "List of the Marine Mollusca of Ireland" (Proc. R. I. Academy (3), v, No. 4, 1900), it was necessary to include them in the present list.

#### LIMNAEIDAE.

### Ancylus fiuviatilis Müller.

Patella lacustris, Brown, Mem. Werner. Soc., vol. ii, p. 533, 1818.

		WD	ED	LD	AN	
			FE	TY	AR	DO
	WM	SL	LE	MO		
		$\mathbf{E}\mathbf{M}$	RO	CV	LK	
	WG	NG	$\mathbf{LF}$	WH	ME	
		SG	KC	KD	DU	
	CL	NT	QC	CW	WI	
NK	LK	ST	KK	WX		
SK	MC	EC	WA			
	WC					

Abundant in all the mountainous parts of the country, but rare in many parts of the central plain, though very generally distributed. This shell shows great variation in size and shape, in texture, and other characters. As a general rule our Irish specimens are small; but in lakes with stony edges and bottoms fair-sized shells are often met with. In such a lake in Co. Down Mr. J. N. Milne has taken some particularly fine white examples, quite equal in dimension to the largest specimens I have seen from other countries.

Ancylus fluviatilis is common in streams on Clare Island and in the lakes of Achill in West Mayo, and has also been taken in a lake on Clear Island in West Cork.

A strongly striated form, similar to the Ancylus striatus of the Atlantic Islands, which according to Wollaston may be regarded as a geographical phasis of the present species, occurs in several places along the west coast.

A small form is exceptionally abun-

dant in the highest of the small tarns on Brandon Mountain in South Kerry, which lies at an altitude of 2300 feet. This small form is that which is commonly met with in peaty waters.

### Acroloxus lacustris (Linné).

Patella oblonga, Brown, Mem. Werner. Soc., vol. ii, p. 533, 1818. Ancylus lacustris, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 33, 1840.

		WD	$\mathbf{ED}$	$\mathbf{L}\mathbf{D}$	AN	
			FE	TΥ	AR	DO
	WM	SL	LE	MO		
		$\mathbf{E}\mathbf{M}$	$\mathbf{RO}$	$\mathbf{C}\mathbf{V}$	LH	
	WG	NG	LF	WH	ME	
		$\mathbf{SG}$	KC	KD	DU	
	CL	NT	$\mathbf{QC}$	CW	WI	
NK	LK	ST	KK	WX		
SK	$\mathbf{MC}$	EC	WA			
	WC					

Like many of our rarer freshwater species, this is mainly confined to the central and north-eastern districts, and there are no records for the more mountainous and non-calcareous districts of the south, west, and north. Species which have a somewhat similar range in Ireland are *Limnaea stagnalis*, *Plan*orbis carinatus, *P. umbilicatus*, and *Anodonta cygnea*.

#### Limnaea auricularia (Linné).

Plate VII, figs. 15-20.

Helix auricularia, Brown, Mem. Werner. Soc., vol. ii, p. 531, 1818. Limneus auricularius, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 29, 1840.

Though widely distributed throughout Ireland, this shell is always local and seldom really common, except in

some of the maritime lakes of the west coast. The prevailing form in the west

```
WDEDLDANFETYARDOWM SLLEMOWM SLLEMOEMROCVLHWGNGLFWHSGKCKDDUCLNTQCCWNKLKSTKKKMECWA
```

is the var. *acuta* of Jeffreys (figs. 15, 16, 17). Even that found in the eastern and southern counties inclines towards this same variety, though Cork examples are fairly typical (figs. 18, 19, 20).

In the lakes of Mullaghderg and Carnboy in West Donegal the majority of the shells are pure white, while the animals are often of a rich yellowishorange colour in the latter locality. Both these lakes are almost at sea-level, and no doubt receive a certain amount of spray during rough weather. With the exception of Achill Island in West Mayo, we have no records of this species being found on any of the western islands, owing probably in most cases to the want of a suitable habitat.

### Limnaea pereger (Müller).

Plate VII, figs. 1-6, 10-14.

Helix putris and H. limosa, Brown, Mem. Werner. Soc., vol. ii, p. 530, 1818. Limneus pereger, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 30, 1840. Limnaea persgra, Scharff, Irish Nat., p. 150, 1892.

The typical Limnaea pereger of the

Continent is not found in Ireland; but in the eastern counties specimens some-

		WD	ED	LD	AN	
			FE	TY	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NC	LF	WH	ME	
		SG	KC	KD	DU	
	CL	NT	0 <u>C</u>	CW	WI	
NK	LK	ST	ŇК	WX		
SK	MC	EC	WA			
	WC					

what approaching the type occur. Many different forms are to be met with in this country, of which the following are the most noteworthy :---

(a) Var. ovata (= L. ovata Drap.). In canals, slow-flowing rivers, and large drains throughout the mainland, but more particularly in the central and eastern counties (fig 5).

(b) Var. boissyi Dupuy. In maritime marshes and lakes and sometimes in peat-bogs, but not typical in the latter habitats. Especially common on the west coasts of Clare, Mayo, and Donegal, and is the form most commonly met with on the western islands (figs. 2, 4).

(c) Var. *lacustris* Leach. In nearly all the larger sheets of water throughout the country, such as Lough Neagh, Lough Erne, Lakes of Killarney, Lough Gill, and many others. This form, according to the late Wm. Thompson, is a deep-water one; and certainly it is seldom taken alive, and differs from the shells living in the marshes and drains connected with some of the lakes mentioned above (figs. 1, 13).

In the peaty mountain and similar isolated tarns of the west coast, many forms of this shell occur, each tarn having a distinct form of its own. In some instances shells from these localities even approach *Limnaea involuta* or *L. praetenuis* in shape and in texture, and are almost as worthy of specific rank as the two shells just mentioned.

# Limnaea involuta Harvey.

Plate VII, fig. 9.

Limneus involutus, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 31, 1840.

		WD	ED	LD	AN	
			FE	TΥ	AR	DO
	M.N	SL	LE	MO		
		ЕM	RO	CV	LH	
	WG	NG	$\mathbf{LF}$	ШW	ME	
		SG	КC	KD	DU	
	CL	NT	QC	СШ	ΠW	
NK	LK	ST	KK	WΖ		
SK	МС	EC	WA			
	WC					

For over half a century Lough Crincaum on Cromaglaun Mountain in North Kerry was considered the only habitat of this interesting Limnaea; but. since the finding of the next species in a similar isolated lough, Mr. Phillips has taken this shell in Barley Lake above Glengarriff in West Cork. It is more than probable that it also occurs in others of the hundreds of small tarns which are scattered over this corner of our island.

# Limnaea praetenuis, Bowell.

Plate VII, fig. 7.

# Limnaea sp.? Stelfox and Milne, Irish Naturalist, p. 288, 1907.

Since its discovery in South Kerry in

Lough Nagarriva, the habitat of *Pisidium hibernicum*, the range of this

		WD	ED	$\mathbf{LD}$	AN	
			FE	TT	$\mathbf{AR}$	DO
	WM	SL	$\mathbf{LE}$	MO		
		ΕM	RO	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		SG	КC	KD	$\mathrm{DU}$	
	CL	NT	QC	$\mathbf{CW}$	WI	
NK	$\mathbf{L}\mathbf{K}$	ST	ΚK	WΧ		
SK	MC	EC	WA			
	WC					

shell has been greatly enlarged owing to some dredging which has been carried out in the lakes of Fermanagh and the southern portion of East Donegal by Major Trevelyan. From Lough Derg in the former division and from Lough Vearty and other neighbouring lakes in Fermanagh this collector has forwarded specimens to the Rev. E. W. Bowell, who, on examining their anatomy, has referred them to this species, of which he was the original describer.

In the peaty lakes of Achill Island and on parts of the mainland of West Mayo very similar shells are met with (fig. 8), but whether they are referable to this or to another new species, or are only aberrant forms of Limnaea pereger. I cannot at present say. It is well to observe that neither this shell nor Limnaea involuta has ever been taken associated with any recognized form of L. pereger, and moreover that in the lakes in which they occur, the water has always been to a great extent peaty. These two important facts might be used as arguments against the specific distinction of these shells; but for the present I suppose

we must abide by the decision of the anatomist, though personally I am not satisfied that they are not old forms of *Limnaea pereger*, which through long isolation in lakes that have steadily become more peaty as time advanced, have gradually altered and become dwarfed. In different lakes we find that the dwarfing process has not always reached the same stage; thus in three of the lakes on Achill Island we find three forms of Limnaea. (Figs. 8, 12.)

I cannot but regret that new species are added to our list from specimens which experiment might prove to be only varieties caused by environment. Experiment has already proved that environment greatly affects the growth of the shell, but we have nothing to tell us the effect on the radula and genitalia of the animal, on which characters most of these modern species are being founded. There are shells in the National Museum, Dublin, which are apparently normal L. pereger. These are stated to be the progeny of L. involuta, reared under artificial conditions.

#### Limnaea stagnalis (Linné).

Plate VII, figs. 33-37.

Helix stagnalis, Brown, Mem. Werner. Soc., vol. ii, p. 530, 1818. Limneus stagnalis, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 31, 1840.

Widely distributed but seldom abundant outside the limestone areas of the central and eastern counties, and absent from such peat-covered districts as West Cork, Kerry, north-west Mayo, and north-west Donegal. In the northeast, though recorded from the divisions

		WD	ED	LD	AN	
			FE	TY	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NC	LF	WH	ME	
		SC	KC	KD	ÐU	
	CL	NT	QC	CW	WI	
NK	LK	ST	KK	WX		
SK	MC	EC	WA			
	WC					

of Derry, Antrim, Down, Armagh, and Tyrone, it is really confined to the basins of the Bann and Lagan Rivers.

It is worth remarking that the areas of Mayo and Donegal from which this species is absent, are those in which Limnaea auricularia var. acuta is most abundant. L. stagnalis reaches the west coast in the sand-dune lakes of West Mayo at Louisburgh, but does not live on any of the western islands. The most interesting variation in the present species is that which is to be found in Lough Neagh and several other large lakes, and is similar to the var. lacustris of Studer, being smaller, thicker, and more tumid than the type. (Figs. 36, 37.)

#### Limnaea palustris (Müller).

Plate VII, figs. 21-26.

Helix palustris, Brown, Mem. Werner.
Soc., vol. ii, p. 530, 1818. Limneus palustris, Thompson, Cat. L. & F.
W. Moll. of Ireland, p. 31, 1840.

Recorded from all county divisions. A

small fragile form (fig. 25) is often found in peaty areas associated with *Pisidium* 

```
WD ED LD AN
FE TY AR DO
WMSL LE MO
EM RO CV LH
WG NG LF WH ME
SG KC KD DU
CL NT QC CW WI
NK LK ST KK WX
SK MC EC WA
WC
```

casertanum and P. personatum, where other species of mollusca apparently cannot live: this form likewise occurs on several of the western islands. Var. corva is frequent in many parts of the country, but particularly in the central and eastern districts, where it is sometimes the only form encountered. The "Limneus glaber" of Thompson, Humphreys, and others is perhaps the young of a slender form of this shell which is sometimes found in marshes. and to my own knowledge occurs in the neighbourhood of Cork and Belfast, two of the localities in which that species was supposed to have been found. This species, like others of the genus, has a well-marked lacustrine form. (Figs. 21, 22.)

### Limnaea truncatula (Müller).

Plate VII, figs. 29-32.

Helix fossaria, Brown, Mem. Werner.
Soc., vol. ii, p. 530, 1818. Limneus truncatulus, Thompson, Cat. L. & F.W.
Moll. of Ireland, p. 32, 1840.

Even more generally distributed than

the last species, and, as it is the most amphibious of the genus, it is often

		WD	ED	LD	AN	
			FE	ΤY	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SG	KC	KD	DU	
	CL	NT	0C	CW	WI	
NK	LK	ST	ŇК	WX		
SK	MC	EC	WA			
	WC					

found in places where it would be impossible for the other Limnaeae to exist. It is frequent in wayside pools which are quite dried up in summer: but the most remarkable habitat in which I have met with it is the great sea-cliff of Croaghmore, on Clare Island. On the rock-faces of this cliff it lives up to an altitude of close on 1000 feet, associated with Hygromia fusca, Pupa cylindracea, P. anglica, Balea perversa, and Clausilia bidentata, and must depend, like the terrestrial species, for its supply of moisture on rain and dew. There are not even perennial runnels on this cliff. In the Dingle peninsula it lives in similar situations, and I have taken specimens Brandon Mountain as high as on 1775 feet. The form met with in the eastern counties and on the limestone districts (fig. 30) is much larger and more rugged than that which prevails in many places in the west, which is more delicate in texture and smaller in size (fig. 29). Some localities in the west yield specimens which, at a cursory glance, might almost be mistaken for Succinea oblonga when dirty, the shouldered appearance of the suture,

so universal in the type, being searcely apparent. (Fig. 31.)

Amphipeplea glutinosa (Müller).

		WD	$\mathbf{ED}$	$\mathbf{L}\mathbf{D}$	AN	
			$\mathbf{FE}$	$\mathbf{T}\mathbf{Y}$	AR	DO
	WM	SL	$\mathbf{LE}$	MO		
		ĘМ	RO	CV	$\mathbf{LH}$	
	WG	NG	LF	WH	ME	
		$\mathbf{SG}$	KC	KD	DU	
	CL	$\mathbf{NT}$	QC	CW	WI	
NK	$\mathbf{L}\mathbf{K}$	$\mathbf{ST}$	KK	WX		
$\mathbf{SK}$	$\mathbf{MC}$	$\mathbf{EC}$	WA			
	WC					

With the exception of the Lough Neagh basin in the north-east, this shell is strictly confined to the limestone plain, where it is sometimes common, and even abundant, in canals, lakes, and large drains or sluggish streams. During the summer months it may be frequently overlooked, owing to its habit of remaining in the deeper parts of its habitats; and it is probably more generally distributed over the central districts than our present knowledge would indicate.

#### Planorbis corneus (Linné).

Helix cornea, Brown, Mem. Werner. Soc., vol. ii, p. 524, 1818.

Much the rarest species of the genus in Ireland, and-assuming that the Markree habitat in Sligo was stocked by specimens brought with water-plantsis confined to a small part of the country drained by the Rivers Barrow and Liffey, where it was first discovered about 1815

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by Capt. Brown. Here it lives in shallow drains and swampy pools, associated

		WD	ED	$\mathbf{L}\mathbf{D}$	AN	
			$\mathbf{FE}$	$\mathbf{T}\mathbf{Y}$	$\mathbf{AR}$	DO
	WM	SL	LE	MO		
		$\mathbf{E}\mathbf{M}$	$\mathbf{RO}$	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		$\operatorname{SG}$	$\mathbf{KC}$	KD	DU	
	$\mathbf{CL}$	$\mathbf{NT}$	QC	$\mathbf{CW}$	WI	
NK	$\mathbf{L}\mathbf{K}$	$\mathbf{ST}$	КK	WX		
SK	$\mathbf{MC}$	$\mathbf{EC}$	WA			
	WC					

with Planorbis umbilicatus, Limnaea palustris, and L. stagnalis. Its habitats appear to be intermediate between those which completely dry up and those, such as canals, in which the water-level seldom varies. Mr. Kennard refers Kildare specimens to the var. mabillei, Bourg.

An old record for Meath seems doubtful, and is omitted for the present.

### Planorbis albus Müller.

Helix alba, Brown, Mem. Werner. Soc., vol. ii, p. 524, 1818.

		WD	ED	LD	AN	
			FE	TY	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SG	KC	KD	DU	
	CL	NT	QC	CW	WI	
NK	LK	ST	ŇК	WX		
SK	MC	EC	WA			
	WC					

Widely and generally distributed, but [Q]

rare in the south-west, west, and north, and absent from many districts, some of considerable area. In the western and north-western counties it is sometimes replaced by *Planorbis glaber*. It has been stated often that these two shells do not live together, but this is certainly not true in Ireland.

### Planorbis glaber Jeffreys.

= P. laevis Alder.

Planorbis laevis, Thompson, Cat. L. and F. W. Moll. of Ireland, p. 34, 1840.

		WD	ED	LD	AN	
			$\mathbf{FE}$	$\mathbf{T}\mathbf{Y}$	$\mathbf{AR}$	DO
	WM	SL	LE	$\mathbf{MO}$		
		$\mathbf{E}\mathbf{M}$	$\mathbb{R}O$	$\mathbf{C}\mathbf{V}$	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		SG	KC	KD	DU	
	CL	NT	QC	CW	WI	
NK	$\mathbf{L}\mathbf{K}$	ST	KK	WX		
SK	$\mathbf{MC}$	EC	WA			
	WC					

Somewhat similar to Limnaea auricularia in its distribution, and, although widely scattered in all four provinces, it is exceptionally local in all but the western and north-western counties; and even in these, it is confined to the maritime lakes. It also occurs on several of the lakes on Achill Island, but otherwise has only been taken on the mainland. Specimens from West Donegal are narrower in the whorls than typical English examples, and appear to almost grade into the Planorbis arcticus of Westerlund. These Donegal examples closely resemble the form found in Lough Skaill in the Orkneys.

# Planorbis crista (Linné).

Turbo Nautileus, Brown, Mem. Werner. Soc., vol. ii, p. 522, 1818. Planorbis imbricatus, Thompson, Cat. L. & F.W. Moll. of Ireland, p. 35, 1840.

		WD	ED	LD	AN	
			FE	$\mathbf{T}\mathbf{Y}$	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SG	$\mathbf{KC}$	KD	DU	
	CL	NT	0C	CW	WI	
NK	LK	ST	ŇК	WX		
SK	MC	EC	WA			
	WC					

Generally distributed throughout the country, but perhaps more abundant in the west, and found on many of the western islands. In some of the central counties, this shell appears rare, and has not so far been recorded for Carlow and King's Co. The three forms—*spinulosa*, *cristata*, and *nautileus*<sup>1</sup> —occur in about equal numbers.

#### Planorbis carinatus Müller.

Plate VII, figs. 53-55.

Helix planata, Brown, Mem. Werner. Soc., vol. ii, p. 524, 1818.

Generally distributed over the central and eastern counties, becoming rare towards and finally absent from the southwest, west, and north-west. Specimens from the central districts are generally

<sup>&</sup>lt;sup>1</sup> Clessin, Deutsche Excursions-Mollusken-Fauna, p. 429.

fairly typical (fig. 53); but the form which prevails in the north-east, and

	WD	ED	LD	AN	
		FE	TY	AR	DO
WM	SL	LE	MO		
	$\mathbf{E}\mathbf{M}$	RO	CV	LH	
WG	NG	LF	WH	ME	
	SC	KC	KD	DU	
CL	NT	QC	CW	WI	
LK	ST	ŇΚ	WX		
$\mathbf{MC}$	EC	WA			
WC					
	WM WG CL LK MC WC	WD WM SL EM WG NG SC CL NT LK ST MC EC WC	WD ED FE WM SL LE EM RO WG NG LF SC KC CL NT QC LK ST KK MC EC WA	WD       ED       LD         FE       TY         WM       SL       LE       MO         EM       RO       CV         WG       NG       LF       WH         SC       KC       KD         CL       NT       QC       CW         LK       ST       KK       WX         WC       VC       VX       VX	WD       ED       LD       AN         FE       TY       AR         WM       L       MO       L         EM       RO       CV       LH         WG       NG       LF       WH       ME         SC       KC       KD       DU         CL       NT       QC       CW       WI         MC       EC       WA       VII       VII         MC       EC       WA       VII       VII         WC       VII       VII       VII       VII

more particularly in the Lough Neagh basin (figs. 54, 55), seems referable to the *Planorbis dubius* of Hartmann (as illustrated by Bourguignat in his "Malacologie du lac des Quatre-Cantons") (see fig. 2, below), and has often been, and still is, mistaken for the next species. Hence several of our northern records for *Planorbis umbilicatus* perhaps belong to this species. The records for Mid and East Cork are omitted for the present, as Mr. Phillips considers all the shells he has so far taken in or seen from these divisions to belong to the next species.



FIG. 2.—*Planorbis dubius* Hartmann (a, b) and *Planorbis carinatus* Müller (c, d) after Bourguignat.

### Planorbis umbilicatus Müller.

Plate VII, fig. 56.

Helix Planorbis, Brown, Mem. Werner. Soc., vol. ii, p. 523, 1818. *Planorbis* marginatus, Scharff, Irish Nat., p. 152, 1892.

		WD	ED	LD	AN	
			FE	$\mathbf{T}\mathbf{Y}$	AR	DO
	WM	$\mathbf{SL}$	LE	MO		
		$\mathbf{E}\mathbf{M}$	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SC	KC	KD	DU	
	CL	NT	00	CW	WI	
NK	LK	ST	KK	WX		
SK	MC	EC	WA			
	WC	_ •				

The distribution of this shell is almost the same as that of *Planorbis* carinatus; but in the southern counties it is much commoner, while in the north-east the reverse is the case, this being the more local species of the two. The habitats of these two shells are apparently different, *Planorbis carinatus* living in rivers, canals, and lakes, while the present species is almost invariably confined to large ditches and swampy places, and is frequently associated with *Planorbis spirorbis* var. leucostoma and Aplecta hypnorum.

# Planorbis vortex (Linné).

Helix Vortex, Brown, Mem. Werner Soc., vol. ii., p. 524, 1818.

A typical "Central" species, and one which is entirely absent from the north-eastern districts, where so many of this group, *i.e.* Central, occur. Some [Q 2] specimens of this shell run very close to the extreme forms of *Planorbis spir*-

		WD	$\mathbf{E}\mathbf{D}$	$\mathbf{L}\mathbf{D}$	AN	
			FE	$\mathbf{T}\mathbf{Y}$	$\mathbf{AR}$	DO
	WM	SL	LE	MO		
		$\mathbf{E}\mathbf{M}$	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SC	KC	KD	DU	
	CL	NT	$\mathbf{QC}$	$\mathbf{CW}$	WI	
NK	LK	$\mathbf{ST}$	KK	WX		
SK	$\mathbf{MC}$	EC	WA			
	WC					

orbis var. leucostoma; but the latter is mainly a marsh shell; whereas the present one, like *Planorbis carinatus*, is seldom met with except in rivers, canals, or lakes.

### Planorbis spirorbis (Linné).

Helix Spirorbis, Brown, Mem. Werner. Soc., vol. ii, p. 524, 1818.

		WD	ED	LD	AN	
			$\mathbf{FE}$	TΥ	AR	DO
	WM	SL	LE	MO		
		$\mathbf{E}\mathbf{M}$	RO	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		SG	KC	KD	DU	
	CL	NT	QC	CW	WE	
NK	LK	ST	ŇК	WX		
SK	MC	EC	WA			
	WC					

Generally distributed, but rare in some of the central counties, where it is to a certain extent replaced by *Planorbis vortex*. Two well-marked forms, which are defined below, are to be found, the extreme examples of which might easily be given specific rank; but it is difficult to distinguish the intermediate forms which seemingly connect these together.

(a) This is often regarded on the Continent as the type of the species. It has more quickly increasing whorls, and in some characters resembles the northern form of *Planorbis glaber*. Mainly confined to the southern counties; but specimens from Dog's Bay, in West Galway, have been referred by the late Prof. Boettger to the "typical Continental *P. spirorbis.*"

(b) The *Planorbis leucostoma* of Michaud. Distinguished by the possession of an internal white rib round the aperture, flatter shell, and more slowly increasing whorls. This is the prevailing form, and is particularly common in the west, and occurs on most of the western islands. Large and specially flat specimens of this form are often confounded with *Planorbis vortex*.

Some specimens of this last variety I cannot separate from Galician examples of *Planorbis septemgyratus* Rossm., from the Westerlund collection in the National Museum, Dublin.

# Planorbis contortus (Linné).

Helix contorta, Brown, Mem. Werner. Soc., vol. ii, p. 524, 1818.

Common and generally distributed over most parts of the mainland, but rare in many of the western districts; and the only island on which it has been taken is Rathlin, in Antrim. It is a shell which varies greatly in size, probably according to the nature of the

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water in which it lives; for it is frequently met with in peaty drains, with no other associates save Pisidia.

		WD	ED	LD	AN	
			FE	TY	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SG	KC	KD	DU	
	CL	NT	QC	CW	WI	
NK	LK	ST	KK	WX		
SK	MC	EC	WA			
	WC					

Planorbis fontanus (Lightfoot).

Helix fontana, Brown, Mem. Werner.
Soc., vol. ii, p. 524, 1818. Planorbis nitidus, Thompson, Cat. L. & F. W.
Moll. of Ireland, p. 37, 1840.

		WD	ED	$\mathbf{L}\mathbf{D}$	AN	
			FE	ΤY	AR	DO
	WM	SL	LE	MO		
		$\mathbf{E}\mathbf{M}$	$\mathbf{RO}$	CV	LH	
	WG	NG	LF	WH	ME	
		$\mathbf{SG}$	KC	KD	DŲ	
	CL	NT	QC	CW	WI	
NK	LK	ST	ŇК	WX		
SK	MC	EC	WA			
	WC					

Generally distributed, but becomes rare towards the south, west, and north, its headquarters being, like that of so many of our other freshwater shells, situated in the central counties. In habits it is similar to *Planorbis crista*, and is seldom found in deep water, preferring the grassy margins of canals, ditches, or lakes, where it is occasionally abundant. It is rare to find specimens of more than medium size, but in Castlebar Lake in West Mayo, during Sept., 1909, I took several shells measuring 6.25 mm. in diam.

# PHYSIDAE.

# Physa fontinalis (Linné).

Bulla fontinalis Brown, Mem. Werner. Soc., vol. ii, p. 516, 1818.

		WD	ED	LD	AN	
			FE	TY	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SG	KC	KD	DU	
	CL	NT	<b>0</b> C	CW	WI	
NK	LK	ST	KK	WX		
SK	MC	EC	WA			
	WC					

Though recorded for all divisions, this shell is seldom met with in the peat-covered areas of the west or north, and has not been recorded from any of the western islands. Over the central, south-eastern, and north-eastern districts it is one of our commonest freshwater species.

### Aplecta hypnorum (Linné).

Bulla Hypnorum, Brown, Mem. Werner.
Soc., vol. ii, p. 517, 1818. Physa
hypnorum Thompson, Cat. L. & F. W.
Moll. of Ireland, p. 34, 1840. Aplexa
hypnorum, Scharff, Irish Naturalist,
p. 151, 1892.

Much more local than Physa fon-

tinalis, although it has a wider range and occurs in those western and northern

		WD	ED	LD	AN	
			$\mathbf{FE}$	ΤY	$\mathbf{AR}$	DO
	WM	SL	$\mathbf{LE}$	MO		
		$\mathbf{E}\mathbf{M}$	RO	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		SG	KC	KD	DU	
	CL	NT	0C	CW	WI	
NK	LK	ST	ŇК	WX		
SK	MC	EC	WA			
	WC					

areas in which that shell is not found. It has also been taken on Inishmeane in West Donegal.

This shell is seldom found without Planorbis spirorbis var. leucostoma, an association which has often been remarked on; but it is scarcely so universally distributed as this species, P. spirorbis frequently occurring without A. hypnorum.

# PALUDESTRINIDAE.

Paludestrina confusa (Frauenfeld).

		WD	ED	$\mathbf{L}\mathbf{D}$	AN	
			FE	TΥ	$\mathbf{AR}$	DO
	WM	SL	$\mathbf{LE}$	MO		
		EM	$\mathbf{RO}$	CV	$\mathbf{LH}$	
	WG	NG	$\mathbf{LF}$	WH	ME	
		$\mathbf{SG}$	KC	KD	DU	
	CL	NT	QC	CW	WI	
NK	LK	ST	KK	WX		
$\mathbf{SK}$	$\mathbf{MC}$	EC	WA			
	WC					

Added to our fauna in 1908 by Mr. Phillips, P. confusa has now been taken by that conchologist in great quantities in the brackish waters and marshes of the Rivers Shannon, Suir, Barrow, and Nore. The Irish form, Mr. Phillips writes me, is uniformly smaller than the English, as the latter is smaller than that of the Continent.

#### Paludestrina ventrosa (Montagu).

Hydrobia ventrosa, Scharff, Irish Nat., p. 178, 1892.

WUED LD AN FE TY AR DO WWSL LE MO EM RO CV LH WG NG LF WHE SG KC KD DU CL NT QC CW W1 SK MC EC WA

Common in several estuaries on the eastern, north-eastern, and western coasts. On the Aran Islands it lives in a brackish pool associated with *Palu*destrina jenkinsi.

#### Paludestrina jenkinsi Smith.

# Hydrobia Jenkinsi, Adams, Irish Nat., p. 234, 1897.

Since its first discovery in this country by Mr. Welch in 1896, this species has been taken in nearly all the maritime counties, and has become alarmingly abundant in many districts, greatly to the inconvenience of competing species. It is also abundant in the

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Lough Neagh basin, though first observed there in 1898. From its pre-

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WDEDLDANFETYARDOWMSLMOHEMROCVLHWGNGLFWHMESGKCKDDUCLNTQCCWHINKLKSTKKWXSKMCECWAH
```

sence in lakes on the Aran Islands, on the Dingle peninsula, and in other isolated stations along the west coast, it can scarcely have been introduced with timber, as was originally suggested; and it is, I think, certainly native. But that it has recently spread locally I also firmly believe; for in its present abundance it could not have been long overlooked.

The testimony of Mr. J. N. Milne would alone convince me of this fact, and there is also that of other conchologists to confirm his statements. Mr. Milne's experience is briefly as follows: he collected regularly for many years, in the marshes opposite Culmore and at Limavady in Derry, and in those of Inch in East Donegal, the dominating species always being Planorbis crista; P. spirorbis, and Aplecta hypnorum. After the lapse of but a few years, he again visited these localities during the closing years of the last century, and found that Paludestrina jenkinsi had appeared in enormous numbers, and was undoubtedly the dominant species. At Inch he failed to find any specimens of Planorbis crista, though the other two shells were still there. During the month of June, 1909, I had an opportunity of working Mr. Milne's station at Limavady Junction. No examples of *Planorbis crista* were seen ; but one of P. spirorbis and several of A. hypnorum were taken, while every scoop brought up hundreds of P. jenkinsi. After the first frosts of autumn, millions of dead shells of this species may be collected along the shores of Lough Foyle, and on those of Lough Neagh, thrown up by waves in large wreaths, which sometimes measure several feet long and may be inches in depth. Like all adaptable species, it shows great local variation, each station having some different characteristics; but the prevailing form is smooth, the vars. carinata and coronata being more local, though in certain localities these may predominate.

### Paludestrina stagnalis (Baster).

Turbo Ulvae, Brown, Mem. Werner. Soc., vol. ii, p. 521, 1818. Hydrobia ulvae, Scharff, Irish Naturalist, p. 178, 1892.

		WD	ED	LD	AN	
			$\mathbf{FE}$	$\mathbf{T}\mathbf{Y}$	$\mathbf{AR}$	DO
	WM	SL	$\mathbf{LE}$	MO		
		$\mathbf{E}\mathbf{M}$	$\mathbf{RO}$	$\mathbf{CV}$	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		SC	$\mathbf{KC}$	KD	DU	
	CL	$\mathbf{NT}$	$\mathbf{QC}$	$\mathbf{CW}$	WI	
NK	LK	$\mathbf{ST}$	$\mathbf{K}\mathbf{K}$	WX		
SK	MC	EC	WA			
	WC					

Common in most estuaries, and occurs

on the coasts of all four provinces. Shows great variation in size and shape, in the depth of suture and other characters.

# Bithynia tentaculata (Linné).

Helix tentaculata, Brown, Mem. Werner.
Soc., vol. ii, p. 531, 1818. Paludina tentaculata, Thompson, Cat. L. &
F. W. Mollusca of Ireland, p. 3, 1840.

		WD	ED	LD	AN	
			FE	TΥ	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SC	KC	KD	DU	
	CL	NT	QC	CW	WE	
NK	LK	ST	KK	WX		
SK	MC	EC	WA			
	WC					

Common over the greater part of the country, but becoming scarcer in all directions away from the central plain, and absent from districts such as West Donegal (metamorphic area), Antrim and Derry (basaltic plateau), West Mayo (metamorphic area), and the mountainous parts of Cork and Kerry.

### Bithynia leachi (Sheppard).

The distribution of this shell greatly resembles that of several of the "central" species; but it has not so extensive a range as *Planobis vortex*, or as *Neritina fluviatilis*. The centre of its distribution is worth noting, being close to the only Irish stations for *Planorbis corneus.* The similarity of the geographical distribution of these two

WD ED LD AN FE TY AR DO WM SL LE MO EM RO CV LH WG NG LF WH ME SC KC KD DU CL NT QC CW WI NK LK ST KK WX SK MC EC WA

shells has already been pointed out by Mr. Welch (Irish Nat., p. 1, 1908).

#### VALVATIDAE.

Valvata piscinalis (Müller).

Plate VII, figs. 27, 28.

Turbo fontinalis, Brown, Mem. Werner. Soc., vol. ii, p. 522, 1818.

		WD	ED	LD	AN	
			FE	ΤY	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NC	LF	WH	ME	
		SG	KC	KD	DU	
	CL	NT	0C	CW	WI	
NK	LK	ST	ŇΚ	WX		
SK	MC	EC	WA			
	WC					

Generally distributed, and common in almost all parts of the mainland, and occurs on Clare Island in West Mayo. The prevailing form according to Mr. Kennard is that known on the Continent under the specific name of *Valvata alpestris*, Blauner. (Fig. 27.)

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# Valvata cristata Müller.

Turbo cristatus, Brown, Mem. Werner. Soc., vol. ii, p. 522, 1818.

		WD	ED	LD	AN	
			FE	TY	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	LF	WĤ	ME	
		SC	KC	KD	DU	
	CL	NT	0C	CW	WI	
NK	LK	ST	ŇΚ	WX		
SK	MC	EC	WA			
	WC					

Perhaps even more generally distributed than the last species, but has not been found except on the mainland.

#### ACICULIDAE.

#### Acicula lineata (Draparnaud).

Acme fusca, Thompson, Cat. L. & F. W.
Moll. of Ireland, p. 29, 1840.
A. lineata, Scharff, Irish Naturalist,
p. 177, 1892.

		WD	ED	LD	AN	
			$\mathbf{FE}$	$\mathbf{T}\mathbf{Y}$	AR	DO
	WM	SL	LE	$\mathbf{MO}$		
		$\mathbf{E}\mathbf{M}$	$\mathbf{RO}$	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		SG	$\mathbf{KC}$	$\mathrm{KD}$	DU	
	CL	NT	QC	$\mathbf{CW}$	WI	
NK	LK	ST	KK	WX		
SK	MC	EC	WA			
	WC					

Widely distributed, but so far unrecorded for twelve divisions, all of which are inland with the exception of R.I.A. PROC., VOL. XXIX., SECT. B.

Wexford. That this shell will eventually be found in all divisions is not improbable : but some of the districts lving in the central plain offer few habitats for such a shade-loving species; and it is therefore possible that it may not live in a few of these areas. Three colour forms are found, the dark-brown type, a paler brown, and the pure white form; of these the last is perhaps the most common of the three, while the other two occur in about equal quantity. On Clare Island-the only island from which the species has been reportedand on the adjoining mainland of West Mayo, I have seen none but the brown forms. In a little sea-gully near Slea Head, the most westerly point of the Dingle promontory, this shell has been taken in great numbers by Mr. Welch and myself; a few handfuls of moss, liverworts, &c., vielding over 200 specimens of the white and brown forms.

#### NERITIDAE.

### Neritina fluviatilis (Linné).

Nerita fluviatilis, Brown, Mem. Werner. Soc., vol. ii, p. 532, 1818.

		WD	ΈD	LD	AN	
			$\mathbf{FE}$	$\mathbf{T}\mathbf{Y}$	AR	DO
	WM	SL	LE	MO		
		$\mathbf{E}\mathbf{M}$	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SG	KC	KD	DU	
	CL	NT	QC	CW	WI	
NK	LK	ST	KK	WX		
SK	$\mathbf{MC}$	$\mathbf{EC}$	WA			
	WC					

In Ireland this is strictly a calcicole [R]

species; and outside the central limestone districts, it is only found in isolated stations in West Galway, West Mayo, Sligo, and Leitrim; all these stations, however, lie on Carboniferous limestone. So far this shell has not been found in any division in Ulster, and its absence from the Fermanagh lakes, where so many "Central" species, such as Planorbis vortex and Anodonta cygnea, occur, is worthy of special notice. Its chief habitats are canals and the larger rivers and lakes, the Shannon being perhaps its present headquarters. In colour and markings there is considerable variation.

# LAMELLIBRANCHIATA.

#### UNIONIDAE.

#### Margaritana margaritifera Linné.

Mya margaritifera, Brown, Mem. Werner. Soc., vol. ii, p. 505, 1818. Alasmodon margaritiferus and A. elongatus, Thompson, Cat. L. and F. W. Moll. of Ireland, pp. 41 and 44, 1840. Unio margaritifer, Scharff, Irish Nat. p. 180, 1892.

	WD	ED	LD	AN	
		FE	ΤY	AR	DO
WM	SL	$\mathbf{LE}$	MO		
	EM	RO	$\mathbf{C}\mathbf{V}$	LH	
WG	NG	$\mathbf{LF}$	WΗ	ME	
	SG	$\mathbf{KC}$	$\mathrm{KD}$	DU	
CL	$\mathbf{NT}$	QC	CW	WI	
$\mathbf{L}\mathbf{K}$	ST	KK	WX		
MC	$\mathrm{EC}$	WA			
WC					
	WM WC CL LK MC WC	WD WM SL EM WC NG SG CL NT LK ST MC EC WC	WD ED FE WM SL LE EM RO WC NG LF SG KC CL NT QC LE ST KK MC EC WA WC	WD ED LD FE TY WM SL LE MO EM RO CV WC NG LF WH SG KC KD CL NT QC CW LE ST KK WX MC EC WA	WDEDLDANFETYARWMLEMOEMROCVLHWCNGLFWHNGLGKODUCLNTQCCWWILKSTKKWXMCECWAH

Abundant in many of the larger

rivers in the mountainous parts of the south, west, and north, and also frequent in some of those in the east. As might be expected, it is absent from most of the central parts of the country, where it is replaced in many of the rivers by Anodonta cygnea. Specimens from the Aughrim River in Wicklow have been identified by the late Prof. Boettger as Margaritana pyrenäica Seemingly scarcer than in Locard. former times in many rivers, perhaps owing to the depredations of the pearlsearchers and their wanton destruction.

# Anodonta cygnea (Linné).

Mytilus cygneus, Brown, Mem. Werner. Soc., vol. ii, p. 515, 1818. Anodon cygneus, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 40, 1840.

		WD	ED	LD	AN	
			FE	$\mathbf{T}\mathbf{Y}$	AR	DO
	WM	SL	LE	MO		
		ΕM	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SG	KC	KD	DU	
	CL	NT	QC	$\mathbf{CW}$	WI	
ΝK	$\mathbf{L}\mathbf{K}$	$\mathbf{ST}$	ΚK	WX		
SK	$\mathbf{MC}$	EC	WA			
	WC					

This bivalve has a somewhat similar range to *Planorbis vortex* and *Neritina fluviatilis*, but is more widely distributed in the north and north-east, occurring in Lough Neagh and the neighbouring districts of Antrim, Down, and Armagh. It reaches the west coast at Westport, in West Mayo, where a small, tumid form is common in the Carrowbeg.

From the extreme south and southeast we have as yet no records; but it should certainly occur in the latter district. The prevailing form is small, 7 inches being about the maximum length. This size is attained only in specimens from canals and the smaller lakes. Shells found in the larger lakes seldom exceed 4 inches. M. Henri Drouet has identified the large form found in the Royal Canal as A. eygnea, but considered the smaller to belong to A. cellensis Schröter.

### CYRENIDAE.

# Sphaerium corneum (Linné).

Tellina cornea, Brown, Mem. Werner.
Soc., vol. ii, p. 508, 1818. Cyclas cornea, Thompson, Cat. L. & F. W.
Moll. of Ireland, p. 38, 1840.

		WD	ED	LD	AN	
			FE	ŤΥ	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SC	KC	KD	DU	
	CL	NT	0C	CW	WI	
NK	LK	ST	ĸк	WX		
SK	MC	EC	WA			
	WC	_				

Generally distributed, but absent from, or extremely rare in, the southwest and north-west, rare in most of the western counties, and not recorded for any of the western islands. In reality it is a "central" species, with a somewhat extended range. Many forms occur; but the most important variation is that met with in some of the lakes of the limestone area, which is very globose and with large, prominent umbones.

NOTE ADDED IN PRESS.—I have recently taken some exceedingly small examples of a Sphaerium in West Mayo. These, although apparently well grown, are smaller than the fry of *S. corneum*; but until I have obtained more specimens and further investigated the matter I cannot say whether they belong to this species or not.

### Sphaerium lacustre (Müller).

Cyclas lacustris, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 38, 1840.

		WD	$\mathbf{ED}$	$\mathbf{L}\mathbf{D}$	AN	
			$\mathbf{FE}$	$\mathbf{T}\mathbf{Y}$	AR	DO
	WM	SL	$\mathbf{LE}$	MO		
		$\mathbf{E}\mathbf{M}$	RO	CV	LH	
	WG	NG	LF	WΗ	ME	
		SG	KC	KD	DU	
	CL	NT	QC	CW	WI	
NK	LK	ST	KK	WX		
SK	MC	EC	WA			
	WC					

Has a distinctly eastern range, and is found in all the eastern maritime divisions. It also occurs in the southern divisions of the central plain and as far west as Clare and North-east Galway. It is always a local shell, but generally common where it is to be found, and in Lough Neagh, at the inlets of some of the larger rivers, it occurs in enormous numbers. Here during certain seasons it may be dredged in bucketfuls.

# Pisidium amnicum (Müller).

Tellina amnica, Brown, Mem. Werner. Soc., vol. ii, p. 508, 1818.

		WD	ED	LD	AN	
			FE	TY	AR	DO
	WM	$\operatorname{SL}$	$\mathbf{LE}$	MO		
		$\mathbf{E}\mathbf{M}$	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SG	KC	KD	DU	
	CL	NT	QC	CW	WI	
NK	LK	$\mathbf{ST}$	KK	WX		
SK	MC	EC	WA			
	WC					

Resembles the last shell in its distribution, but has a wider range. Often associated with it in the north-eastern districts; but Mr. Phillips tells me that in the south he rarely finds these two species together, though sometimes occurring in the same district, the present one seeming to favour large rivers and canals, while *Sphaerium lacustre* occurs most frequently in ditches and sluggish streams.

Pisidium henslowanum (Sheppard).

		WD	ED	$\mathbf{L}\mathbf{D}$	AN	
			$\mathbf{FE}$	$\mathbf{T}\mathbf{Y}$	AR	DO
	WM	SL	$\mathbf{LE}$	MO		
		$\mathbf{E}\mathbf{M}$	$\mathbf{RO}$	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		$\mathbf{SG}$	$\mathbf{KC}$	KD	DU	
	CL	NT	QC	$\mathbf{CW}$	WI	
NK	LK	ST	ΚK	WX		
SK	$\mathbf{MC}$	EC	WA			
	WC					

An exceedingly local shell, and is

only known from a few central and north-western localities. There is, however, a doubtful record for Dublin, which points to the possibility that it has been overlooked in other parts of the country.

# Pisidium subtruncatum Malm.

Pisidium fontinale, Scharff, Irish Nat., p. 180, 1892.

		WD	ED	$\mathbf{L}\mathbf{D}$	AN	
			FE	$\mathbf{T}\mathbf{Y}$	AR	DO
	WM	SL	$\mathbf{LE}$	MO		
		$\mathbf{E}\mathbf{M}$	$\mathbf{RO}$	$\mathbf{C}\mathbf{V}$	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		$\operatorname{SG}$	$\mathbf{KC}$	KD	DU	
	CL	NT	$\mathbf{QC}$	CW	WI	
NK	$\mathbf{L}\mathbf{K}$	ST	$\mathbf{K}\mathbf{K}$	WX		
SK	MC	$\mathbf{EC}$	WA			
	WC					

Generally distributed throughout the mainland, and occurs on some of the western islands.

# Pisidium pulchellum Jenyns.

 WD
 ED
 LD
 AN

 FE
 TY
 AR
 DO

 WM
 SL
 MO
 H

 WM
 EM
 CV
 LH

 WM
 RO
 CV
 LH

 WM
 NG
 LF
 WH

 SG
 KC
 KD
 DU

 CL
 NT
 QC
 CW
 W1

 SK
 KK
 WX
 K

 SK
 MC
 EC
 WA

Distinctly more local than *Pisidium* subtruncatum, but is nevertheless

widely distributed throughout the mainland. Has also been taken on Clare Island and Achill Island in West Mayo.

# Pisidium casertanum Poli.

? Pisidium cinereum, Thompson, Cat. L. & F. W. Moll. of Ireland, p. 40, 1840.

		WD	ED	LD	AN	
			FE	$\mathbf{T}\mathbf{Y}$	$\mathbf{AR}$	DO
	WM	SL	$\mathbf{LE}$	MO		
		$\mathbf{E}\mathbf{M}$	RO	CV	$\mathbf{LH}$	
	WG	NG	$\mathbf{LF}$	WH	$\mathbf{ME}$	
		$\mathbf{SG}$	KC	KD	DU	
	CL	$\mathbf{NT}$	QC	CW	WI	
NK	LK	$\mathbf{ST}$	ΚK	WX		
SK	$\mathbf{MC}$	EC	WA			
	WC					

Very generally distributed. The *P. pusillum* var. grandis of most English authorities. In peat-bogs, ditches, and pools of peaty water this species and *P. personatum* are particularly abundant, and are often to be found where no other shell can apparently live. In the lakes of West Mayo a peculiar form of this species occurs; and specimens sent to Mr. B. B. Woodward were at once recognized by him as a lacustrine form.

#### Pisidium obtusale Pfeiffer.

Widely distributed, but is a somewhat local shell. Occurs on some of the western islands. On the Dingle promontory, in South Kerry, this species is very abundant in some of the mountain tarns, and occurs in the Coomb-a-knock Lake on Brandon Mountain, up to an altitude of 2300 feet.

		WD	ED	$\mathbf{L}\mathbf{D}$	AN	
			FE	$\mathbf{T}\mathbf{Y}$	AR	DC
	WM	SL	$\mathbf{LE}$	MO		
		$\mathbf{E}\mathbf{M}$	RO	$\mathbf{C}\mathbf{V}$	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		$\mathbf{SG}$	KC	KD	DU	
	CL	$\mathbf{NT}$	$\mathbf{QC}$	$\mathbf{CW}$	WI	
NK	$\mathbf{L}\mathbf{K}$	$\mathbf{ST}$	$\mathbf{K}\mathbf{K}$	WX		
SK	$\mathbf{MC}$	$\mathbf{EC}$	WA			
	WC					

Pisidium nitidum Jenyns.

		WD	ED	LD	AN	
			FE	$\mathbf{T}\mathbf{Y}$	$\mathbf{AR}$	DO
	WM	SL	$\mathbf{LE}$	MO		
		$\mathbf{E}\mathbf{M}$	RO	CV	LH	
	WG	NG	$\mathbf{LF}$	WH	ME	
		$\mathbf{SG}$	KC	KD	DU	
	CL	$\mathbf{NT}$	QC	$\mathbf{CW}$	WI	
NK	LK	ST	$\mathbf{K}\mathbf{K}$	WX		
SK	MC	$\mathbf{EC}$	WA			
	WC					

Generally distributed, but, like *P. pulchellum* and *P. obtusale*, is local and often absent from large areas. Like the other members of the genus, this shell is frequently met with on the western islands. It is also frequently common in mountain tarns, which have stony bottoms, with little vegetation.

### Pisidium pusillum (Gmelin).

Generally distributed on the mainland, and is also found on some of the islands. The old records for this shell probably include both the next species and *P. obtusale*.

		WD	ED	LD	AN	
			FE	TY	$\mathbf{AR}$	DO
	WM	$\operatorname{SL}$	LE	MO		
		ΕM	$\mathbf{RO}$	CV	LH	
	WG	NC	$\mathbf{LF}$	ШW	ME	
		$\mathbf{SG}$	KC	KD	DU	
	CL	NT	0C	CW	WI	
NK	$\mathbf{L}\mathbf{K}$	ST	КК	WХ		
SK	$\mathbf{MC}$	EC	WA			
	wn					

### WC

Pisidium personatum Malm.

		WD	ΕD	LD	AN	
			FE	TT	$\mathbf{AR}$	DO
	WM	SL	ĿΕ	MO		
		EМ	RO	CV	LH	
	WG	NG	$\mathbf{LF}$	WН	ME	
		$\mathbf{SG}$	KC	$\mathrm{KD}$	DU	
	CL	NT	QC	CW	WI	
NK	LK	ST	КK	WX		
SK	MC	ЕC	WA			
	W.C					

Widely distributed on the mainland and islands, and particularly common in boggy areas. Only recently recognized in this country by Mr. Woodward.

# Pisidium milium Held.

		WD	ED	LD	AN	
			FE	TΥ	AR	DO
	WM	SL	LE	MO		
		EM	RO	CV	LH	
	WG	NG	LF	WH	ME	
		SG	KC	KD	DU	
	CL	NT	QC	CW	WI	
NK	$\mathbf{L}\mathbf{K}$	ST	ŇΚ	WX		
SK	MC	EC	WA			
	WC					

Generally distributed on the mainland and islands.

Pisidium hibernicum Westerlund.

		WD	ED	LD	AN	
			$\mathbf{FE}$	$\mathrm{TY}$	$\mathbf{AR}$	DO
	WМ	SL	$\mathbf{LE}$	MO		
		ЕM	RO	CV	LH	
	WG	NG	LF	WΗ	ME	
		$\mathbf{SG}$	KC	КD	DU	
	$\mathbf{CL}$	NΤ	QC	CW	WI	
NK	$\mathbf{L}\mathbf{K}$	ST	$\mathbf{K}\mathbf{K}$	WX		
SK	MC	$\mathbf{EC}$	WA			
	WC					

This species, which, like Limnaea inroluta and L. praetenuis, is unknown outside Ireland, is now known to inhabit several lakes in South Kerry and one in West Cork. All of these lie at an altitude of over 1,000 feet, and the greater number of them are intensely peaty. Its only associates so far observed have been Limnaea praetenuis, Ancylus fluriatilis, and other Pisidia.

Some English conchologists have considered this species to be a form of *Pisidium obtusale*; but I learn from Mr. Woodward that, judging by the hinge, it is a good species, and that its nearest ally in the Britannic area is *Pisidium milium*.

#### Pisidium steenbuchi Möller.

# ? Pisidium globulare, Scharff, Ir. Nat., p. 179, 1892.

Though recorded as a fossil from Clare and Kildare, this species was until 1910 unknown in the living state in Ireland. It, however, inhabits Keel Lough on

Achill Island, where it is associated with *P. lilljeborgi* and the lacustrine form of

WD ED LD AN FE TY AR DO WM SL LE MO EM RO CV LH WG NG LF WHME SG KC KD DU CL NT QC CW WI NK LK ST KK WX SK MC EC WA

P. casertanum, while Major Trevelyan has dredged it in several lakes in Fermanagh and East Donegal. The shells which Dr. Scharff has recorded as Pisidium globulare—a synonym of the present shell—are now regarded by Mr. B. B. Woodward as a form of P. pusillum. Both P. steenbuchi and P. lilljeborgi would appear from their distribution to belong to that group of migrants which invaded this country from the north at some very remote period, and to which Vertigo lilljeborgi also belongs.

Pisidium lilljeborgi Clessin.

		WD	$\mathrm{ED}$	LD	AN	
			FE	$\mathbf{T}\mathbf{Y}$	AR	DO
	WM	SL	$\mathbf{LE}$	MO		
		$\mathbf{E}\mathbf{M}$	RO	$\mathrm{CV}$	LH	
	WG	NG	LF	WH	ME	
		$\mathbf{SG}$	$\mathbf{KC}$	KD	$\mathrm{DU}$	
	$\operatorname{CL}$	$\mathbf{NT}$	$\mathbf{QC}$	CW	WI	
NK	$\mathbf{L}\mathbf{K}$	ST	$\mathbf{K}\mathbf{K}$	WX		
SK	$\mathbf{MC}$	$\mathbf{EC}$	WA			
	WC					

Though not discovered in this country until recently, this shell has now been taken in several of the western divisions, from West Donegal to Achill Island in West Mayo. Its known habitats are all lakes with rather scanty vegetation and stony bottoms, lying in barren and uncultivated districts, but it is probably widely distributed in the western and northern counties.

# 3. LIST OF ERRONEOUS AND DOUBTFUL RECORDS.

Though many of the doubtful records in the following list will in all probability be eventually verified, it has been considered prudent not to include them in Section 2 at present, as they are mainly founded on old records, and are not backed up by existing specimens. Where a record is listed as erroneous, it does not mean that the particular shell in question is necessarily absent from that division, but simply that the examples on which the record was founded are now considered to belong to another species. Though probably not complete, I hope the list includes the majority of the erroneous and doubtful records. Many of the former are due to the earlier conchologists, who evidently believed that Ireland possessed all the species found in England. They were therefore careless when making inquiries as to the origin of the so-called Irish examples.

# Proceedings of the Royal Irish Academy.

Hyalinia lucida Drap.—Reported from South Kerry, West Cork, Northeast Galway, West Galway, Leitrim, Cavan, West Donegal, East Donegal, Down, and Antrim; but all records so far for these divisions undoubtedly refer to the large Irish form of *H. cellaria* (= *Vitrea hibernica* Kennard). Fermanagh, doubtful: the specimens in the Thompson collection are undoubted specimens of this species; but the collection has been so tampered with that I do not like to trust the label, which bears the title, "Florencecourt, Co. Fermanagh," as Thompson nowhere refers to these specimens.

**H**. helvetica Blum.—Recorded by Taylor from West and East Cork, Waterford, South Kerry, South Tipperary, Sligo, and Monaghan; but no authentic specimens seem to be in existence. Probably all records refer to *H. cellaria*. (See correspondence in Irish Nat., vol. xix., pp. 210, 242, 254).

**H**. petronella Charp.—Recorded by Westerlund from "Ireland" (see p. 80, *supra*). Probably an error.

Zonitoides excavatus Bean.—Monaghan, recorded by error in the Conchological Society's Census, 1902. Down, doubtful: no specimens extant. Dublin, doubtful until verified.

**Pyramidula rupestris** Drap.—Down, doubtful: recorded from "Scrabo" by Thompson. Never seen there since, and there are no specimens in the Thompson collection from that locality.

Helicigona lapicida L.—Reported from Belfast by Jeffreys, but specimens afterwards proved to have come from England.

**Hygromia granulata** Alder.—"*H. sericea*" has been reported from Kildare, Dublin, Down, and East Donegal. All doubtful until verified.

**Hygromia sericea** Drap.—Unknown in Ireland. All records refer to forms of *H. hispida* or to *H. granulata*.

Arianta arbustorum L.-Dublin, erroneous (*H. aspersa*, juv.). Reported from North Kerry, Limerick, and Down; but no specimens in existence.

Helix pisana Müll.—South Kerry, West Galway, and Kildare : all doubtful; no specimens in existence. Queen's County, doubtful : there is a specimen in the Dublin Museum from the Warren collection, labelled, "La Bergerie"; but this must be considered a doubtful record for the present.

**H.** hortensis Müll.—Recorded by J. G. Milne from Achill Island, in West Mayo; but I feel sure that Mr. Milne must have mistaken examples of *H. nemoralis* var. *albolabiata* for this species, as this variety is found in the locality mentioned by him, though not recorded in his list.

Azeca tridens Pult.—Recorded for Clare in the Conchological Society's Census for 1902. Undoubtedly a printer's error.

Caecilioides acicula Müll.—Reported from Limerick by Thompson.

Pupa secale Drap.-There was a specimen of this shell in the Natural

History Museum at South Kensington labelled "Ireland"; but no specimens have ever been known to have been found in this country. See also Thompson, Ann. Mag. Nat. Hist., vi., 113. 1840-41.

**Ena obscura** Müll.—Down, doubtful: shells reported by Captain Brown under the name of *Hclix Lackhamensis* probably refer to large examples of this species. It has never been found since in Down, and as there are no specimens in any collection, it must be considered a very doubtful record.

**E.** montana Drap.—Brown reports *Helix Lackhamensis* from Queen's County and Down; both records must be referred to *E. obscura*. Reported from Dublin in appendix to Walsh and Whitelaw's History of Dublin.

Vertigo alpestris Alder.-Dublin, erroneous. West Mayo, doubtful.

**V. lilljeborgi** West.—Clare, doubtful. A shell resembling this species was taken on the Aran Islands by Dr. Scharff, but lost before finally identified.

V. moulinsiana Dupuy.—West Galway, erroneous. Specimens are all V. lilljeborgi West.

**V. angustior** Jeff.—Mid or West Cork, doubtful. It is not certain under which division the old record should be placed.

V. pusilla Müll.—Reported by Thompson from Kenmare in South Kerry, and from "Limerick, Cork, and Kerry" by R. Welch. Journ. of Conchology, xi, 16. 1904.

**Clausilia laminata** Mont.—Reported from Church Island, Lough Gill, in Sligo. There are specimens in the Thompson collection of this species labelled "Giant's Causeway"; but it is difficult to know whether to trust the record or not.

**Succinea putris** L.—South Kerry and West Galway, doubtful. All records so far refer to the small obese form of *S. pfeifferi*.

**S. oblonga** Drap.—There are specimens under this name from Limerick in the Hyndman collection in Belfast; but they are only *S. pfeifferi* var. *contortula*. Also reported from Armagh, doubtful.

Limnaea glabra Müll.—There are several old records for this shell—Cork, Dublin, and Belfast—but no specimens are forthcoming.

Planorbis corneus L.-South Kerry, Dublin, and Meath, doubtful, no specimens.

**P**. vortex L.—Derry, Down, Antrim, Mid Cork, and West Galway, erroneous: only *P. spirorbis* var. *leucostoma*. Queen's Co. and Kildare, doubtful.

**P. carinatus** Müll.—Mid and East Cork, doubtful. Mr. Phillips considers all the specimens he has collected in these divisions to be referable to *P. umbilicatus*, although some of them have been identified as the present shell by English authorities.

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**P. glaber** Jeff.—North Kerry and Mid Cork, doubtful: no specimens in existence.

**Segmentina nitida** Müll.—Reported from Co. Tipperary by Jeffreys and others. Probably owing to misinterpretation of *Planorbis nitidus*, Thompson, which is of course *P. fontanus* Lightfoot.

Acicula lineata Drap.—Queen's County, doubtful : recorded in the diary of the late Rev. B. J. Clarke from Spire Hill.

**Paludestrina ventrosa** Mont.—A single dead example of this shell was taken some years ago by Mr. J. N. Milne at Trawbreaga Bay in East Donegal. This must be taken as a doubtful record until living specimens are found.

**Paludina vivipara** L.—The record of Captain Brown seems so emphatic that it is impossible to consider it erroneous, and there is a possibility that the species may have at that time lived in one of the several mill-dams at Newtownards. Although Brown states that he found it "in a stream," this is not likely, as the only one near Newtownards is swift, stony, and shallow, and very different from the usual habitats of this shell. The finding of a dead specimen near Limerick by Mr. Fogerty [86] has awakened fresh interest in this species; and I have often wondered lately if it were possible that Captain Brown had collected his specimens while stationed somewhere in the centre of Ireland, and afterwards forgotten and mistaken the locality. There are many unworked areas in the central plain; and there seems no reason, from its distribution in Britain, why *P. vivipara* should be absent from Ireland.

Neritina fluviatilis L.- East Cork, doubtful.

**Dreissensia polymorpha** Pallas.—Reported from Dublin by Lowe [146] in 1883. Undoubtedly an error.

**Sphaerium rivicola** Leach.—Reported from the Liffey at Lucan, Dublin, undoubtedly a mistake. Some collector in all probability mistook some of the very large shells of *Pisidium amnicum*, which are to be found in this river, for the present species. (See Forbes and Hanley, ii, 135.)

**Pisidium henslowanum** Shepp.—Recorded from the River Dodder, in Dublin, by Clarke in his diary. Doubtful.

**P. subtruncatum** Malm.—North and South Kerry, West and East Cork, Waterford, Limerick, Kilkenny, Wexford, Queen's County, West Galway, Wicklow, Dublin, Longford, Leitrin, Louth, Tyrone, Armagh, and Derry. Doubtful.

P. pulchellum Jenyns.—Mid and East Cork, Kilkenny, North-east Galway, Dublin, and Louth. Doubtful.

P. casertanum Poli.—North Kerry, East Cork, West Galway, Dublin, Cavan, Monaghan, and Armagh. Doubtful.

P. obtusale Pfeiffer .-- West, Mid, and East Cork, Waterford, Kilkenny,

West Galway, Meath, Sligo, Cavan, Louth, West Donegal, Tyrone, Armagh, and Derry. Doubtful.

P. nitidum Jenyns.—East Cork, North Tipperary, Carlow, Queen's County, Wicklow, Meath, Sligo, Cavan, and Louth. Doubtful.

P. pusillum Gmelin.—North Kerry, Mid and East Cork, Waterford, Kilkenny, West Galway, Kildare, Wicklow, Westmeath, Longford, East Mayo, Sligo, Leitrim, Cavan, Louth, Tyrone, and Armagh. Doubtful.

P. personatum Malm.-Cavan, Armagh, and Down. Doubtful.

P. steenbuchi Möller.-Westmeath, doubtful.

#### 4. LIST OF INTRODUCED SPECIES.

We have two kinds of introductions to deal with—"natural" and "artificial." The former includes those shells which from time to time may be washed up on our coasts by the sea, or those brought by the many casual methods which have been appealed to by naturalists and others to account for the present geographical distribution of plants and animals.

#### Unsuccessful Natural Introductions.

The only species of which I can find any record of natural introduction are *Pomatias* (*Cyclostoma*) *elegans* and *P. ferrugineus*. Neither of these shells, however, has been able to establish itself in Ireland, although they are both better adapted to withstand immersion in the sea than the great majority of the species found in this country. Even if able to reach our shores alive, it seems probable that, under present conditions, "alien" species, unless specially protected, would be speedily wiped out of existence by the competition of the truly native fauna.

**Pomatias elegans** Müll.—Sea-borne specimens of this operculate have been recorded from various places on our coast. Forbes and Hanley [94] mention that as many as 100 specimens were washed up near Bundoran (East Donegal) in one day.

*General Distribution.*—Widely distributed over Europe, and occurs in Britain as far north as Lancashire and Yorkshire.

**P. ferrugineus** Lam.—This is the *Cyclostoma productum* Turton, recorded by Thompson as found by Dr. Turton near the sea in the west of Ireland.

*General Distribution.* According to Forbes and Hanley this shell is found in Algeria, Balearic Isles, and southern Spain.

Between the two groups—natural and artificial—I must place two species whose origin is unknown. In the case of these, undoubted introductions, there

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is no shadow of evidence to show that their importation was due to man, nor is there any real evidence of introduction by natural means :---

Species whose means of Introduction are Unknown.

**Helicodonta personata** Lan.—A dead example of this shell was picked up in the sandhills at Newcastle. in Down, by the late S. A. Stewart, in 1870. Possibly sea-borne.

*General Distribution.*—Central Europe, especially the mountainous districts of eastern France, Germany, and Switzerland.

Helicella zaccarensis Kollekt.—A half-grown living specimen of this rare Algerian xerophile was taken by the writer near Rostrevor, in Down, in February, 1898. Origin unknown.

General Distribution.—So far as is known at present, this shell is confined to Mount Zaccar, in Algeria.

In the second group we have all those shells which are brought into this country with merchandise. Most of these make their appearance in nursery gardens and hot-houses, where foreign plants are constantly arriving. Fruit has also been proved to be a means of importation, thanks to the investigations of Mr. W. A. Green. When introduced into hot-houses many of these shells succeed in establishing themselves; but so far we have no instance of any foreign species becoming naturalized in the open air, except those which have been introduced at Magheramorne with railway ballast. As most of the aliens come from a warmer climate than ours, this is not to be wondered at. In the case of fruit, it is not usually unpacked until it has arrived in a shop; and therefore there is not so much likelihood of shells thus imported being able to establish themselves. The list of species introduced by artificial means is, up to the present, as follows:—

# Artificial Introductions.

**Testacella haliotidea** Drap.—This species has recently been taken in a garden at Strabane (Tyrone) by the Rev. A. H. Delap. Though future investigation may prove it to be native, and Dr. Scharff is inclined to regard it as such, I think, judging by its distribution and that of the other members of the genus, that it is more likely to have been imported with plants.

Agriolimax laevis Müll [?).—This slug, which has been found in many greenhouses, differs from our native examples of *A. lacris* in its colour, which is of a peculiar slaty-purple tinge. Occurs in Dublin, Belfast, and at Castlewellan in Down.

**Hyalinia lucida** Drap.—Common in the greenhouses at Glasnevin and Castlewellan, and also in several private gardens near Belfast. The Glasnevin examples appear to resemble southern French rather than our native forms.

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**H.** nitidula Drap.—A large form referable to the var. *nitens* has been introduced with other species on to the railway near Magheramorne, in Antrim.

Zonitoides minusculus Binney.—Common in the hot-houses at the Botanic Park in Belfast.

General Distribution.-North America.

**Zonitoides** sp.—Mr. Phillips has recently found at Glasnevin a single example of a shell resembling a small Z. nitidus. On comparing this with a shell taken by myself or Mr. Welch at Crawford's Nursery, in Belfast, in 1907, I find that they are identical. Mr. Welch and I had, at the time it was found, passed the Belfast specimen over as a peculiar form of Z. nitidus; but after seeing that collected by Mr. Phillips I have no doubt that both must be referred to some foreign species. This shell resembles Hyalinia arborca Say, and also H. petronella Charp.; but is distinguished from the latter by its closer striae, and from the former by its narrower whorls. From Z. excavatus it is at once distinguished by its narrower umbilicus, though, when viewed from above, it closely resembles that species.

**Patulastra flavida** Ziegler.—Fairly common in some of the houses at Glasnevin. This shell is easily kept in captivity; and I have now (December, 1910) quite a number of half-grown examples, the progeny of two specimens brought from Glasnevin in February of the present year.

General Distribution.—Southern Europe, including some of the Mediterranean Isles.

**Helicodiscus lineatus** Say.—First taken by Mr. Phillips in the hot-houses at University College, Cork, and since found at Glasnevin and Castlewellan.

General Distribution.—North America.

**Helicella virgata** Da Costa.—A large and very high-spired form of this shell has been introduced (with ballast?) on the Midland Railway near Magheramorne, in Antrim, together with other species.

H. intersecta Poiret.-With H. virgata.

**H**. cantiana Mont.—There are specimens of this shell in the Dublin Museum from Stillorgan Park, Co. Dublin; but whether it has established itself there or not I cannot say. It has also been introduced at Tivoli, near Cork, and seems to have become quite naturalized. (Irish Nat., Jan. 1911).

General Distribution.—Central Europe and southern Britain.

H. cartusiana Müll. Imported into Belfast with currants from Turkey.

General Distribution.—Widely distributed in the southern half of Europe, and also found in the south-east corner of England.

**H. pyramidalis** (? = H. pyramidata Drap.).-Recorded by Mr. Green as imported with raisins into Belfast.

General Distribution,-Mediterranean littoral,

**Hyrgomia rufescens** Pennant.—Introduced with *Helicella virgata* at Magheramorne, in Antrim.

This species has made its appearance in many gardens in the north, and is now recorded for all the Ulster counties, though in the time of William Thompson it was apparently quite unknown north of Banbridge, in Down. How much of this extension of its range is due to legitimate migration, and how much to importation with plants, &c., it is impossible to say; and I have therefore recorded it in the list for all the Ulster divisions, though it appears to have been only recently naturalized in most of them.

Helix pisana Müll.—Imported into Belfast with bananas.

**H**. limbata Drap.—A single living specimen was taken by the writer some years ago in Dickson's Nursery at Belfast. No example seen since.

General Distribution. Widely distributed in France and occurs in Spain.

Hemicycla (*Helix*) guanartemes Grass.—Also obtained in Belfast, in imported bananas, by Mr. Green. Wollaston gives many interesting notes on this species in his Testacea Atlantica, p. 364.

General Distribution.-Confined to Grand Canary, with allied species in the island of Teneriffe.

**Carychium minimum** Müll.—A form differing from our native specimens is common on the outside of damp pots in some of the houses at Glasnevin and Castlewellan. Associated in the former place with the species of Limnaea mentioned below.

**Subulina octona** Chemnitz.—Abundant in several greenhouses in Belfast, Glasnevin, and Castlewellan. Usually associated with the next species.

General Distribution.—Tropical America and reported from tropical Africa and Madagascar.

**Opeas goodalli** Miller.—Has been found in all greenhouses from which the last species has been obtained, except those at Castlewellan.

General Distribution .--- West Indies.

Limnaea sp.—A small species is very abundant at Glasnevin, on the outside of damp pots in the Fern-house. In many ways this shell resembles the small western Irish form of *L. truncatula*; but no authority to which I have sent specimens has cared to say definitely that it is that species. Its colour, which is a clear, transparent yellow, is quite unlike that of any examples of *L. truncatula* I have seen.

**Physa** sp.—Common in the lily-tank at Glasnevin, and recorded by Mr. Green as *Physa acuta* Drap. In a group like that of the Physae it is practically impossible to give an imported species a name, unless one has some idea as to the origin of the specimens. Mr. Standen has kindly compared this shell with those in the Manchester Museum, and has written to me that it is practically identical with examples of *Physa gabbi* Tryon, from Oregon, U.S.A.

**Physa** sp.—A few specimens in one of the small tanks at Glasnevin. These are, according to Mr. Standen, similar to specimens of *Physa gyrina* Say, also an American species.

**Physa** *sp.*—Common in the lily-tank at Castlewellan. Quite a small species.

**Physa** sp.—Common in the lily-tank at the Botanic Park at Belfast, where Mr. Phillips first took it in 1909. It is still common there, although this tank is dried and carefully cleaned every spring, the cleaning process taking about a fortnight's time.

**Planorbis corneus** L.—Believed to have been introduced with water-plants into an artificial pond at Markree Castle, Sligo, but future research may possibly prove it to be native.

**Pomatias elegans** Müll.—Recorded by Rev. B. W. Adams in the British Association Guide to the Dublin District in 1878, as being found at Glasnevin. Perhaps a temporary introduction.

An instance of the means by which shells are imported into this country may be interesting. When visiting Mr. R. Ll. Praeger recently in Dublin, I obtained the "shakings" of moss used by German horticulturists when sending him plants. In this material I obtained the following species :--

From Erfurt in Germany :---

Vitrina pellucida Müll. Hyalinia alliaria Miller. " radiatula Alder. " pura Alder. Euconulus fulvus Müll. Punctum pygmaeum Drap. Acanthinula aculcata Müll. Cochlicopa lubrica Müll. Caecilioides acicula Müll. Vertigo pusilla Müll.

From Lindau in Bavaria:----

Vitrina	sp. (broken).	Hygromia sp. (too young to name).
Hyalini	a alliaria Miller.	Cochlicopa lubrica Müll.
>>	radiatula Alder.	Succinea sp. (broken).
,,	pura Alder.	

The majority of these shells were undoubtedly living when they reached this country, and if the moss containing them had been placed in some damp situation, I have little doubt that some of them would have become naturalized. Mr. Praeger informs me that after arrival in Ireland this moss is often used for re-packing, and sent to various parts of the country: so that mollusks thus imported may acquire quite a wide dissemination.

# 5. BIBLIOGRAPHY.

Compiled by R. J. WELCH, M.R.I.A.

ADAMS, Rev. Benjamin William :

1 [List of Mollusca, Dublin and Wicklow] in Guide to the County of Dublin, part 2, p. 54. 1878.

Adams, Lionel Ernest, B.A.:

- 2 The Collector's Manual of Land and Freshwater Shells. 8vo. London, 1884.
- 3 Idem. 2nd edition. Svo. Leeds, 1896.
- 4 Paludestrina Jenkinsi Smith, in Ireland. Journ. of Conch. ix, 15. 1897.
- 5 Land and Freshwater Mollusca of the Ballycastle District. Irish Nat., vi, 179-183. 1897.
- 6 Paludestrina Jenkinsi Smith. A New Irish Shell. Irish Nat., vi, 234-236. 1897.
- 7 Hyalinia Draparnaudi Beck, in North Ireland?. Irish Nat., vii, 82-83. 1898.
- 8 Paludestrina Jenkinsi Smith, in two new Irish Localities. Journ. of Conch., ix, 114. 1898.
- 9 Paludestrina Jenkinsi Smith, var. minor, nov., in South Ireland. Irish Nat., vii, 199. 1898.
- 10 Observations on some British Land and Freshwater Shells. [Limnaca involuta, &c.] Journ. of Conch., ix, 297-302. 1900.
- 11 The Census of British Land and Freshwater Mollusca. Journ. of Conch., x, 217-237. 1902.

See also STUBBS, A. G., and Lionel E. ADAMS, 266.

ALCOCK, Thomas, M.D.:

 12 Notes on Natural History Specimens lately received from Connemara.
 [Includes lists of non-marine mollusca.] Proc. Lit. and Phil. Soc. Manchester, iv, 192. 1864-65.

ALDER, Joshua:

- 13 Notes on the Land and Freshwater Mollusca of Great Britain, with a revised list of Species. Mag. Zool. & Bot., ii, 101. 1838.
- 14 A Catalogue of the Mollusca of Northumberland and Durham [on p. 137 mentions *Gulnoria lacustris*, Leach, in Lough Neagh]. Trans. Tyneside Nat. F. Club, i, 97–209. 1846–50. [Reprint also, London, 1848.]

ALLMAN, Prof. George James, M.D., F.R.S., M.R.I.A.:

15. Description of a new Genus of Pulmonary Gasteropod [Geomalacus]. Ann. Mag. N. H., xvii, 297. 1846.

# ANON. :

16 Some New Varieties of Irish Land Mollusca [A refer. to Dr. Westerlund's description (quoted in full in Latin) (see 352) of a new var. of Succinea pfcifferi from Dublin, and of Clausilia bidentata from Antrim]. Irish Nat., ix, 131–132. 1900.

# ASHFORD, Charles:

17 Note on Limnaea glutinosa, Müller [with Limnaea auricularia, &c.]. Journ. of Conch., ii, 6. 1879.

# BARKER, John, M.D., M.R.I.A.:

18 Notes on some dissections of the Freshwater Pearl Mussel (Unio Margaritifer) [from Kerry and Donegal, also Bann pearl fishery at Portglenone]. Proc. Nat. Hist. Soc. Dublin, iv, 111. 1862-65.

Belfast Naturalists' Field Club:

- 19 [Many records in the Excursion Reports in the Proceedings and in The Irish Naturalist.]
- 20 Guide to Belfast and the adjacent counties. By members of the Belfast Naturalists' Field Club. [Land and Freshwater Shells, pp. 115-116.] 8vo. Belfast, 1874.
- 21 A Guide to Belfast and the counties of Down and Antrim. Prepared for the meeting of the British Association by the Belfast Naturalists' Field Club. [L. & F. W. Moll., pp. 189–94.] 8vo. Belfast, 1902.
- 22 [Local species from Co. Louth exhibited by R. Welch.] Irish Nat., xv, 272. 1906.

See Praeger, R. Ll., 194, 196, 197.

#### BELLARS, Henry J.:

23 Illustrated Catalogue of British Land and Freshwater Shells [Bulimus acutus, Co. Dublin.] Chester, 1858.

# BENDALL, Wilfred:

24 The Locality for *Limnaea involuta* Thompson, Journ. of Conch., iv, 349.
1885. Also quoted in Zoologist (3), x, 78. 1886.

# BERKENHOUT, JOHN :

25 Synopsis of the Natural History of Great Britain and Ireland. 2 vols. 1789.

R.I.A. PROC., VOL. XXIX., SECT. B.

[T]

BOATE, see REDDING, Sir Robert, F.R.S., 198.

BOWELL, Rev. Ernest William, M.A.:

- 26 Vitrina pyrenaica in Ireland. Irish Nat., xvii, 44. 1908.
- 27 On Limnaea praetenuis, N. Sp., and L. glabra, Müll. Irish Nat., xvii, 45-49, Plate 2. 1908.
- 28 On the Anatomy of Vitrina pyrenaica. Irish Nat., xvii, 94-98, Plate 4, 1908.
- 29 On the Anatomy of *Vitrea Scharffi*. Journ. of Malacol. Soc. Lond., viii, 52-56. 1908.
  See KENNARD, A. S., 136.
  See TOMLIN, J. R., and REV. E. W. BOWELL, 290.

#### BRIDGMAN, W. K.:

30 Amphipeplea involuta. Zoologist, xii, 4478. 1854.

- BROWN, Capt. Thomas, F.L.S. :
  - 31 Account of the Irish Testacea [1815]. Mem. Wern. N. H. Soc., ii, 501-536, Pl. 24. 1818. Also Reprint with Plate, 8vo. Edinburgh, 1817.
  - 32 Illustrations to Recent Conchology. 1827.
  - 33 Illustrations of the Recent Conchology of Great Britain and Ireland. 2nd ed., 4to. London, 1844.
  - 34 Illustrations of the Land and Freshwater Conchology of Great Britain and Ireland. 8vo. 27 Plates. London, 1845.

BUCKLAND, Francis Trevelyan, M.A. [Frank Buckland]:

35 A Run through Connemara and Galway. Chapter X. Field, xxiv, 400, Dec. 10, 1864. [Unio margaritifera at Oughterard. The account of the pearls and pearl fishing is reprinted in Buckland's "Curiosities of Natural History," 4th Series, 334-338. 1878.]

CHASTER, George W., L.R.C.P., and J. R. le Brockton Tomlin, B.A. :

36 The Re-discovery of Vertigo Lilljeborgi in Ireland. Irish Nat., xii., 13-14. 1903.

CHRISTY, Robert Miller:

37 Admission of Land-shells to the British List. [Helix personata in Co. Down.] Sci. Gossip, xix, 112 and 179. 1883.

CLARKE, Rev. Benjamin James, M.A.:

38 On the Species of the Genus Limax occurring in Ireland. Ann. Mag. N. H., xii, 332-342, Plate 10-12, 1843.

138

 A Naturalist's Diary of La Bergerie and its Vicinity. 1837. [MS. in National Museum, Dublin.]
 See SCHARFF, R. F., 237.

COCKERELL, Theodore Dru Alison :

- 40 Helix nemoralis. [Dublin vars.] Naturalists' World, ii, 235. 1885.
- 41 Helix Pisana var. alba, at Rush, Co. Dublin. Journ. of Conch., iv, 368. 1885.
- 42 Helix nemoralis var. ponderosa [at White Strand, Billicarberhy (Ballycarbery). Hyalinia nitida var. viridescens from Valentia also mentioned.] Naturalists' World, ii, 176, 177. 1885.
- 43 Notes on some varieties of British Shells. Journ. of Conch., v, 79, 80. 1886.
- 44 Mollusca of the Skelligs and Valentia. Zool. (3), x, 418-20. 1886.
- 45 Limax arborum and the influence of altitude on Colour. Zool., xliv, 341. 1886.
- 46 The Mollusca of Clonmel, Ireland. Sci. Gossip, xxii, 187. 1886.
- 47 Notes on some species of Inland Mollusca [Succinea vitrea Jeff., var. aurea Cockl.]. Ann. Mag. N. H. (5), xix, 174–76. 1887.
- 48 Practical Naturalists' Society—Conchological Recorder's Report for 1886. Naturalists' World, iv, 43. 1887.
- 49 Land and Freshwater Shells Peculiar to the British Isles. Nature, xlvi, 76, 77. 1892.

COLE, Professor Grenville Arthur James, F.G.S., M.R.I.A. :

50 The Shell of Helix nemoralis. Irish Nat., v, 47. 1896.

# COLLIER, Edward :

- 51 Notes on a Conchological Excursion to the West of Ireland. Journ. of Conch., viii, 42–46. 1895.
- 52 Pupa anglica Fér., var. alba. nov. Journ. of Conch., ix, 152. 1899.
- 53 [Succinea oblonga, Co. Cork, Kerry S., Co. Fermanagh.] Journ. of Conch., x, 53, 1902.
- 54 Helix nemoralis L., in N.W. Donegal. Journ. of Conch., xii, 290-292. 1909.

COLLIER, Edward, and Robert STANDEN :

- 55 Further Conchological Notes from the West of Ireland. Journ. of Conch., viii, 177–190. 1896.
- COLLIER, E., A. W. STELFOX, and R. J. WELCH :
  - 56 [Exhibited many species and vars. from localities in W. Donegal,
    E. Donegal, Sligo, Galway, Kerry, at Annual Meeting Conch. Soc.,
    1905.] Journ. of Conch., xi, 268, 269. 1905.

[T 2]

COLLINGE, Walter Edward, M.SC., F.L.S, F.E.S:

- 57 [Notes on Irish Mollusca]. Conchologist, ii, 26–27. 1892.
- 58 Catalogue of the Slugs of the British Isles. Brit. Nat., pp. 176–179. 1892.
- 59 Notes on the Variation of the Genus Arion Fér. Ann. Mag. N. H., (6) ix, 307. 1892.
- 60 Description of the Anatomy, &c., of a New Species and var. of Arion. Ann. Mag. N. H., (6) xii, 252. 1893.
- 61 Some Notes on the Irish Slugs. Irish Nat., ii, 148. 1893.
- 62 The Anatomical Characters of Arion flagellus Clige. Irish Nat., vi, 316. 1893.
- 63 Note on a Species of Limax from Ireland. Journ. of Malacol., iii, 51–52. 1894.
- 64 Some Slugs from North-West Ireland. Irish Nat., v, 144. 1896.
- 65 On Some European Slugs of the Genus Arion. Proc. Zool. Soc. London, 439-50. 1897.
- 66 Arion empiricorum Fér., var. Bocagei Simr. Irish Nat., ix, 106–107. 1900.
- [COLLINGE, Walter Edward.]

67 A new Irish Vertigo. Journ. Malacol., x, 67. 1903.

COOKE, Rev. Alfred Hands, M.A., F.Z.S. :

68 Molluses. The Cambridge Natural History, iii. 8vo. London, 1895.

- COSTA, Emanuel Mendes da :
  - 69 Historia Naturalis Testaceorum Britanniae; or, the British Conchology ... In English and French. 4to. London, 1778.

# **UROWTHER**, Henry :

70 [Bulimus acutus from Dublin exhibited, Leeds Conchological Club.] Naturalist, (N.S.) iii, 2. 1877.

DARBISHIRE, Robert Dukenfield, F.S.A., F.G.S. :

71 Land Shells at Dog's Bay, Connemara. Journ. of Conch., iv, 317. 1885.

DELAP, Rev. Alexander Henry, M.A.:

- 72 The Mollusca of Clonmel, Ireland. Sci. Gossip, xxii, 234. 1886.
- 73 Additional localities for Irish Land and Freshwater Mollusca. Irish Nat., ii, 84. 1893.

DELAP, Miss Maud Jane :

74 New localities for Geomalacus maculosus. Irish Nat., xv, 190. 1906.

140

DIXON, George, and John William WATSON:

75 A Descriptive Manual of British Land and Freshwater Shells. [Pupa venetzii Charp. = Vertigo angustior, in Cork and Kerry.] Darlington, 1858.

DONOVAN, Edward:

76 Natural History of British Shells. 8vo. London [1779 & 1802].

DUBLIN NATURALISTS' FIELD CLUB:

77 Excursion to the Shannon [Clausilia laminata on Hare Isd.]. Irish Nat., ix, 20. 1900.

Dyson, David:

78 The Land and Freshwater Shells of the district around Manchester: with their particular localities. [Some Irish References.] Manchester, 1850.

EVANS, William Hill, M.D.:

79 The Locality for *Limnaea involuta*, Thompson. Journ of Conch., iv, 355. 1885.

# FARRAN, Charles, M.D.:

80 Helix Pisana and its localities. Nat. Hist. Review, i, 149. 1854.

### FARRAN, George Philip:

- 81 Land and Freshwater Mollusca from Co. Westmeath. Irish Nat., vi, 200. 1897.
- 82 Land Mollusca of Narin. Irish Nat., viii, 184. 1899.

# FAYLE, J.:

83 List of Shells found in the neighbourhood of Waterford. The Naturalist, viii, 190–192. 1858.

FOGERTY, John Henry Archbold [Harry Fogerty]:

- 84 Some Land and Freshwater Shells of the Limerick District. [Limerick and Clare.] Journ. Limerick Field Club, iii, 64-67. 1906.
- 85 Anodonta cygnea in Co. Clare. Irish Nat., xv, 189, 235. 1906.
- 86 Viviparus [dead shell] in Co. Limerick. Irish Nat., xviii, 159. 1909.
- 87 Carychium minimum near Limerick. Irish Nat., xix, 49. 1910.
- 88 New Station for *Helix hortensis* in Ireland. Irish Nat., xix, 243. 1910.
- 89 Shell Drift at Ballinacurra, Limerick. Journ. of Conch., xii, 98. 1910.
- 90 Carychium minimum near Limerick. Journ. of Conch., xii, 71. 1910.

FOOT, Frederick James, Geological Survey, Ireland :

- 91 Notes on the Freshwater Mollusca in the neighbourhood of Ennis, and the relation between those living there in the Lakes, and those fossilized in the Marl, with observations on the accidental presence of a marine species. Proc. Dublin Nat. Hist. Soc., i, 195-96. (1849-1855). 1860. See also Nat. Hist. Review, ii, 195. 1859.
- FORBES, Prof. Edward, F.R.S., F.L.S., F.G.S. :
  - 92 Report on the distribution of Pulmoniferous Molluscs in the British Isles. [Irish species, 137, 138; and table, 144-147.] Report of the Ninth Meeting of the Brit. Assoc., held at Birmingham in 1838. 1839.
  - 93 On the Connection between the Distribution of the existing Fauna and Flora of the British Isles, and the Geological Changes which have affected their area, especially during the epoch of the Northern Drift. Mem. Geol. Survey Gt. Brit., i, 336-432. 1846.

FORBES, Prof. Edward, and Sylvanus HANLEY:

94 A History of British Mollusca and their Shells. 4 vols. 8vo. London, 1853.

GLOVER, Miss Maria :

95 Notes on the British Land and Freshwater Shells collected by the late Mr. Thomas Glover [*Helix ericetorum* and *H. virgata*, Dublin and Connemara]. Journ. of Conch., ii, 369, 370. 1906.

GLOYNE, C. P. :

96 Discovery of Succinea oblonga (Draparnaud) near Cork. Quart. Journ. of Conch., i, 97. 1875.

GODWIN-AUSTEN, Lt.-Col. Henry Haversham, F.R.S., F.R.G.S. :

97 Land and Freshwater Mollusca of India [figs. and description of Geomalacus maculosus, anatomy, radula and jaw], i, 60-63, plate 12. 1882.

GOODSIR, John:

98 An account of the anatomy of *Limnaea involuta*, Harvey. Ann. Mag. Nat. Hist., v, 22–25. 1840.

GRAINGER, Rev. Canon John, D.D., M.R.I.A.:

99 On the shells found in the Post-tertiary deposits of Belfast. Proc. Dublin Univ. Zool. & Bot. Assoc., i, 202–222. 1859.

GRAY, J. E., see TURTON, W., 292.

GREEN, William Alfred :

100 Scalariform *Helix nemoralis* living at Bundoran. Irish Nat., ix, 271. 1900.
- 101 Amphipeplea (Limnaea) glutinosa in the River Bann. Irish Nat., x, 132. 1901.
- 102 New Inland Station for Hydrobia (Paludestrina) Jenkinsi. Irish Nat., x, 145. 1901.
- 103 A few notes on imported Mollusca. Journ. of Conch., x, 185. 1902.

#### GRIERSON, Philip Henry :

- 104 Notes on the Mollusca of Co. Leitrim. Irish Nat., x, 110. 1901.
- 105 Coecilianella acicula in Co. Kilkenny. Irish Nat., xi, 250. 1902.
- 106 Some Land and Freshwater Shells from Co. Clare. Irish Nat., xi, 139. 1902.
- 107 Succinea oblonga near Mallow. Irish Nat., xii, 54. 1903.
- 108 Coecilianella acicula in Co. Waterford. Irish Nat., xii, 54. 1903.
- 109 Notes on the Mollusca of Co. Kilkenny. Irish Nat., xii, 307-311. 1903.
- 110 Coecilianella acicula in Ulster. Irish Nat., xiii, 30. 1904.
- 111 [Amalia gagates in Co. Louth] Journ. of Conch., xiii, 60. 1904.
- 112 Notes on the Mollusca of North Cork and Waterford. Irish Nat., xiii, 164-169. 1904.
- 113 Vertigo angustior in Co. Carlow. Irish Nat., xiii, 294. 1904.
- 114 Notes on the Mollusca of the north-east of Co. Wicklow. Irish Nat., xiv, 8-11. 1905.
- 115 Notes on the Mollusca of Co. Louth. Irish Nat., xiv, 213. 1905.
- 116 [Succinia oblonga, Amphipeplea glutinosa, &c., from Co. Meath, exhibited at Conch. Soc.] Journ. of Conch., xi, 218. 1905.
- 117 Note on Vitrina elongata Drap. Journ. of Conch., xii, 190. 1906.

### HANLEY, Sylvanus, B.A., F.L.S. :

118 Freshwater Shells collected in Wexford. Ann. Mag. Nat. Hist., vi, 395. 1841.

See also FORBES, Prof. Edward, and Sylvanus HANLEY, 94.

#### HARTING, James Edmund, F.L.S. :

119 Rambles in search of Shells. [Mentions Irish local catalogues at end of book.] 8vo. London, 1875.

### HEYNEMANN, D. F.:

- 120 Zur Kenntniss von Geomalacus. Nachrichtsblatt der deutschen malakozoologischen Gesellschaft. 1869.
- 121 Ueber Geomalacus. Malakozoologische Blätter, xxi, 25-36. 1873.
- 122 On the French species of the Genus Geomalacus. Ann. Mag. Nat. Hist., (4) xi, 271-275. 1873.

HINCKS, William:

123 On Mr. Grav's Edition of Turton's Manual [a criticism with notes anent several species from Cork]. Ann. Nat. Hist., v, 366-367. 1840.

HOGAN, Rev. Arthur Rikey, M.A. :

124 Notes on the Land and Freshwater Mollusca of the Co. Dublin. Nat. Hist. Review, i, 93-94. 1854.

HUMPHREYS. John D :

125 Contributions towards a Fauna and Flora of the County of Cork [Land and Fresh Water Mollusca by John D. Humphreys]. London and Cork, 1845.

IRISH FIELD CLUB UNION :

[Excursion to Cavan] see PRAEGER, Robert Lloyd, 194.

Excursion to Ballycastle [Co. Antrim] see PRAEGER, R. LL, 197.

Galway Conference, 1895: see STANDEN, Robert, 249.

Kenmare Conference, 1898: see STANDEN, Robert, 251.

Sligo Conference, 1904: see WELCH, R., and A. W. STELFOX, 348.

Cork Conference, 1907: see WELCH, R., A. W. STELFOX, and J. N. MILNE, 260, 349.

Rosapenna Conference, 1910: see STELFOX, A. W., and R. WELCH, 263.

JEFFREYS, John Gwyn, LLD., F.R.S., F.G.S.:

- 126 A Synopsis of the Testaceous Pneumonobranchous Mollusca of Great Britain. Read Nov.-Dec., 1828.) Trans. Linn. Soc., xvi, 323-392, 1833.
- 127 A Supplement to the Synopsis of Testaceous Pneumonobranchous Mollusca of Great Britain. Trans. Linn. Soc., xvii, 505-523. 1833.
- 128 Gleanings in British Conchology [Vertigo alpestris, Co. Dublin, an error in Nat. Hist. Review, i, 94]. Ann. Mag. Nat Hist., (3) ii, 132. 1858
- 129 Further Gleanings in British Conchology. [Testacella maugei at Cork and Pisidium Reclusianum, at Belfast, errors in Baudon's Monog.] Ann. Mag. Nat. Hist., (3) iii, 30-43 and 106-120, 2 Plates. 1859 [and Reprint, London. 1859].
- 140 Additional Gleanings in British Conchology, with additions and corrections. [Reprint from Ann. Mag. Nat. Hist., Sept. 1859.] London, 1859.
- 131 British Conchology, i and iv. 8vo. Plates. London, 1862.

- 132 Heliz personata Lamarek. [at Newcastle, Co. Down.] Ann. Mag. Nat. Hist., (4) vi, 423. 1870.
- 133 Notes on some British Land and Freshwater Shells. Ann. Mag. Nat. Hist., (5) ii, 377–382. 1878.

### JORDAN, Hermann:

134 Die Binnenmollusken der nördlich gemässigten Länder von Europa und Asien und der arktischen Länder. [Map and many tables of distribution.] Halle, 1883.

### KEMP, Stanley W.:

- 135 Geomalacus maculosus on Deenish Island, Co. Kerry. Irish Nat., xiv, 262. 1905.
- KENNARD, Alfred Santer, F.G.S. :
  - 136 On Vitrea (Hyalinia) hibernica, N. Sp. With notes on the anatomy by Rev. Ernest William Bowell, M.A. Irish Nat., xvi, 325, Plate 42, 1907.
  - 137 On Vitrea Scharffi n. sp. Proc. Malacol. Soc. Lond., viii, 50-51, 1908.
  - 138 Supposed Occurrence of Vitrea (Hyalinia) helvetica in Ireland. Irish Nat., xix, 254. 1910.

KENYON, G.:

139 Remarks on the British Land and Freshwater Shells. Mag. Nat. Hist., i, 424. 1828.

### KEW, Harry Wallis, F.Z.S.:

140 A holiday in South-western Ireland. [References to Irish L. & F. W. Mollusca.] Irish Nat., xix., 64-73. 1910.

KNIGHT, Rev. George Alexander Frank, M.A., F.R.S.E. :

- 141 On the Phenomenon of Sinistrorsity in the Mollusca. [Irish records, pp. 113-115.] Trans. Perthshire Soc. Nat. Sci., iv, 100-119.
   3 Plates. 1905.
- 142 Notes on the Marine Mollusca of Port-Stewart, North Ireland. Trans. Nat. Hist. Soc. Glasgow, N.S. vi, 1–17. 1899–1900. [Separate copies issued April, 1901.]

LAYARD, Edgar Leopold, C.M.G., F.Z.S. :

143 The Fauna and Flora of Ireland. Sci. Gossip., N.S. ii, 10-11. 1896. LEACH, William Elford :

144 Synopsis of the Mollusca of Great Britain [1820]. London, 1852. LOVELL, M. S.:

145 The Edible Molluscs of Great Britain and Ireland with Recipes for cooking them. London, 1867.

R.I.A. PROC., VOL. XXIX., SECT. B.

· LOWE, Edward Joseph, F.G.S., F.R.A.S. :

146 The Conchology of Nottingham. [Many Irish references.] London, 1853.

LUCAS, Bernard Richard, F.G.S. :

- 147 The result of six hours' Collecting in Sligo, Easter, 1906. Journ. of Conch., xii, 219. 1908.
- 148 Testacella haliotidea and other Mollusca in Co. Kerry. Irish Nat., xvii, 22. 1908.

149 New Localities for Vitrea hibernica. Irish Nat., xvii, 22. 1908.

MASSY, Miss Anne Letitia:

150 Land Shells from Co. Limerick. Irish Nat., viii, 143. 1899.

- 151 New Locality for Paludestrina Jenkinsi. Irish Nat., xi, 19. 1902.
- 152 Coecilianella acicula in Co. Dublin. Irish Nat., xi, 324. 1902.
- 153 [Otina otis at Narin, Donegal.] Irish Nat., xii, 22. 1903.
- 154 Opercula of Bithynia tentaculata. Journ. of Conch., xi, 178. 1906.

MATON, M. George, and Rev. Thomas RACKET:

155 A Descriptive Catalogue of the British *Testacea* (1804). Trans. Linn. Soc. Lond., viii, 17-250. 1807.

- MILNE, J. G. :
  - 156 Contributions towards a list of Irish Mollusca. Journ. of Conch., vi, 167-175. 1890.
  - 157 Notes on the Land and Freshwater Molluscs of Achill Island. Journ. of Conch., vi, 412-421. 1891.

MILNE, James Napier :

158 Helix arbustorum near Armagh. Irish Nat., iv, 348. 1895.

159 Helix virgata in Co. Down. Irish Nat., xv, 111. 1906.

160 Succinea oblonga in Antrim. Irish Nat., xv, 190. 1906.

MILNE, James Napier, and Arthur Wilson STELFOX :

- 161 Some new Molluscan Records for Co. Tyrone. Irish Nat., xv, 75. 1906.
- 162 A new station for *Helix virgata*. Irish Nat., xv, 76. 1906. See STELFOX, A. W., and J. N. MILNE, 260.

MOFFAT, Charles Bethune, B.A. :

163 The Hedgehog and its food. Irish Nat., ix, 50. 1900.

MONTAGU, George :

164 Testacea Britannica, London, 1803.

165 Supplement to Testacea Britannica. London, 1808.

MORE, Alexander Goodman, F.R.S.E., F.L.S., M.R.I.A.:

- 166 Notes on the Animal of *Limnaea involuta* (Harvey). Ann. Mag. Nat. Hist., (4) iv, 46. 1869.
- 167 Limnaea involuta probably a Variety of L. peregra. Zool., xlvii. 154-155. 1889.

[MOSLEY, Seth Lister, as Editor]:

168 Shells from Kilmore, Ireland. [Helix virgata, H. ericetorum, H. hortensis.] Naturalists' Journ., viii, 6E. 1899.

Moss, William :

169 The Genitalia and Radulae of the British Hyaliniae. [Irish records of Hyalinia draparnaudi.] Trans. and Ann. Rep. Manchester Micro. Soc., 24–28. 1898.

NELSON, William :

170 [Exhibited Succinea oblonga from Ballincollig, Cork, at Meeting of Leeds Nat. Field Club and Sci. Assoc.] Naturalist, N.S., i, 62. 1875.

NORMAN, Rev. Canon Alfred Merle, M.A., F.R.S., D.C.L. :

171 Occurrence of *Limax Gayates*, near Torquay and at Killarney. [Garden of Lake Hotel.] Zool., xii, 4284. 1854.

- O'CONNOR, Miss Frances Sarah :
- 172 Spider carrying Snail-shell. Irish Nat., v, 299. 1896.

O'CONNELL, John H.:

173 The Hedgehog and its food. Irish Nat., ix, 50. 1900.

### **OLDHAM**, Charles :

ORR, Hugh Lamont :

- 175 The Hedgehog and its food [*Helix nemoralis* used]. Irish Nat., viii, 268. 1899.
- 176 The Hedgehog and its food. Irish Nat., ix, 110. 1900.
- 177 The Dispersal of Molluscs [*Helix rupestris* carried in limestone]. Irish Nat., viii, 250. 1899.

178 Vertigo edentula on Furze bushes. Irish Nat., xi, 173. 1902.

PHILLIPS, Robert Albert:

179 Valvata cristata in Co. Cork. Irish Nat., ii, 112. 1893.

- 180 Additions to the Shell-fauna of Cork. Irish Nat., ii, 200. 1893.
- 181 Land and Freshwater Mollusca [of Co. Cork]. In 1894 Reprint of Charles Smith's Antient and Present State of the County and City of Cork, ii, 264-266. Cork, 1894.
- 182 Hyalinia helvetica Blum. An addition to the Irish Fauna. Irish Nat., iii, 45. 1894.

<sup>174</sup> Vallonia excentrica Sterki, in Ireland. Journ. of Conch., xi, 173. 1905.

- 183 Hydrobia Jenkinsi, Smith, in South-east Ireland. Irish Nat., ix, 213. 1900.
- 184 Vertigo moulinsiana, Dupuy. An addition to the Irish Fauna. Irish Nat., xvii, 89, Plate 3. 1908.
- 185 Paludestrina confusa, Frauenfeld, an addition to the Irish Fauna. Irish Nat., xviii, 143. 1909.
- 186 Vertigo moulinsiana in Queen's County. Irish Nat., xviii, 205. 1909.
- 187 Limnaea involuta in Co. Cork. Irish Nat., xviii, 205. 1909.
- 188 Paludestrina confusa in Kilkenny and Clare. Irish Nat., xviii, 242. 1909.
- 189 The Non-Marine Mollusca of Inishmore [Aran Isds.]. Irish Nat., xix, 115. 1910.
- 190 Is Hyalinia helvetica, Blum, found in Ireland? Irish Nat., xix, 242.1910.

POTIEZ, V. L. V., and A. L. G. MICHAUD :

191 Galerie des Mollusques du Muséum de Douai. [Figures some Irish shells sent by Wm. Thompson from Belfast.] 8vo. Paris, 1838.

PRAEGER, Robert Lloyd, B.A., B.E., M.R.I.A. :

- 192 Land Shells from Co. Donegal. ["Pocket" of Vertigos, &c.] Irish Nat., i, 171. 1892.
- 193 Helix arbustorum L. in Leitrim. Irish Nat., ii, 302. 1893.
- 194 The Field Clubs in Cavan. [Clausilia laminata in Farnham woods.] Irish Nat., v, 193-199. 1896.
- 195 Among the Fermanagh Hills. [*Heliv arbustorum* at Poulaphuca, p. 232.] Irish Nat., xiii, 232-241. 1904.
- 196 Belfast and Dublin Naturalists' Field Clubs. [Excursion to the Mouth of the Boyne, &c., June 16th.] [Helix pisana abundant.] Irish Nat., iii, 180–181. 1894.
- 197 The Irish Field Club Union. Excursion to Ballycastle [Co. Antrim], 2-5 July, 1897. [Helix arbustorum, H. fusca, &c.] Irish Nat., vi, 216-218. 1897.

RACKET, Rev. Thomas, see MATON, M. George, and Rev. Thomas RACKET, 155.

REDDING, Sir Robert, F.R.S. :

- 198 A letter concerning Pearl Fishing in the North of Ireland [Unio? Tyrone, Donegal; also Louth, Waterford, Kerry.] Phil. Trans., xvii, 659. 1693. Abridged ed., 512-513. 1809.
  - See also "Natural History of Ireland," by Dr. Gerard BOATE, Thos. MOLINEUX, and others. 1726 and 1755.

### **REDDING**, John Roland:

199 Helix nemoralis [Co. Dublin varieties]. Sci. Gossip. xxii, 19. 1886.
200 [Helix hortensis from Dublin localities exhibited at the Conch. Soc.] Journ. of Conch., xi, 188. 1904.

#### **REEVE**, Lovell Augustus :

201 The Land and Freshwater Mollusks indigenous to, or naturalized in, the British Isles. 8vo. London, 1863.

RIMMER, Richard, F.L.S. :

202 The Land and Freshwater Shells of the British Isles. 8vo. Plates 1-10. London, 1880.

### ROEBUCK, William Denison, F.L.S. :

- 203 British Slug List. [Some Irish Records.] Journ. of Conch., iv, 39– 43. 1883.
- 204 Limax cinereo-niger, an addition to the list of British Slugs. Zool.,
  (3) vii, 304. 1883.
- 205 Slugs in Co. Waterford. Zool., (3) vii, 507-508. 1883.
- 206 Limax maximus v. Ferussaci in Co. Antrim. Journ of Conch., iv, 222. 1884.
- 207 New varieties of *Limax arborum* and *Arion ater*. [Mayo, Cork.] Journ. of Conch., iv, 375. 1885.
  See TAYLOR, J. W., and W. D. ROEBUCK, 277, 278.
  See WILLIAMS, J. W., 353.

#### ROGERS, Thomas :

- 208 On the viviparous nature of *Balea* [*Balea perversa* at Killarney]. Journ. of Conch., vii, 40. 1892.
- 209 The eggs of the Kerry Slug. Irish Nat., ix, 168, Plate 5. 1900.

### RUTTY, John, M.D.:

210 Essay towards a Natural History of the County Dublin, vol. i-ii. 8vo. Dublin, 1772.

SCHARFF, Robert Francis, PH.D., B.SC., M.R.I.A., F.L.S., F.Z.S.:

- 211 An excursion to Donegal. Journ. of Conch., vi., 165. 1890.
- 212 Arion minimus (Simroth), a British Slug. Journ. of Conch., vi, 267-269. 1890.
- 213 The Slugs of Ireland. Sci. Trans. Roy. Dublin Soc. (2) iv, 513-558,
   2 plates. 1891. [See also abstract in Sci. Proc. R.D.S., (N.S.) vii,
   192-195. 1891-1892.]
- 214 The Irish Land and Freshwater Mollusca. Irish Nat., i, 45-47, 65-67, 87-90, 105-109, 135-138, 149-153, 177-181.
   1892.

- 215 Perforations in Carboniferous Limestone. [Helix aspersa.] Irish Nat., i, 118. 1892.
- 216 Some Remarks on the distribution of the British Land and Freshwater Mollusca. The Conchologist, ii, 1. 1892.
- 217 Mollusca from Woodenbridge [and Arklow], Co. Wicklow. Irish Nat., ii, 149. 1893.
- 218 Testacella scutulum Sow. Irish Nat., ii, 200. 1893.
- 219 Testacella scutulum Sow. Irish Nat., ii, 253, 1893.
- 220 Note on the Geographical Distribution of Geomalacus maculosus Allm. in Ireland. Proc. Malacol. Soc. London, i. 17. 1893.
- 221 Helix rufescens in Belfast. Irish Nat., ii, 277. 1893.
- 222 Rare Shells from Co. Sligo. Irish Nat., ii, 301. 1893.
- 223 Helix fusca in Co. Dublin. Irish Nat., ii., 302. 1893.
- 224 A New Irish Species of Arion. Irish Nat., ii, 302. 1893.
- 225 A supposed new Species of *Limax* from Ireland. Irish Nat., iii, 261. 1894.
- 226 Testacella haliotidea, F. Big., in Co. Dublin. Irish Nat., iv, 80, 1895.
- 227 An addition to the Irish Molluscan Fauna. [Pisidium hibernicum Westr.] Irish Nat., iv, 335. 1895.
- 228 Land and Freshwater Mollusca [of Clonbrock, N.E. Galway]. Irish Nat., v, 223-224. 1896.
- 229 Mollusca of Ballycastle District. [Helix costata.] Irish Nat., vi, 87. 1897.
- 230 Hyalinia excavata in County Fermanagh. Irish Nat., vi, 281. 1897.
- 231 The Land Mollusca of the Great Skellig. Irish Nat., vii, 9-11. 1898.
- 232 The Mollusca of the Great Skellig. Irish Nat., vii, 49. 1898.
- 233 Some Animals from the Macgillicuddy's Reeks. [Limax marginatus var. nov. niger, Scharff.] Irish Nat., viii, 213-218. 1899.
- 234 The History of the European Fauna. 8vo. London, 1899.
- 235 Arion ater, var. Bocagei, in Ireland. Irish Nat., ix, 47. 1900.
- 236 Arion empiricorum, Fér., var. Bocagei Simr. Irish Nat., ix, 107–108. 1900.
- 237 The Diary of an Irish Naturalist. [Some Queen's Co. Mollusca collected by the late Rev. B. J. Clarke., M.A.] Irish Nat., xiii, 163. 1904.

See Clarke, Rev. B. J., 39.

- 238 The Origin of the Land & Freshwater Mollusca at present living in the British Isles. Journ. of Conch., xi, 138-144. 1905.
- 239 Helix torm ensis in Ireland [tonnensis, Sandberger]. Irish Nat. xv, 109. 1906.

- 240 Testacella haliotidea in the North of Ireland. Irish Nat., xvii, 163.1908.
- 241 Land and Freshwater Mollusca [of Dublin district]. Handbook to the City of Dublin and the Surrounding District. Prepared for the Meeting of the British Association, pp. 147–151. September, 1908.

S[CHARFF], R[obert] F[rancis], PH.D., M.R.I.A. :

242 [Note on the re-discovery in Ireland of Vertigo Lilljeborgi by Messrs. Chaster and Tomlin in West Galway]. Irish Nat., xii, 14. 1903.

[SCHARFF, Robert Francis, PH.D., M.R.I.A.].

243 Pisidium personatum Malen [Malm], an addition to the Irish Fauna.
[A reference to B. B. Woodward's article, Proc. Malacol. Soc. Lond., viii, 124. 1908.] Irish Nat., xviii, 56. 1909.
See WOODWARD, B. B., 358.

SCULLY, REGINALD William, L.R.C.P.I., F.L.S. :

244 A new locality for Geomalacus maculosus. Zool., (3) xv, 35. 1891.

- SMITH, Edgar A., I.S.O., F.Z.S. :
- 245 Note on *Paludestrina Jenkinsi*. Proc. Malacol. Soc. London, vii, 203. 1907.

SOWERBY, George Brettingham (3), F.L.S. :

246 Illustrated Index of British Shells. 4to. London, 1859.

STANDEN, Robert, (Hon. Curator Conch. Soc., G.B. & I.):

- 247 Land and Freshwater Mollusca collected around Portsalon, Co. Donegal, Ireland. Journ. of Conch., vii, 195. 1893.
  - 248 Shells from Co. Donegal. Irish Nat., iii, 261. 1894.
  - 249 Land and Freshwater Mollusca [of West Galway mainly; coll. on Irish Field Club Union Excursion, July, 1895]. Irish Nat., iv, 266-270. 1895.
  - 250 The Land Mollusca of Ballycastle and District, Co. Antrim. Irish Nat., vi, 1-9. 1897.
  - 251 Mollusca [Land and Freshwater]. Report of the Second Triennial Conference and Excursion [Irish Field Club Union], held at Kenmare, July 7 till 13, 1898 [Succinea oblonga, Limnaea involuta, &c.]. Irish Nat., vii, 218-226. 1898.
  - 252 Reversed Shells in the Manchester Museum [Helix nemoralis from Bundoran]. Journ. of Conch., xi, 228-236. 1905.

STELFOX, Arthur Wilson, A.R.I.B.A. :

253 Helicella zakarensis in Co. Down. Irish Nat., xv, 110. 1906.

- 254 Some notes on the Land and Freshwater Mollusca of Galway and District. Irish Nat., xvi, 353-364. 1907.
- 255 Additional notes on the Land and Freshwater Mollusca of northwest Donegal. Irish Nat., xviii, 86–92. 1909.
- 256 Additional localities for the new Irish Vitrina. Irish Nat., xviii, 204. 1909.
- 257 Is *Hyalinia helvetica*, Blum found in Ireland ? Irish Nat., xix, 210– 211, plate 15. 1910.
- 258 The Distribution of Bythinia Leachii in Ireland. Irish Nat., xix, 240. 1910.
- 259 Some records of Land and Freshwater Mollusca from the Counties Roscommon and Longford. Irish Nat., xix, 241-242. 1910.
- STELFOX, Arthur Wilson, and James Napier MILNE :
  - 260 Further notes on the Land and Freshwater Mollusca of Cork West and Kerry. Irish Nat., xvi, 286–288, plates 35, 36, 37. 1907.
- STELFOX, Arthur Wilson, and Robert John WELCH:
  - 261 The Land and Freshwater Mollusca of North-west Donegal. 1, Bunbeg, Gweedore, Horn Head, and Glenveagh Areas, by A. W. Stelfox. 2, Rosguill Peninsula and Sheephaven Dunes, by R. Welch, M.R.I.A. Irish Nat., xv, 62–70, plate 2. 1906.
  - 262 Land and Freshwater Mollusca [of Lambay, Co. Dublin, in report of the special survey of the island]. Irish Nat., xvi, 41-42. 1907.
  - 263 Land and Freshwater Mollusca [of N.W. Donegal and Tory Island, in Report of I.F.C.U. Conference, Rosapenna, July, 1910]. Irish Nat., xix, 172-178, plates 5 & 10. 1910.
    See Collier, E., A. W. Stelfox, and R. Welch, 56.
    See MILNE, J. N., and A. W. Stelfox, 161, 162.
    See Welch, R. J., and A. W. Stelfox, 347 to 350.
- STEWART, Samuel Alexander, A.L.S., F.B.S. EDINB. :
  - 264 Helix personata in Ireland [Newcastle, Co. Down-a dead shell]. Sei. Gossip, xix, 159. 1883.
  - 265 The Portrush Raised Beach. Irish Nat., vi, 287–290. 1897.

STUBBS, Arthur Goodwin, and Lionel Ernest ADAMS, B.A.:

- 266 Supplementary notes on the Mollusca of South-West Ireland. Irish Nat., vii, 261-263. 1898.
- SWANTON, Ernest William :

267 Zoned shell (*Helix virgata*). Naturalists' Journ., viii, 1E. 1899. TATE, Ralph, A.L.S., F.G.S. :

268 A Plain and Easy Account of the Land and Freshwater Mollusks of Great Britain. Fcp. 8vo. London, 1866.

TAYLOR, John William, F.L.S. :

- 269 Life-Histories of British Helices [*Helix arbustorum*]. Journ. of Conch., iii, 241–259. 1881.
- 270 [Helix aspersa in Co. Mayo.] Journ. of Conch., iv, 100, 1883.
- 271 On the specific distinctness and the Geographical Distribution of *Testacella scutulum* G. B. Sowerby. Journ. of Conch., v, 337. 1888.
- 272 Vertigo pusilla var. albina. Journ. of Conch., vii, 194. 1893.
- 273 Arion empiricorum, Fér. var. Bocagei Simr. Irish Nat., ix, 106. 1900.
- 274 Monograph of the Land and Freshwater Mollusca of the British Islands. 8vo. i, 1894–1900; ii, 1907. [Still appearing periodically in parts, many plates and maps of distribution, British and foreign.]
- 275 Vitrina elongata in Ireland: an addition to the Fauna of the British Isles. Irish Nat., xvi, 225-231, plate 26. 1907.

T[AYLOR], J[ohn] W[illiam], F.L.S. :

- 276 Distribution of Acme lineata v. alba Jeffr. [Galway, Kerry]. Sci. Gossip, xix, 185. 1883.
- TAYLOR, John William, F.L.S., and William Denison ROEBUCK, F.L.S. :
  - 277 Census of the Authenticated Distribution of British Land and Freshwater Mollusca. Journ. of Conch., iv, 319-336. 1885.
  - 278 Authenticated materials towards a Land and Freshwater Molluscan Fauna of Ireland. Proc. Roy. Irish Acad. (2), iv, 672–692.
    1888.

See WILLIAMS, J. W., 353.

**THOMPSON**, William :

- 279 Description of *Limneus involutus*, Harvey MS., with an account of the Anatomy of the Animal. By John Goodsir. Ann. Nat. Hist., v, 22-25, plate i. 1840.
- 280 Catalogue of the Land and Freshwater Mollusca of Ireland. Ann Mag. Nat. Hist., vi, 16-34, 109-126, 194-206. 1841.
- 281 Cyclostoma elegans, Lam., an Irish shell. Ann. Mag. Nat. Hist., viii, 228. 1842.
- 282 Report on the Fauna of Ireland, Div. Invertebrata. Report Brit. Assoc., 245-291. 1843. [Reprinted separately, London, 1844.]
- 283 Additions to the Fauna of Ireland [*Testacella maugei* Fér.] Ann. Mag. Nat. Hist., xx, 174. 1847.
- 284 Natural History of Ireland, iv. 8vo. London, 1856.

TOMLIN, John Read Le Brockton, M.A., F.E.S. :

285 Land-shells at the Giant's Causeway. Irish Nat., iii, 67. 1894. R.I.A. PROC., VOL. XXIX., SECT. B. [X]

- 286 Helix ericetorum, Müll., reversed. Irish Nat., vi, 324. 1897.
- 287 A new Irish Vertigo. Irish Nat., xii, 110. 1903.
- 288 Vertigo heldi in Ireland. Journ. of Conch., x, 307-308. 1903.
- 289 Land and Freshwater Mollusca at Cloghane, Co. Kerry. Journ. of Conch., xii, 77. 1910.
- TOMLIN, J. R. Le B., and Rev. Ernest William BOWELL, M.A. :
  - 290 Vertigo moulinsiana Dupuy. Journ. of Conch., xii, 212-215, 1908; and 297-298, 1909.
     See CHASTER, G. W., and J. R. Le B. TOMLIN, 36.
- TURTON, William, M.D.:
  - 291 A Conchological Dictionary of the British Islands. 8vo. London, 1819.
  - 292 A Manual of the Land and Freshwater Shells of the British Islands. Small 8vo, 10 plates. London, 1831. 2nd Edition. 8vo. London, 1840. New Edition with additions by John Edward Gray, PH.D., F.R.S., 8vo, 12 plates. London, 1857.

### TYE, G. Sherriff:

- 293 *Helix cantiana* (Montagu). [False record near Dublin given in Gray's Turton, p. 36, questioned.] Midland Nat., i, 324. 1878.
- 294 "Admission of Land-shells to the British List." Sci. Gossip, xix, 146. 1883.

- 295 On the Land and Freshwater Mollusca of Finnoe, Co. Tipperary [North]. Nat. Hist. Review, i, 84–87. 1854.
- 296 On the Discovery in Ireland of new Shells. Journ. Roy. Dublin Soc., ii, 39. 1855-1859.
- 297 On the Discovery in Ireland of a new British Shell. Journ. Roy. Dublin Soc., i, 386. 1858.

WALPOLE, William White :

298 Catalogue of the Land and Freshwater Shells inhabiting the Neighbourhood of Dublin. Zool., xi, 4022-4024. 1853.

### WARREN, Miss Amy:

- 299 The Land and Freshwater Mollusca of Mayo and Sligo. Zool. (3), iii, 25–29. 1879.
- 300 Limax flavus in the West of Ireland. Irish Nat., i, 126. 1892.
- 301 Rare Molluses from Co. Sligo. [Vertigo angustion living in marsh.] Irish Nat., i, 170-171. 1892.
- 302 Helix rufescens in the North of Ireland. Irish Nat., ii, 301. 1893.

WALLER, Edward :

WARREN, Thomas William:

- 303 List of Shells with localities [MS. in National Museum, Dublin]. [1836?]
- WATSON, J. W., see DIXON, G., and J. W. WATSON, 75.

WELCH, Robert John, M.R.I.A. :

- 304 Helix arbustorum [Co. Antrim]. Irish Nat., v, 213. 1896.
- 305 Mollusca of Cavan Excursion [I. F. C. U., July, 1896]. Irish Nat., v, 274. 1896.
- 306 Helix arbustorum in Co. Derry. Irish Nat., v, 318. 1896.
- 307 Helix fusca. Irish Nat., v, 318. 1896.
- 308 Land and Freshwater Mollusca from Great Killary and Westport. Irish Nat., vi, 304-305. 1897.
- 309 [County Record exhibits at Conchological Society of Great Britain & Ireland.] Journ. of Conch., ix, 111-112. 1897.
- 310 Land-shell "Pockets" on Sand-dunes. Irish Nat., vii, 77–82. 1898.
- 311 Hydrobia Jenkinsi, Smith, in Co. Donegal. Irish Nat., vii, 150. 1898.
- 312 Helix limbata, Drap., a Pyrenean Shell introduced at Belfast. Irish Nat., vii, 150. 1898.
- 313 Land Mollusca of Co. Tipperary. [Some Cashel and Holycross Records.] Irish Nat., vii, 169. 1898.
- 314 Hydrobia Jenkinsi, Smith, in Co. Down. Irish Nat., vii, 271. 1898.
- 315 Land and Freshwater Mollusca of Clonbrock, Co. Galway [Galway N.E.]. Irish Nat., viii, 143. 1899.
- 316 Reversed Helix ericetorum, at Bundoran. Irish Nat., ix, 21. 1900.
- 317 Amphipeplea glutinosa, Müller, in Ireland. Irish Nat. ix, 48. 1900.
- 318 Abnormalities in the shell of *Helix nemoralis*. Irish Nat., ix, 163, plate 5. 1900.
- 319 Large Colony of Vertigo antivertigo Drap. in Co. Down. Journ. of Conch., ix, 280-281. 1900.
- 320 Planorbis corneus in Co. Sligo. Irish Nat., x, 131. 1901.
- 321 Longevity of Land Mollusca [Helix aspersa]. Irish Nat., x, 145. 1901.
- 322 Additions to the list of Mollusca of Clonbrock. Irish Nat.. xi, 20. 1902.
- 323 Eggs of Arion hortensis. Irish Nat., xi, 46. 1902.
- 324 Mollusca from Shell-marl, Clonbrock, Co. Galway, and Portaferry, Co. Down. Irish Nat., xi, 46. 1902.

- 325 Scalariform *Helix nemoralis* [Bundoran, E. Donegal]. Journ. of Conch., x, 244-246, plate 2. 1902.
- 326 Some new stations for Mollusca. Irish Nat., xi, 174. 1902.
- 327 Longford Land and Freshwater Mollusca. Irish Nat., xi, 174. 1902.
- 328 Abnormal Land Mollusca from Bundoran. Irish Nat., xi, 184. 1902.
- 329 The association of *Helix nemoralis* and *H. hortensis* in Ireland. Journ. Conch., x, 302-303. 1903.
- 330 Clausilia bidentata and Balea perversa in Ireland. Journ. of Conch., x, 312. 1903.
- 331 Pockets of Landshells, Bannmouth Dunes, Portstewart. Journ. of Conch., x, 338-339. 1903.
- 332 Paludestrina (Hydrobia) Jenkinsi. Irish Nat., xiii, 118. 1904.
- 333 Rare or Local Irish Land and Freshwater Mollusca. Journ. of Conch., xi, 16-19. 1904.
- 334 Some results of a Flood in North Ireland [Co. Derry]. Journ. of Conch., xi, 28. 1904.
- 335 [Mollusca Co. Cavan, &c., exhibited at Conchological Society.] Journ. of Conch., xi, 93. 1904.
- 336 Freshwater Shells in Masses in Shell-Marl. Journ. of Conch., xi, 191. 1905.
- 337 Land and Freshwater Mollusca from Co. Roscommon. Irish Nat., xv, 76. 1906.
- 338 Helix hortensis in Co. Antrim. Irish Nat., xvi, 251. 1907.
- 339 Limax cinereo-niger-a correction. Irish Nat., xvi, 370. 1907.
- 340 Melampus bidentatus in Co. Cork—a correction. Irish Nat., xvi, 371. 1907.
- 341 Bythinia Leachii, an addition to the Irish Fauna, with some notes on its distribution and also on that of *Planorbis corneus*. Irish Nat., xvii, 1-5, plate 1. 1908.
- 342 Exotic Land Mollusca at Belfast. Irish Nat., xvii, 23. 1908.
- 343 Testacella maugei, Fér., at Cork. Irish Nat., xvii, 163. 1908.
- 344 Land-shell Rain-wash at Horn Head, Co. Donegal. Irish Nat., xviii, 113. 1909.
- 345 Pisidium personatum-a correction. Irish Nat., xviii, 120. 1909.
- 346 Helir hortensis in Co. Down. Irish Nat., xviii, 205. 1909. See Belfast Naturalists' Field Club, 22.

WELCH, R. J., and A. W. STELFOX, A.R.I.B.A. :

- 347 The Mollusca of Bushy Park, Dublin. Irish Nat., xiii, 121–126, plate 1. 1904.
- 348 Land and Freshwater Mollusca [of Sligo and Leitrim, collected on the I. F. C. U. Excursions, Triennial Conference, Sligo, July, 1904]. Irish Nat., xiii, 183–193, plates 6, 7, 8, 11, 12, 13. 1904.
- 349 Land and Freshwater Mollusca [of W., Mid, and E. Cork, and Waterford, coll. on I. F. C. U. Excursions, Triennial Conference, Cork, July, 1907]. Irish Nat., xvi, 273-286, plates 27, 29, 32. 1907.
- 350 Mollusca of Bushy Park, Dublin. [Additions.] Irish Nat., xvii, 23. 1908.

See Collier, E., A. W. Stelfox, and R. J. Welch, 56. See Stelfox, A. W., and R. J. Welch, 261 to 263.

### WESTERLUND, Carl Agardh, PH.D. :

- 351 Fauna Molluscorum terrestrium et fluviatilium Sveciae, Norvegiae et Daniae. [Many Irish references.] Stockholm, 1873.
- 352 Novum Specilegium Malacologicum. [New vars. of Succinea pfcifferi from Dublin, and Clausilia bidentata from Antrim.] Annuaire du Musée Zoologique de l'Académie Impériale des Sciences des St. Petersbourg, 1898, 155-183.
  See ANON., 16.

### WILLIAMS, J. W., M.R.C.S., F.L.S. :

- 353 Land and Freshwater Shells: An introduction to the study of Conchology. . . . With a chapter on the Distribution of the British Land and Freshwater Mollusca, by J. W. Taylor, F.L.S., . . . and W. Denison Roebuck, F.L.S. [Young Collector Series], sm. 8vo. London, 1889.
- 354 Shells from Ireland [Galway, Mayo]. Midland Nat., xii, 219. 1889.
- 355 Limnaea involuta probably a variety of L. peregra. Zool. (3), xiii, 235. 1889.

WOLLASTON, T. V.:

356 Irish Locality of Amphipeplea involuta. Zool., iv, 1216. 1846.

WOODWARD, Bernard Barnham, F.L.S., F.G.S., F.R.M.S.:

- 357 List of British non-Marine Mollusca. Journ. of Conch., x, 352-367. 1903.
- 358 Note on the occurrence of *Pisidium personatum*, Malm, in the British Islands. Proc. Malacol. Soc. London, viii, 124. 1908.

359 Note on the occurrence in the British Isles of living specimens of *Pisidium Steenbuchii*, Mörch, and *P. Lilljeborgii*, Clessin, with notes of new records of *Pisidia* for the Lake District, and fresh localities for *P. supinum*, A. Schm. Proc. Malacol. Soc. London, ix, 5. 1910.

See Scharff, R. F., 243.

WRIGHT, Prof. Edward Perceval, M.A., M.D., M.R.I.A., F.L.S.:

360 On collecting and arranging the British Mollusca [Irish species marked 69-85]. Nat. Hist. Review, ii. Proc. of Societies, 65-85. 1885.

WRIGHT, Charles East:

361 Helix nemoralis eaten by Rabbits [with note by Lionel Ernest Adams]. Journal of Conch., xii, 268. 1908.

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### DESCRIPTION OF PLATE VII.

Figures 1-20 are magnified 1.05 diameters; nos. 21-26 are  $\times$  1.25; nos. 27, 28  $\times$  1.4; nos. 29-32  $\times$  1.5; nos. 33-50  $\times$  1.06; nos. 51, 52  $\times$  1.5; and nos. 53-56 are  $\times$  1.4 diameters.

Fig	-			
1.	Limnaea	pereger,		Lough Rea, S.E. Galway. R. A. Phillips. July 1909.
2.	>>	>>	•	Arlands Lough, Keadew, West Donegal. A. W. S.
				Sept. 1908.
3.	**	"	•	Dredged at a depth of 120–160 feet in Lough Mask, East Mayo. W. F. de V. Kane. July 1909.
4.	"	"		From a shallow peaty pool on Inishmeane, off the coast of West Donegal. A. W. S. Sept. 1908.
5.	,,	>>		River Barrow, King's Co. A. W. S. Sept. 1906.
6.	,,	33	•	From a limestone quarry near Carlingford, Louth. A. W. S. Feb. 1906.
7.	<b>L</b> imnaea	praetenui	8,	Lough Nagarriva (alt. 1,200 feet), West Cork.
8.	<b>L</b> imnaea	sp.,		Lough Nakeeroge (alt. 28 feet), Achill Island, West Mayo A W S March 1910
9.	Limnaea	involuta,		Lough Crincaum (alt. 900 feet), near Killarney, North Kerry, A. W. S. July 1907.
10.	<b>L</b> imnaea	percyer,	•	From a brackish marsh near Drogheda, Meath. A. W. S. May 1909.
11.	>>	23	•	Lough Carrowmore, West Mayo. A.W.S. March 1910.
12.	<b>L</b> imnaea	peregris,	٠	Sraheens Lough, Achill Island, West Mayo. A. W. S. April 1909.
13.		22	•	Lough Neagh, Crumlin, Antrim. A.W.S. Dec. 1909.
14.	,,	33		New Ross, Wexford. R. A. Phillips.
15.	Limnaea	avricular	riα,	Arlands Lough, Keadew, West Donegal. A. W. S. Sept. 1908.
16.	,,	21	•	Carnboy Lough, Carrickfin peninsula, West Donegal, A. W. S. Sept. 1905. (Young)
17.	,,	"		Carnboy Lough, Carrickfin peninsula, West Donegal, A.W.S. Sept. 1905. (Full-grown.)
18,	22	.,		Warrenpoint Reservoir, Down. A. W. S.
19.	.,	11		Lough of Cork, Mid Cork. R. A. Phillips.
20.	3.9			Pond in Belvoir Park, Belfast, Down. A. W. S.
				May 1898.

21	. Limna	ea palustr	is ,	Ross Lake, West Galway. A. W. S. Sept. 1906.
22	• • • • • •	,,		Lower Lough Erne (Davy Island), Fermanagh.
				A. W. S. Sept. 1900.
23	• ,,	,,		River Erne at Ballyshannon, East Donegal.
				A. W. S. July 1909.
24	• • • • •	,,		Mill dam at Comber, Down. A. W. S. March 1906.
25	· ,,	,,		From a peat bog (600 feet alt.). Cuilcagh Mt.
				Cavan. A. W. S. July 1909.
26	· · · · ·	,,		From the estuary of the River Bann, Derry.
				A. W. S. June 1910.
27	Valvate	a piscinal	is .	Dredged, 8-30 feet, in Lower Lough Erne,
				Fermanagh. R. Welch. Sept. 1900.
28.	,,	,,		Mill dam, Avoniel (Belfast), Down. R. Welch.
				Aug. 1896.
29.	Limnae	a truncat	ula,	Marsh at Gallerus, Dingle, South Kerry. A.W.S.
				Sept. 1910.
30,	"	,,		Chalk quarry at Magheramorne, Antrim. R. Welch.
				March 1898.
31.	"	,,		From the sea-cliff of Croaghmore, Clare Island,
				West Mayo. A. W. S. Sept. 1910.
32.	,,	,,	•	On damp cliffs at Cushendun, Antrim. R. Welch.
				May 1897.
33.	Limnae	a stagnali	s, .	Pool at Cranfield Pt. (L. Neagh), Antrim. R. Welch.
				July 1897.
34.	"	,,	•	Marsh near Mullingar, Westmeath. A. W. S.
				March 1910.
35.	"	,,	•	Limestone quarry, near Armagh City, Armagh.
				R. Welch. Aug. 1898.
36.	> >	,,	•	Washing Bay, Lough Neagh, Tyrone. A. W. S.
~ ~				Jan. 1906.
37.	"	>>	•	Mill dam, Magherafelt, Derry. A. W. S. May 1910.
38,	Succinea	pfeifferi	•	Shore of Lough Neagh, Derryadd Bay, Armagh,
2.0				R. Welch. June 1909.
39.	"	27	•	Marsh at Killough, Down. A. W. S. July 1909.
±0.	Succinea	sp.	•	Near Kenmare, South Kerry. R. Welch. May 1898.
±1.	Succinea	pfeifferi	•	Sea-slopes of Cruit Island, West Donegal. A. W. S. Sept 1908.
12				Marsh near Sligo Town, Sligo, A. W. S. July 1904.
 13.	,, Succinea	mtris	,	Cloughiordan, North Tipperary. R. A. Phillips
		<i>I</i> 00	•	June 1908.

<del>11</del> .	Succinca putris		The Gearagh, West Cork. A.W.S. July 1907.
<u>1</u> 5.	Succinca pfeifferi		Ballinacollig, Mid Cork. R. A. Phillips.
<del>1</del> 6.	<sup>23</sup> 32	b	Limestone quarry at Carlingford, Louth. R. Welch. Feb. 1906.
47.	77 23		Rosses Point, Sligo. A. W. S. July 1904.
<del>1</del> 8.	Succinca oblonga	٠	Limestone quarries at Carrickreagh, Fermanagh. B. Welch, Sept. 1900.
49.	23 23	٠	Bed of a small peaty stream in sand-dunes, Dooaghtry, West Mayo. A. W. S. Sept. 1909.
50.	\$7 22	-	In a wood on the shore of Lough Neagh at Antrim. Castle, Antrim. R. Welch. Aug. 1907.
51.	Hyalinia cellaria	·Ĵ	Woodford, S.E. Galway. R. A. Phillips. Sept. 1910.
52.	· · ·	.]	• 1 1
53.	Prodescorpia	Ň,	Lough Galliagh, Enniskillen, Fermanagh. A.W.S July 1909.
54.	23 23	٠	The White Bog, Killough, Down. A. W. S. June 1909.
55.	2° 77	٠	Mouth of Antrim River, Lough Neagh, Antrim. A. W. S. Aug. 1907.
56.	Planorbis ambilica	1118,	Drain near Milford, Armagh. A.W.S. March 1908.

Nos. 6, 19, 21, 30, 34, and 53 show the forms of the various species commonly met with in the limestone plain; Nos. 7, 8, 9, 11, 12, 25, and 54 were all taken from peaty waters; Nos. 1, 3, 13, 18, 22, 36, 37, and 55 are lacustrine forms; while Nos. 2, 4, 10, 15, 16, 17, and 26 are maritime ones, of which Nos. 10 and 26 came from distinctly brackish habitats.



Variation in form and size.

STELFOX .- LAND AND FRESH-WATER MOLLUSKS OF IRELAND.



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### IV.

# THE WOODLICE OF IRELAND: THEIR DISTRIBUTION AND CLASSIFICATION.

### By DENIS R. PACK BERESFORD, B.A., M.R.I.A., AND NEVIN H. FOSTER, M.B.O.U.

### PLATE VIII.

### (BEING THE TENTH REPORT FROM THE FAUNA AND FLORA COMMITTEE.)

#### Read JANUARY 23, 1911. Published MARCH 16, 1911.

AFTER several years study of the detailed distribution of Woodlice (Crustacea Isopoda Terrestria) in Ireland, and having now authenticated the existence of the four common species—Oniscus asellus, Porcellio scaber, Philoscia muscorum, and Trichoniscus pusillus—in each of the 40 county divisions into which the country has been divided, and also of Ligia oceanica—the seashore species—all round our coasts, we think it a suitable opportunity to offer this paper, giving the present state of our knowledge of the group; while we have embodied in it all the records at present known, so far as we have been able to trace them in various journals, as well as by the result of our own investigations.

We offer also a series of tables to help those who may continue the study to identify such specimens as may come before them, as well as figures of two species which have not as yet occurred in any other part of the British Isles; and we have, in fact, endeavoured to bring our knowledge of the distribution of this group in Ireland as fully up to date as possible, so as to form a basis for further work in it. We need hardly say that the foundation on which we ourselves started was Dr. Scharff's paper on "The Irish Woodlice," published in *The Irish Naturalist*, vol. iii., in 1894.

We have to offer our best thanks to Dr. Scharff both for the advice and assistance he has given us in the course of our investigations, and for allowing us to examine and record the Woodlice preserved in the National Museum in Dublin.

Numerous friends and correspondents residing in various parts of Ireland have also rendered us great service in sending us from time to time specimens

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collected by them; had it not been for the help thus received, our lists would have been far from complete for some of the species. We have to record our thanks in this respect to the following:---Miss Agnew, Charles Anderson, Capt. H. Pack Beresford, R. J. Pack Beresford, Rev. R. Boyle, D. C. Campbell, the late John Cottney, Miss Cuffey, Miss M. J. Delap, F. J. Devlin, Dr. George Fogerty, Mrs. Foster, Miss Foster, S. A. Gordon, Rev. John Going, J. N. Halbert, S. Henry, Rev. W. F. Johnson, H. Wallis Kew, S. K. Kirker, Rev. Canon Lett, Mrs. Millar, J. N. Milne, Miss Mitchell, John McCandless, Dr. McCann, E. L. L. McClintock, Miss McDonnell, T. J. McElderry, Dr. J. L. Nevin, H. L. Orr, Robert Patterson, W. H. Patterson, R. A. Phillips, R. Ll. Praeger, Mrs. Revington, Dr. R. F. Scharff, Rev. W. S. Smith, R. Southern, A. W. Stelfox, Miss Stewart, N. E. Stephens, W. R. Stitt, J. Swain, Dr. Trumbull, P. A. Ussher, Rowland Wade, R. Welch, Miss Westropp, T. J. Westropp, and W. C. Wright.

The number of species now known in Ireland is twenty-five, being an addition of seven to the list published by Dr. Scharff in 1894. Of these no less than twenty-four have been found in Co. Dublin; two of them (Metoponorthus melanurus and Eluma purpurascens) have not been discovered elsewhere in the Britannic area, and one (Philoscia couchii) is apparently confined in England to Devon and Cornwall. These remnants of the Lusitanian fauna were found at Howth, though it is possible that careful search in some of the south-western counties may also reveal their presence there.

Three only of our species need be regarded as artificially introduced, viz.: Trichoniscus stebbingi, only found in a very hot house in Glasnevin Gardens, Dublin; Armadillidium nasatum, found only in houses kept at stove heat; and Metoponorthus pruinosus, which we find chiefly in greenhouses or in the gardens adjoining them. Liqia oceanica is common all round the coast where the shore affords suitable habitat, and it also penetrates up tidal rivers, so that we are able to record it even in the non-maritime county of Armagh. Trichoniscus pygmaeus will probably be found eventually to have an extended range, as this species, first discovered in Ireland in 1908, has since been found in every county in which opportunity has been afforded for a careful search; its small size doubtless accounting for the fact of its having so long been overlooked. It is also possible that Haplophthalmus mengii may also prove though not common, at least widely distributed in the vicinity of the coast-line, all our records for this species being coastal, with the exception of three, two of them being about one mile, and one eight miles, from the shore. Perhaps the most interesting result of our inquiries into the distribution of Woodlice occurs in the case of Armadillidium vulgare. This species, which is so common in the south-east of Ireland, seems to be entirely

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absent from the north-west. Dr. Scharff has already called attention to the absence of this species from the central bogs of Ireland;<sup>1</sup> and Dr. Chilton also notes its absence from a collection made at various times in county Galway by Professor D'Arcy Thompson, which collection is now in University College, Dundee.<sup>2</sup> Whether these boggy regions form a barrier which cuts it off from the north-west we cannot say; but the fact remains that no specimen has been found north of a line drawn from Larne to Galway. *A. vulgare* is a common species in Munster and Leinster, with the exception of the counties of Kerry and Longford. From Connaught it has been recorded only from two localities in S.E. Galway; whilst in Ulster it is plentiful on the limestone formation in Armagh, not uncommon in a limited area in Down (in the neighbourhood of Downpatrick), and has been found in one or two spots in the southern end of Antrim, the remaining counties in the province being apparently devoid of this species.

In recording the detailed distribution of Woodlice in Ireland we have





<sup>1</sup> Irish Naturalist, vol. v., p. 225.

<sup>2</sup> Ibid., vol. viii., p. 115.

followed the 40 county divisions as scheduled by R. Ll. Praeger.<sup>1</sup> In this scheme some of the larger Irish counties have been divided, so as to render each of the divisions more nearly approaching to an approximate size. Each county division is designated by a number commencing with Kerry South, No. 1, in the south-west, and ending with Londonderry, No. 40, in the north. A glance at the map (p. 167) shows how these numbers are arranged, and the names of the county divisions to which these numbers are attached.

As the publication of a separate map of the above type for each species dealt with would entail considerable expense, we have adopted the system detailed by R. Ll. Praeger.<sup>2</sup> By this method no outlines are given, but the reference numbers of the county divisions are placed as nearly as possible relatively to each other as they would appear on the map of Ireland. All the numbers of the county divisions are inserted in each sketch-map; the numbers printed in heavier type denoting that, in the county divisions so printed, the species in connexion with which the sketch-map is given has been recorded.

			N	umber of Species					Number of Species
1	Kerry South,	••	•••	11	21	Dublin,	••		24
2	Kerry North,		••	9	22	Meath,	••		9
3	Cork West,	• •	••	8	23	Westmeath,			5
4	Cork Mid,	• •		10	24	Longford,		••	4
5	Cork East,	••	••	7	25	Roscommon,		••	5
6	Waterford,	• •		9	26	Mayo East,			4
7	Tipperary South,			6	27	Mayo West,		••	10
8	Limerick,		••	7	28	Sligo,			7
9	Clare,		••	8	29	Leitrim,	• •		7
10	Tipperary North,	• •		10	30	Cavan,			4
11	Kilkenny,			9	31	Louth,			9
12	Wexford,			8	32	Monaghan,			5
13	Carlow,	• •		15	33	Fermanagh,		• •	7
14	Queen's Co.,		• •	7	34	Donegal East,		••	11
15	Galway South-ea	st,		6	35	Donegal West,	• •		7
16	Galway West,	••		11	36	Tyrone,		* *	6
17	Galway North-ea	st,		7	37	Armagh,	••		11
18	King's Co.,	••		8	38	Down,	••		15
19	Kildare,	••	• •	10	39	Antrim,			14
<b>2</b> 0	Wicklow,		•	11	40	Londonderry,	••	• •	9

### TABLE I.—LIST OF COUNTY DIVISIONS WITH NUMBER OF SPECIES OF WOODLICE RECORDED THEREFROM.

<sup>1</sup> Irish Topographical Botany. 1901.

<sup>2</sup> Irish Naturalist, vol. xv., pp. 88-94. 1906.

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	Coun Divisio	ty ons	County Divisions
Ligia oceanica,	24	Porcellio scaber,	 40
Trichoniscus pusillus,	40	,, pictus,	 20
" vividus,	4	,, dilatatus,	 14
,, roseus,	17	,, laevis,	 8
,, pygmaeus,	14	Metoponorthus pruinosus,	 10
,, stebbingi,	1	,, cingendus,	 10
Trichoniscoides albidus,	4	,, melanurus,	 1
Haplophthalmus mengii,	8	Cylisticus convexus,	 11
,, danicus,	2	Armadillidium vulgare,	 23
Philoscia muscorum,	40	,, pulchellum,	 6
,, couchii,	., 1	,, nasatum,	 3
Platyarthrus hoffmannseggii,	8	Eluma purpurascens,	 1
Oniscus asellus,	40		

TABLE II.—LIST OF SPECIES OF WOODLICE WITH NUMBER OF COUNTY DIVISIONS FROM WHICH EACH HAS BEEN RECORDED.

In order to facilitate the identification of any species, we give (Plate VIII, fig. 1) a diagrammatic view of the dorsal surface of a Woodlouse, and also (fig. 2) a face view.

The "tracheae" on which some of the distinguishing characteristics are based, and which are not shown in the diagram, are seen as white spots in the breathing-plates or pleopods, which are borne under the abdominal segments.

It may be well to note here that the colouration of some of the species presents many variations, rendering this character of little value in classification. Furthermore, in the examination of specimens preserved in spirit it is found that in many cases the life-colours are entirely changed, as in *Trichoniscus roseus*, which, on immersion in spirit, almost immediately loses its bright rosy colour and becomes white, or *Metoponorthus pruinosus*, from which the bluish bloom is instantly removed.

Coming now to a more detailed review, we may remark that the twentyfive species known to inhabit Ireland are included in twelve genera. The characteristics which distinguish these genera may be set out in tabular form as follows:—

#### GENERA.1

A. The two rami of the uropods alike in shape.

I. The flagellum with more than ten joints.

(a). Abdomen broad		•		Ligia.
(b). Abdomen narrow	•	•		Ligidium.

<sup>&</sup>lt;sup>1</sup> By the aid of this table, which is adapted from that published by Webb and Sillem in "The British Woodlice," 1906, it is possible to identify the genus to which any given specimen belongs. For the benefit, however, of anyone who is not acquainted with these tables, it may be well to take a

II. The flagellum with less than ten joints.	
(c). Abdomen broad	Haplophthalmus.
(d). Abdomen narrow.	
<ul><li>(d<sup>1</sup>). Left mandible with 2, right with only 1 pencil behind the cut- ting parts (Sars)</li></ul>	Trichoniscus.
$(d^2)$ . Left mandible with 3, right with	
2 pencils behind the cutting	
parts (Sars)	Trichoniscoides.
B. The outer ramus of the uropods broader than the inner.	
I. Tail-appendages projecting.	
(a). Able to roll into a ball. $\cdot$ .	Cylisticus.
(b). Not able to roll into a ball.	
$(b^1)$ . Flagellum with 1 joint only .	Platyarthrus.
$(b^2)$ . Flagellum with 2 joints.	
* abdomen broad	Porcellio.
** abdomen narrow	Metoponorthus.
(b <sup>3</sup> ). Flagellum with 3 joints.	
* abdomen broad	Oniscus.
** abdomen narrow	Philoscia.
II. Tail-appendages not projecting.	
(c). Compound eye	Armadillidium.
( <i>d</i> ). Simple eye	Eluma.

We have included in this table the genus Ligidium for convenience of reference, though it has not yet occurred in Ireland.

concrete example: let us suppose, therefore, that a specimen of *Philoscia muscorum* is being studied. On comparing the specimen with the characters given, it will be seen at once that the outer ramus of the uropod is broader than the inner; it must therefore be referred to Section B.

In this section we find that it belongs to the subsection  $\langle b \rangle$ , as it cannot roll up into a ball; and finding that it possesses 3 joints in the flagellum, it is evident that it must be referred to  $\langle b^3 \rangle$ , when its narrow abdomen shows that it belongs to the genus Philoscia.

On turning, then, to the table (given at the head of each genus having more than one British species in the following detailed sections) which differentiates the various species of that genus, and finding that the apex of the telson is sharp-pointed, there is no difficulty in identifying it as *Philoseia muscorum*. It must be borne in mind that these tables are only intended as guides in distinguishing the Britannic species at present known.

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### LIGIA.

Seventeen species of the genus Ligia are known from various parts of the world, but of these one species only inhabits our area.

Ligia oceanica (Linn.).

		35	34	<b>40</b>	39	
			33	36	37	38
	27	28	29	32		
		26	25	30	31	
	16	17	24	<b>23</b>	22	
		15	18	19	21	
	9	10	14	13	20	
2	8	7	11	12		
1	4	5	6			
	3					

This species literally swarms all round our coasts, wherever rocks or shingle afford it a suitable habitat. We have records of it from every county division which has a coast-line (with the exception of S.E. Galway, where it no doubt exists) and even from the shore of Co. Meath, which is almost entirely a stretch of sand. It might almost be called a semi-marine animal, as it is never found more than a few feet above high-tide mark. We have also found this species a considerable distance up the tidal portion of the River Blackwater in Co. Waterford and also up the tidal canal almost to the town of Newry in Co. Armagh.

#### TRICHONISCUS.

Of the six species of the genus Trichoniscus known to inhabit England only four have been found in Ireland; but we have one species, T. *vividus*, which has not so far been taken in England. They may be distinguished from each other as follows:—

SPECIES. A. Single-lens eye. (a). Body surface smooth and shining vividus. (b). Body surface rough and tuberculated.  $(b^{1})$ . Apex of telson squarely truncated . roseus.  $(b^2)$ . Apex of telson rounded linearis. . B. Compound eye of three lenses. (a). Body surface covered with strong tubercles. stebbingi. (b). Body surface covered with strong spines pointing backwards spinosus. . (c). Body surface smooth or slightly granulated.  $(c^{1})$ . Body surface very smooth, apex of telson concave, outer ramus of uropods nearly twice the length of the basal joint, outer ramus longer than inner pusillus, .

	elson	oi	apex	ular	e grar	surfac	Body	$(c^2).$
	pods	fι	mus o	ter ra	ze, ou	conca	not	
	basal	$\operatorname{th}$	th to	leng	al in	out equ	abo	
	al in	е	about	$\operatorname{ami}$	two r	nt, the	joi	
pygmaeus.						$\operatorname{gth}$	len	

Two of these species—i.e. *spinosus* and *linearis*—have not as yet been found in Ireland, but we include them in the above table for convenience of reference, as being very likely to occur eventually.

Trichoniscus pusillus Brandt.

		35	34	<b>40</b>	39	
			33	36	37	38
	27	28	29	32		
		26	25	30	31	
	16	17	24	23	22	
		15	18	19	21	
	9	10	14	13	20	
2	8	7	11	12		
1	4	5	6			
	3					

One of the commonest of our Woodlice, this little species is almost ubiquitous in damp places; in fact, a handful of damp moss or rubbish can hardly be collected anywhere without containing specimens of it. It ranges all over Northern and Mid Europe, and has also been taken in Northern Africa (Algeria) and in America (Budde-Lund).

#### Trichoniscus vividus (Koch).

This species, which lives in very damp situations, is, so far as our present knowledge of its distribution goes, confined to the valleys of the Barrow and Slaney rivers. Although we have records of it up to the present only from four of the county divisions, we think it will probably be traced eventually all along the courses of these rivers and their tributaries.

		35	34	40	39	
			33	36	37	38
	27	28	29	<b>32</b>		
			26	25	30	31
	16	17	<b>24</b>	23	<b>22</b>	
		15	18	19	21	
	9	10	14	13	20	
<b>2</b>	8	7	11	12		
1	4	5	6			
	3					

Originally taken at Portlaw, Co. Waterford (Kinahan), it has since been taken at Cappagh in the same county (R.F.S.); and has also been found at Gowran, Co. Kilkenny (D. R. P. B.); Borris and Tinnahinch (R.A.P.), and near Bagenalstown at Fenagh, and at Kilcarry Bridge, Co. Carlow (D. R. P. B.); and also near Ballickmoyler, Queen's Co. (D. R. P. B.).

It has not yet been taken in England or in Scotland, while on the Continent of Europe it occurs in France (Budde-Lund), and in Spain (Dollfus).

#### Trichoniscus roseus (Koch).

Though usually found in gardens,

often in cinder paths, and commonly in greenhouses, this species has frequently

		35	34	40	39	
			33	36	37	38
	27	28	29	32		
		26	25	30	31	
	16	17	24	23	22	
		15	18	19	21	
	9	10	14	13	20	
<b>2</b>	8	-7	11	12		
1	4	5	6			
	3					

been taken in the open country. It was taken under stones in the semidried-up bed of a mountain stream at Glenade, Co. Leitrim (A. W. S.); and on a railway spoil-bank at Portumna, N. Tipperary (R. Ll. P.). It is recorded from several places in England and Scotland, where, as with us, it is commonest in old gardens (Webb and Sillem). It occurs all over Central and Southern Europe, and in Northern Africa (Algeria) (Budde-Lund).

Trichoniscus pygmæus G. O. Sars.

		35	34	40	39	
			33	36	37	38
	27	28	<b>29</b>	32		
		26	25	30	31	
	16	17	<b>24</b>	23	22	
		15	18	19	21	
	9	10	14	13	20	
<b>2</b>	8	7	11	12		
1	<b>4</b>	5	6			
	3					

This minute species was first discovered in Ireland in 1908 at Hillsborough, Co. Down (N. H. F.); and a

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few days later at Glasnevin, Co. Dublin (J. N. H.). It had probably escaped recognition so long on account of its very great general likeness to T. pusillus. This resemblance is more marked in preserved specimens than in life, when its slower movements, greater proportional length, and dark dorsal line make it fairly conspicuous. It is usually found in damp situations, decaying boards lying in gardens affording a favourite habitat, whilst we have found it by no means uncommon under deeply embedded stones. Since its first capture it has been found at Dingle, S. Kerry (A. W. S.); Borrisokane, N. Tipperary (R.A.P.); Bagenalstown, Co. Carlow (D. R. P. B.); Carton. (R, J. P. B.), and Hill of Allen (A. W. S.), Co. Kildare ; Ferbane. King's Co. (D. R. P. B.); Howth, Co. Dublin (D. R. P. B.); Monaghan (A. W. S.); Bundoran, E. Donegal (N. H. F.); Tory Island, Bunlin, and Doe Castle, W. Donegal (A. W. S. and R. W.); Albany, Co, Tyrone (N. H. F.); Navan Fort, Co. Armagh (N. H. F.); Dromore and Castlewellan, Co. Down (N. H. F.); Belfast, Sallagh Braes, and Glenariff, Co. Antrim (A. W. S.); and Castlerock, Co. Londonderry (N. H. F.).

Trichoniscus pygmaeus was first taken in Great Britain by Mr. A. Patience early in 1906, and he has since found it to be widely distributed over the Clyde faunal area. The only other localities from which it is recorded Island in England are Lundy (B. F. Cummings), Newcastle-on-Tyne, and Kew Gardens (R. S. Bagnall). On the Continent it has been recognized only in Norway by its describer, Prof. G. O. Sars.

[2 A]

Trichoniscus stebbingi Patience. The only Irish records of this species are from the Botanic Gardens, Glasnevin, Dublin, where it was taken in the greenhouses by Mr. R. S. Bagnall in 1908, and on a subsequent occasion in the same place by one of us (D. R. P. B.).

		35	34	40	39	
			33	36	37	
	27	28	29	<b>32</b>		
		26	25	30	31	
	16	17	24	23	22	
		15	18	19	21	
	9	10	14	13	20	
2	8	7	11	12		
1	4	<b>5</b>	6			
	3					

38

#### TRICHONISCOIDES.

The genus Trichoniscoides was created by Prof. G. O. Sars for the species T. albidus; and he distinguishes it from the genus Trichoniscus by the presence of 3 pencils behind the cutting part of the left and 2 behind the cutting part of the right mandibles; whereas in Trichoniscus, these pencils are 2 and 1 respectively. Prof. G. Budde-Lund does not, however, recognize this generic distinction, and includes this species in the genus Trichoniscus. It is not for us to say which of these great authorities is correct, so we content ourselves with recording the species under Sars' genus.

Trichoniscoides albidus (Budde-Lund).

		35	34	40	39	
			33	36	37	38
	27	28	29	32		
		26	25	30	31	
	16	17	24	23	22	
		15	18	19	21	
	9	10	14	13	20	
<b>2</b>	8	7	11	12		
1	4	5	6			
	3					

The first specimens referable to this species were taken by one of us amongst the shingle on the sea-shore of the Broad Strand, Howth (D. R. P. B.), and it was subsequently found at Rathmines, Co. Dublin (N. E. S.); Clare Island (R.F.S. and N. H.F.), and Louisburgh (A. W. S.), W. Mayo; Bundoran, E. Donegal (N. H. F.); St. John's Point (A. W. S. and N. H. F.) and Newcastle, Co. Down (A. W. S.). Its capture in Ireland has not been previously recorded.

In England it has been taken at Eton (Stebbing), and Sunderland (Brady), while Mr. Patience records it from Kew Gardens; Newcastle-on-Tyne; and from many localities in the neighbourhood of Glasgow.

It occurs in France (Dollfus), Denmark, and Holland (Budde-Lund), and at Christiania, Norway (Sars).

### HAPLOPHTHALMUS.

Only two species of the genus Haplophthalmus are known, and both have been taken in Ireland. They are easily distinguished from each other.

### Species.

Α.	Bars	or	ridges	running	across	$_{\mathrm{the}}$	body	-segm	ents,	
	two	) pr	ominer	$t \cdot tubercontrol tubercontrol$	eles on	the	third	abdor	$\operatorname{ninal}$	
	seg	men	ıt, .	•	•		•	•		mengii.

B. Rows of tubercles running across the body-segments, no large tubercles on the third abdominal segment, . danicus.

Haplophthalmus mengii (Zaddach).

		35	34	40	<b>39</b>	
			33	36	37	38
	27	28	29	32		
		26	<b>25</b>	20	31	
	16	17	<b>24</b>	23	<b>22</b>	
		15	18	19	21	
	9	10	14	13	20	
2	8	7	11	12		
1	4	5	6			
	3					

Originally discovered in the British Isles at Corcomroe Abbey, Co. Clare, by Canon Norman and Mr. W. F. de V. Kane, this species has since been found at Stradbally, S. Kerry (A. W. S.); Carrigrohane, Mid Cork (R. A. P.); Glasnevin, Howth, and Clondalkin, Co. Dublin (D. R. P. B.); Glenade, Co. Leitrim (A. W. S.); Bundoran, E. Donegal (A. F.); Doe Castle, W. Donegal (A. W. S.); and Castlerock, Co. Londonderry (N. H. F.). It has been recorded from only two localities in England, and seems elsewhere to be confined chiefly to the central parts of Europe, but it has occurred in Norway.

### Haplophthalmus danicus Budde-

Lund.						
		35	34	40	39	
			33	36	37	38
	27	<b>28</b>	29	32		
		26	25	30	31	
	16	17	<b>24</b>	23	<b>22</b>	
		15	18	19	21	
	9	10	14	13	20	
<b>2</b>	8	7	11	12		
1	4	5	6			
	3					

This species has only been taken at two places in Ireland, in the palm-house in the Botanical Gardens, Glasnevin, Co. Dublin (R. S. B.); and in a garden rubbish yard at Fenagh, Co. Carlow (D. R. P. B.). It has been found at a good many places in England. Its European distribution seems to be very similar to that of *H. mengii*.

### PHILOSCIA.

Three species of the genus Philoscia have been taken in the British Isles, though only two of them have been found in Ireland. They may be distinguished from each other as follows :—

#### Species.

A. Apex of telson sharp-pointed,

muscorum. [2]A 2] B. Apex of telson rounded.

(a).	Outer ramus of	uropods more	$\operatorname{than}$	${\rm double}$	the	
	length of the	inner ramus,				couchii
	_					

(b). Outer ramus of uropods less than double the length of the inner ramus, . . . . . patiencei

Philoscia patiencei has not yet been taken in Ireland.

Philoscia muscorum (Scopoli).

		35	34	40	39	
			33	36	37	38
	27	28	29	32		
		26	25	30	31	
	16	17	24	23	22	
		15	18	19	21	
	9	10	14	13	20	
2	8	7	11	12		
1	4	6	6			
	3					

This species is one of the commonest we have in damp places, and is easily recognized, though it is subject to great variation in colour. In many places bright red and yellow specimens occur.

We have received it from numerous localities in all of the 40 county divisions. It is equally common in Great Britain, and all over the Continent of Europe, and is also found in Northern Africa.

#### Philoscia couchii Kinahan.

This rare species was found originally at Talland Cove near Polperro in Cornwall, by Prof. Kinahan, and was described by him in 1858. In Ireland it has been found only on the southern

		35	34	40	<b>39</b>	
			33	36	37	38
	27	28	29	32		
		26	25	30	31	
	16	17	<b>24</b>	23	22	
		15	18	19	21	
	9	10	14	13	20	
<b>2</b>	8	7	11	12		
1	4	5	6			
	3					

shore of the Hill of Howth, where it was taken in some numbers by one of us (D. R. P. B.) in Sept., 1908. Its habitat here, as in Cornwall where it was discovered, is amongst the shingle, just above high-water mark. Since Professor Kinahan's discovery it has only been taken in two other localities in England, both being in Devonshire.

M. A. Dollfus records it from France, Spain, and Sicily, and Canon A. M. Norman from Sebastopol, Crimea.

It has also been taken in the Azores, Canaries, and along the Mediterranean coast of Africa, and at Syracuse in Asia (Dollfus).

### PLATYARTHRUS.

The genus Platyarthrus, of which there are two known species, is repre-
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sented in Ireland by one only, namely *P. hoffmannseggii* Brandt. The other species of the genus is found in the Mediterranean region only.

#### Platyarthrus hoffmannseggii Brandt.

		35	34	40	39	
			33	36	37	38
	27	28	29	32		
		26	25	30	31	
	16	17	24	23	22	
		15	18	19	21	
	9	10	14	13	20	
<b>2</b>	8	7	11	12		
1	4	5	6			
	3					

This species is the well-known blind Woodlouse that is found only in ants' nests. It is said by Prof. Budde-Lund to inhabit the whole of Europe; but in Great Britain it is apparently more or

less a southern species, not having been taken further north than Oxford, though it has been obtained in a couple of localities in Scotland. In Ireland it appears to have a south-casterly distribution, having been recorded only from Glengariff, W. Cork (R. F. S.); Cork (N. H. F.), and Carrigrohane (R.A.P.), Mid Cork; Lismore (R.F.S.), Cappoquin (J. N. H.), and Waterford (H. W. K.), Co. Waterford; Goresbridge, Kilkenny (D. R. P. B.); Bagenalstown (R. F. S.), and Tinnahinch (R. A. P.), Co. Carlow; Leixlip. Co. Kildare (R. F. S.); and Lucan, Co. Dublin (J. N. H.); and close to Wexford town, Co. Wexford (R.A.P.).

#### ONISCUS.

M. Budde-Lund describes only two species of the genus, as known to himself, but he includes two more as possibly distinct species, out of many that have been described. Both the species mentioned are found in Europe, but only one has so far been taken in the British Islands.

Oniscus asellus Linn.

		35	34	40	39	
			33	36	37	38
	27	28	29	32		
		26	25	30	31	
	16	17	24	23	22	
		15	18	19	21	
	9	10	14	13	20	
2	8	7	11	12		
1	4	5	6			
	3					

The great variations of colour to which this species is liable probably account for many of its synonyms, which are numerous.

It is one of the very commonest species we have, and abounds in all parts of Ireland. Though usually of a dirty grey colour, we find yellow and even red-coloured specimens in many parts of the country. M. Budde-Lund describes this species under the name of *O. murarius* Cuvier, and says that it ranges all over Europe (though it is found less commonly in the south), and is found also in N. America and Greenland, as well as one of the Azores.

#### PORCELLIO.

The genus Porcellio contains very nearly a quarter of all known species of Woodlice, and ranges all over the world, though the great majority of species are found in Europe and northern Africa. Only four species have up to the present been taken in Ireland, as compared with six in Great Britain. The two species (rathkei and ratzeburgii) which have not yet occurred in Ireland are, however, included in the following table, as they are very likely to be eventually taken here :---

SPECIES,<sup>1</sup>

A. Five pairs of tracheae.<sup>2</sup>  $(\alpha)$  The basal joint of the flagellum about half the length of the terminal joint. ratzeburgii. (b). The two joints of the flagellum nearly equal in length rathkei. B. Two pairs of tracheae. I. Lateral plates of the first body-segments produced backwards, more or less sharp. (a) Apex of telson rounded. dilatatus. . (b). Apex of telson sharp-pointed.  $(b^1)$ . Basal joint of flagellum much longer than the terminal joint pictus.  $(b^2)$ . The two joints of the flagellum nearly equal in length . . scaber II. Lateral plates of the first body-segments hardly produced backwards, blunt and rounded . laevis. . Porcellio scaber Latreille. Porcellio scaber, in fact, seems to range This is one of our very commonest species. It is often found in company with Oniscus asellus, and, like that

species, may be found in large colonies under the bark of trees. It also exists in enormous numbers amongst decaying seaweed and debris on the seashore. Though usually of a uniform grey, specimens with reddish side-plates are often seen, and bright-coloured and speckled specimens are not unusual. Equally common in Great Britain,

	35	34	40	39	
		33	36	37	38
27	28	29	32		
	26	25	30	31	
16	17	24	23	22	
	15	18	19	21	
9	10	14	13	20	
8	7	11	12		
4	5	6			
3					
	27 16 9 8 4 3	35 27 28 26 16 17 15 9 10 8 7 4 5 3	35       34         33         27       28       29         26       25         16       17       24         15       18         9       10       14         8       7       11         4       5       6         3	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$

over the whole world wherever the climate is sufficiently temperate.

<sup>2</sup> This characteristic, which is easily detected in living specimens, is hardly to be recognized in preserved ones.

<sup>&</sup>lt;sup>1</sup> These characteristics are those given by M. Budde-Lund in his "Isopoda Terrestria."

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Porcellio pictus Brandt.

11 12

23 22 15 18 19 21 10 14 13 20

27 28 29

16 17 24

7

9

8

3

2

1 4 5 6

35	34	40	39			
	33	36	37	38		
<b>28</b>	<b>29</b>	32				
26	25	30	31			

This species affects a much drier habitat than obtains with Woodlice in general in this country, being often found in the crevices of garden walls facing south, than which hotter and drier situations can hardly be found. It not unfrequently makes its way, too, into dwelling-houses, even invading beds.

It seems not unlikely that this peculiarity may account for its being often overlooked; for, until a year or two ago, it was considered to be one of our rarest species. We have now received it from or taken it ourselves in many parts of Ireland; but though it seems to be widely distributed, it does not seem to be numerous anywhere. One collector, however (S. A. G), sending us numerous specimens from Loughgilly, Co. Armagh, says that it appears to be the commonest species in that neighbourhood. It has been recorded from only a few places in England and Scotland; but on the Continent it seems to range over the whole of the north and centre of Europe, and it has also occurred in N. America. This species is called P. spinicornis Sav in Miss Richardson's monograph on American Isopods.

Porcellio dilatatus Brandt.

		35	34	40	39	
			33	36	37	38
	27	28	29	32		
		26	25	30	31	
	16	17	<b>24</b>	23	22	
		15	18	19	21	
	9	10	14	13	20	
<b>2</b>	8	7	11	12		
1	4	5	6			
	3					

In Porcellio dilatatus we have a species about which it is difficult to say with certainty whether it is really native or not. It occurs throughout Europe generally, however, in or near houses or in cellars.

It is found in similar situations in this country; but we find it more commonly in greenhouses and conservatories, where it is often numerous. In warm greenhouses we have found specimens of very light colour due apparently to a superficial bloom like that of Metoponorthus pruinosus. We have also a few records of its occurrence in the open country, as at Ventry Bay (R. W. and A. W. S.) and Valencia Island (M. J. D.), S. Kerry; Dog's bay, W. Galway (R. W.); Killala, W. Mayo (N. H. F.); Lough Erne, Co. Fermanagh (R. P.): Bundoran, E. Donegal (N. H. F.); and Coney Island, Lough Neagh, Co. Armagh (R.W.). It has been recorded from only about five localities in the south of England, whilst on the Continent it has been found in France, Spain, Holland, Germany, and Denmark, ranging north into Norway. Outside Europe it occurs in Madeira, the Azores, and Australia.

Porcellio lævis Latreille.

		35	34	40	39	
			33	36	37	38
	27	28	29	32		
		26	25	30	31	
	16	17	24	23	22	
		15	18	19	21	
	9	10	14	13	20	
2	8	7	11	12		
1	4	5	6			
	3					

This species appears to be fairly common in the neighbourhood of Dublin (R. F. S.); but elsewhere in Ireland it must be considered rare.

The only localities outside Co. Dublin from which we have records of it are: Tralee, N. Kerry, (Mrs. R.); Cappagh, Co. Waterford (P.A.U.); Galway City (C. Chilton); Enniskerry, Co. Wicklow (A. W. S.); Drogheda, Co. Louth (R. W.); Richhill, Co. Armagh (N. H. F.); and Belfast, Co. Antrim (R. W.). In England it is recorded from only a very few localities in the south-east; but it has perhaps the widest general distribution of any species of Woodlouse, ranging as it does over the whole world, with perhaps the sole exception of the Australasian region.

#### METOPONORTHUS.

The genus Metoponorthus appears to have a world-wide distribution, but the majority of species are European. Three species only have been taken in Ireland, and one of these has not yet been found in England.

The following characteristics serve to distinguish the three species :----

#### SPECIES.<sup>1</sup>

Α.	Three pairs of tracheae, oval body,	cingendus.
В.	Two pairs of tracheae, oblong body.	
	(a). Epistoma or clypeus has a curved ridge run-	
	ning transversely across it; telson produced	
	into a sharp point,	pruinosus.

(b). Epistoma or clypeus smooth, without transverse ridge; telson short, triangular, . melanurus. ...

#### Metoponorthus pruinosus (Brandt).

Found almost exclusively in hothouses and frames, or close to them outside in the summer time, this species is, we think, certainly not a native of this country, though we have two

records of its having been taken in the open country, first under stones at the mouth of the Boyne river, Co. Meath, by Dr. Scharff in 1894, and again in an old quarry near Greystones, Co. Wicklow, by Mr. N. E. Stephens in Professor Kinahan states that 1909.

<sup>1</sup> These characteristics are those given by M. Budde-Lund in his "Isopoda Terrestria."

it is common in Ireland; but Dr. Scharff expresses his disagreement with this

		35	34	40	39	
			33	36	37	38
	27	28	29	32		
		26	25	30	31	
	16	17	<b>24</b>	23	22	
		15	18	19	21	
	9	10	14	13	20	
2	8	7	11	12		
1	4	5	6			
	3					

view, and the results of our investigations entirely confirm the latter opinion. It is very probable that its distribution may eventually be traced all over the country in hot-houses, as it is often to be found in large numbers in such places. There are only a few records of its occurrence in the S.E. of England; but it has also been taken in Scotland; while in other parts of the world it is, as M. Budde-Lund says, a "cosmopolitan species."

#### Metoponorthus cingendus Kinahan.

		35	<b>34</b>	40	39	
			33	36	37	38
	27	28	29	32		
		26	25	30	31	
	16	17	<b>24</b>	23	22	
•		15	18	19	21	
	9	10	14	13	20	
2	8	$\overline{7}$	11	12		
1	4	5	6			
	3					

This species is very common in Kerry and Cork, from which counties we have respectively records from 10 and 7 localities. It occurs also in several of the maritime counties on the west coast and in the south-eastern corner, and

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seems to be commonest in mountainous districts. It has been taken in England in Devonshire only; while on the Continent it is recorded from the south of France and Spain only.

# Metoponorthus melanurus

Budde-Lund.

	35	34	40	39	
		33	36	37	38
27	28	29	32		
	26	25	30	31	
16	17	24	23	<b>22</b>	
	15	18	19	21	
9	10	14	13	20	
8	7	11	12		
4	5	6			
3					

 $\mathbf{2}$ 

1

A few specimens of this very rare Woodlouse were taken on the southern cliffs of the Hill of Howth, Co. Dublin, by Mr. J. N. Halbert in 1909, and were recorded in the Irish Naturalist, vol. xix, p. 92, by Dr. Scharff. A further examination of the locality shows that it exists there in some numbers, living under tufts of grass and Silene maritima on the face of the cliff. It has not yet been taken in Great Britain, nor indeed anywhere nearer than the south of France. The only other localities for which M. Budde-Lund records it are Corsica and one or two spots in northern Africa. It is another example of those southern or "Lusitanian" species, so many of which are found in Ireland. and which add so much interest to the study of the fauna and flora of this country.

We give a figure (Plate VIII., fig 3) of this interesting species, as none has hitherto been published in any English paper.

 $[2 \ B]$ 

#### CYLISTICUS.

With the genus Cylisticus we come to the first of that class of Woodlouse which is capable of rolling itself into a ball, though in this genus the power is not so complete as in those which follow. This is owing to the fact that the tail-appendages (uropods) are long and styliform, and project beyond the end of the telson, whereas they are always very short and broad in the genera Armadillidium and Eluma.

There are seven known species of this genus, but only one is found in this country.

Cylisticus convexus (De Geer).

		35	34	40	39	
			33	36	37	38
	27	28	29	32		
		26	25	30	31	
	16	17	24	23	22	
		15	18	19	21	
	9	10	14	13	<b>20</b>	
<b>2</b>	8	7	11	12		
1	4	5	6			
	3					

This species, though recorded from eleven counties, is nowhere abundant in Ireland. It has been taken at Killaloe, N. Tipperary (R. A. P.); Goresbridge, Co. Kilkenny (R. F. S.); Borris, Co. Carlow (R. F. S.); Leixlip, Co. Kildare (R. F. S.); Howth, Co. Dublin (D. R. P. B.); Clare Island, W. Mayo (R. Ll. P. and D. R. P. B.); Tempo, Co. Fermanagh (R. F. S.); Ballyshannon, E. Donegal (A. W. S.); Ballyholme (D. R. P. B.), Groomsport (W. H. P.), Hillsborough (N. H. F.), Ballynafeigh (J. N. M.), and Magheralin (A. W. S.), Co. Down; Belfast, Co. Antrim (A. W. S. and R. W.); and Londonderry City (D. C. C.). From this list it can be seen that it is more plentiful in the neighbourhood of Belfast than in any other part of the country. It occurs in scattered localities over the greater part of northern Europe and also in North America (Budde-Lund). In England it has been found only in the south, but it has also been taken in several parts of Scotland.

#### ARMADILLIDIUM.

There are, according to M. Budde-Lund, forty-five species of the genus Armadillidium, the great majority of them being inhabitants of Europe and northern Africa. Only three of these species have as yet been taken in Ireland; but we give also the characteristics by which A. depressum Brandt, found in the neighbourhood of Bristol, and A. album Dollfus, recorded from the estuary of the Taw and Torridge. Devonshire, in England, may be distinguished, as it is possible that these species may eventually be found in this country.

#### Species.

A. Outer ramus of the uropods oval-oblong, always longer and wider than the basal segment, apex of telson	
obtusely pointed,	nasatum.
B. Outer ramus of the uropods trapezoidal, generally shorter and narrower than the basal segment.	
(a). Apex of telson broadly rounded or semi- circular.	
( $a^1$ ). Inner ramus of uropod narrow, the same width throughout, posterior angle of the lateral plate of the first segment of pereion truncated,	pulchellum.
<ul> <li>(α<sup>2</sup>). Inner ramus of uropod short and broad, especially at its end where it spreads out, colour uniform white (Dollfus),</li> </ul>	album.
(b). Apex of telson truncate.	
$(b^1)$ . Body-surface smooth and shining, frontal lobe small, $\ldots$ $\ldots$	vulgare.
$(b^2)$ . Body-surface rough and tubercular, frontal lobe prominent,	depr <b>e</b> ssum.
A sure d'ill'd'aux mulacese Totaville Mosth of d'Touth 't	:

Armadillidium vulgare Latreille.

		35	<b>34</b>	<b>40</b>	39	
			33	36	37	38
	27	28	29	32		
		26	25	30	31	
	16	17	24	23	22	
		15	18	19	21	
	9	10	14	13	20	
2	8	7	11	12		
1	4	5	6			
	3					

Exceedingly common in the southeastern part of Ireland, this species gradually gets scarcer as one goes north, and is apparently entirely absent from the north-western half of the country.

In Meath and Louth it is not uncommon; and on the limestone near Armagh City it is plentiful (N. H. F.); but in Co. Down it has been taken only at Portaferry (J. N. M.), Killough (A. W. S.), Downpatrick (N. H. F.), and Seapatrick (R. W.); while in Co. Antrim it has been found only at Kilroot (R. W.), and Magheramorne in large numbers (A. W. S. and N. H. F.). It occurs in England and Scotland, and ranges over the whole of Europe, and has been taken in the neighbouring parts of Asia and Africa, and also in a few isolated localities in North and South America, and in Australia, where it has probably been introduced (Budde-Lund). 2 B 2

# Armadillidium pulchellum Brandt.

		35	34	40	39	
			33	36	37	38
	27	28	29	32		
		26	25	30	31	
	16	17	24	$\underline{23}$	22	
		15	18	19	21	
	9	10	14	13	20	
2	8	$\overline{\ell}$	11	12		
1	4	5	6			
	3					

First found in the British Islands at Ballymote, Co. Sligo (R. F. S.), this beautifully marked little species has since been discovered at Borrisokane, N. Tipperary (R. A. P.); Kilcarry Bridge and Fenagh, Co. Carlow (D. R. P. B.); Carrickmines, Co. Dublin (J. N. H.); Kiltoom, Co. Roscommon (A. W. S.); and at Ballyquintin Point, Co. Down (D. R. P. B.), where it occurs in considerable numbers. It has been found at two or three places only in England, but ranges over the greater part of northern and central Europe in scattered localities (Budde-Lund).

Armadillidium nasatum Budde-Lund.

		35	34	40	39	
			33	36	37	38
	27	28	$\underline{29}$	32		
		$\underline{26}$	25	30	31	
	16	17	24	23	$\frac{22}{2}$	
		15	18	19	21	
	9	10	14	13	20	
2	8	7	11	12		
1	4	ō	6			
	3					

So far as our present knowledge goes this seems to be undoubtedly an introduced species, as it has hitherto been found only in greenhouses. It occurs in the south of England, however, in the open (Webb and Sillem), so may possibly be found eventually out of doors in this country too. This species was first noted in Ireland, by one of us (N. H. F.), at Hillsborough, Co. Down, and was found at almost the same time by Mr. J. N. Halbert in the hot-houses in the Botanic Gardens, Glasnevin.1 The only other places at which it has been taken in Ireland are Belvoir Park (N. H. F.), Crawfordsburn (R. W.), and Bangor (D. R. P. B.), Co. Down; and in Belfast, Co. Antrim (H. L. O.).

M. Dollius gives the measurements of this species as  $15 \times 7$  mm.; but the largest specimen we have obtained in Ireland so far only measures 10 mm. in length, the great majority only attaining to about 8 mm. We have specimens from the bank of the river Avon, Somerset, which measure  $14 \times 7.5$  mm., one of these being of a pale tawny colour tinged with pink, and having light brown markings. This of course is a specimen preserved in spirit; but in our experience the colours are little affected thereby in specimens of this genus.

On the Continent it is found in France, Spain, and Italy, in which latter country it is common.

<sup>&#</sup>x27;Erroneously recorded as Armadillidium pictum, Irish Nat., vol. xvii, p. 135, subsequently corrected to A. nasatum ibid., vol. xviii, p. 54.

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#### ELUMA.

There are only two known species of the genus Eluma, i.e. E. purpurascens and E. helleri. The latter species has only lately been described by Dr. Verhoeff, from the Island of Teneriffe.<sup>1</sup>

Eluma purpurascens Budde-Lund.

		35	34	40	39	
			33	36	37	38
	<b>27</b>	28	29	32		
		26	25	30	31	
	16	17	<b>24</b>	<b>23</b>	<b>22</b>	
		15	18	19	21	
	9	10	14	13	<b>20</b>	
<b>2</b>	8	7	11	12		
1	4	5	6			
	3					

This interesting southern species was first discovered in Ireland in 1908, when it was found in large numbers on the Hill of Howth (D. R. P. B.), and at Portmarnock (R. S. B.), in Co. Dublin. It has not yet been found in Great Britain; but it has a very wide distribution round the shores of the Atlantic. The headquarters of the species seem to be in the Atlantic archipelagoes, the Canarics, Azores, and Madeira, where it is very abundant. It has been taken also in western Algeria, and in Spain, Portugal, and France. We give two figures of this species (Plate VIII., fig. 3, A and B).

#### BIBLIOGRAPHY.

- BAGNALL, R. S.—On *Philoscia patiencei*, a new Terrestrial Isopod. Ann. Mag. Nat. Hist. (ser. 8), vol. i, pl., 1908.
- On the occurrence in Belgium of a recently described Terrestrial Isopod, *Trichoniscus stebbingi*, Patience. Ann. de la Soc. Royale Zool. et Malacologique de Belgique, tom. xliii, 1908.
- Records of some Irish Woodlice. Irish Nat., vol. xvii, p. 259, 1908.
- ----- On *Armadillidium album*, a rare Woodlouse new to the Fauna of Great Britain. Zoologist (4th ser.), vol. xii, pp. 152–154, 1908.
- ---- On some Terrestrial Isopods from the Glasnevin Botanic Gardens, Dublin. Irish Nat., vol. xviii, pp. 42-44, 1909.
- Armadillidium nasatum and A. pictum. Irish Nat., vol. xviii, p. 54, 1909.

BATE AND WESTWOOD.-British Sessile-eyed Crustacea, vol. ii, Isopoda, 1868.

BELFAST NATURALISTS' FIELD CLUB.—Guide to Belfast and the adjacent Counties [British Association Guide], 1874.

<sup>1</sup> Über Isopoden, Archiv für Biontologie, vol. ii, 1908.

- BELFAST NATURALISTS' FIELD CLUB.—Guide to Belfast and the Counties of Antrim and Down [Brit. Assoc. Guide], 1902.
- ---- [Notes on Woodlice observed] Proceedings, Ser. ii, vol. vi, Part II, 1909.

- BELFAST AND DUBLIN NATURALISTS' FIELD CLUBS.—Proceedings in Irish Nat., vol. iii, p. 181, 1894.
- BUCHANAN-WOLLASTON, H. J., AND D. R. PACK BERESFORD.—Contributions to the Natural History of Lambay, Co. Dublin, Isopoda. Irish Nat., vol. xvi, p. 59, 1907.
- BUCKLE, C. W.—Entomological Notes from Ulster. Irish Nat., vol. xi, p. 43, 1902.
- BUDDE-LUND, G.—Crustacea Isopoda Terrestria, 1885.
- A Revision of the Crustacea Isopoda Terrestria, Part 1, Eubelum, 1899.
- ---- A Revision of the Crustacea Isopoda Terrestria, Part I, *Eubelum*; Part II, Spherilloninae; Part III, Armadillo, 1904.
- CARL, Dr. J.—Étude sur Trichoniscides (Isopodes terrestres) de la collection de M. A. Dollfus. La Feuille des Jeunes Naturalistes, 4th Series. July, 1908, et seq.
- CARR, J. W.—Nottinghamshire Crustacea and Arachnida. Nottingham Naturalists' Society, Transactions, 1902–1903.
- CHILTON, CHARLES.—Some Land Isopods from Co. Galway. Irish Nat., vol. viii, p. 115, 1899.
- Note on the Sexual Characters of Ligia oceanica. Ann. Mag. Nat. Hist. (Ser. 7), vol. iii, 1899.
- CUMMINGS, BRUCE F.—Notes on Terrestrial Isopods from North Devon. Zoologist (4th Ser.), vol. xi, pp. 465-470, 1907.
- Notes on the Fauna of Lundy Island. Zoologist (4th Ser.), vol. xiii, pp. 441–446, 1909.
- ----- The Land Isopoda of Lundy Island. Ann. Mag. Nat. Hist. (Ser. 8), vol. iv 1909.
- FARRAN, E. C.— Trichoniscus roseus near Dublin. Irish Nat., vol. iv, p. 296, 1895.
- FOSTER, NEVIN H.—Irish Field Club Union, Cork Conference Report— Isopoda. Irish Nat., vol. xvi, p. 302, 1907.
- ----- Trichoniscus pygmæus, a Woodlouse new to Ireland. Irish Nat., vol. xvii, p. 56, 1908.
- ---- Armadillidium [pictum] nasatum. Irish Nat., vol. xvii, p. 135, pl. 6, 1908 (corrected in vol. xviii, see next item).
- Armadillidium pictum, a correction. Irish Nat., vol. xviii, p. 54, 1909.

<sup>[</sup>Notes on Woodlice observed] Proceedings, Ser. ii, vol. vi, Part III. 1910.

#### PACK BERESFORD AND FOSTER-The Woodlice of Ireland. 187

- FOSTER, NEVIN H.—Irish Field Club Union, Rosapenna Conference Report. Isopodia Terrestria. Irish Nat., vol. xix, p. 187, 1910.
- FOSTER, NEVIN H., AND D. R. PACK BERESFORD.—See Pack Beresford, D. R., and N. H. Foster, *infra*.
- HOGAN, A. R.—On a new British Oniscoid [*Platyarthrus hoffmannseggii*] found in Ants' nests, Nat. Hist. Rev., vol. vi, 1859.
- KANE, W. F. DE V.—Haplophthalmus mengii in Ireland. Irish Nat., vol. ix, p. 246, 1900.
- KINAHAN, J. R.—Analysis of certain Genera of Terrestrial Isopods. Nat. Hist. Rev., vol. iv, 1857.
- ----- On the Genera *Philoscia*, *Itea*, and *Philougria*. Nat. Hist. Rev., vol. v, 1858.
- ----- On the Genus Platyarthrus, etc. Nat. Hist. Rev., vol. vi, 1859.
- NORMAN, A. M. Note on the discovery of *Ligidium agile*, Persoon, in Great Britain. Ann. Mag. Nat. Hist. (Ser. 4), vol. xi, 1873.
- ----- British Land Isopoda. Ann. Mag. Nat. Hist. (Ser. 7), vol. iii, 1899.
- —— British Land Isopoda. Ann. Mag. Nat. Hist. (Ser. 7), vol. xiv, pp. 449– 450, 1904.
- Revised nomenclature of the species described in Bate and Westwood's "British Sessile-eyed Crustacea." Ann. Mag. Nat. Hist. (Ser. 7), vol. xvi, pp. 78–95, 1905.
- PACK BERESFORD, D, R.—Woodlice in Co. Carlow. Irish Nat., vol. xv, p. 142, 1906.
- Woodlice in Co. Carlow. Irish Nat., vol. xvi, p. 250, 1907.
- ----- Cylisticus convexus in Co. Down. Irish Nat., vol. xvi, p. 351, 1907.
- ----- Some new Irish Woodlice. Irish Nat., vol. xvii, p. 206, 1908.
- ----- Eluma purpurascens, a Woodlouse new to the British Isles. Irish Nat., vol. xvii, pp. 255–258, pl. 10, 1908.
- PACK BERESFORD, D. R., AND N. H. FOSTER.—On the Distribution of Woodlice in Ireland as known at the end of 1908. Irish Nat., vol. xviii, pp. 92– 93, 1909.
- PACK BERESFORD, D. R. AND H. J. BUCHANAN-WOLLASTON.—See Buchanan-Wollaston, H. J., and D. R. Pack Beresford, *supra*.
- PATIENCE, A.—On some Terrestrial Isopods new to the Clyde Faunal Area, and some notes on the Distribution of the Rarer Species. Nat. Hist. Soc. of Glasgow, Transactions, vol. viii, Part I., 1906.
- ----- On a new British Terrestrial Isopod (*Trichoniscus spinosus*). Ann. Scott. Nat. Hist., No. 62, plate, 1907.

- PATIENCE, A.— On a new British Terrestrial Isopod (*Trichoniscus stebbingin*. Journ. Linn. Soc., Zoology, vol. xxx, No. 195, plate, 1907.
- On a new British Terrestrial Isopod (*Trichoniscus linearis*). Ann. Mag. Nat. Hist., (Ser. 8), vol. i, plate, 1908.

— On Trichoniscoides albidus, B.-L., and T. sursi, Pat. Ann. Mag. Nat. Hist. (Ser. 8), vol. ii, 1908.

PATTERSON, ROBERT.—Irish Field Club Union, Sligo Conference Report, Amphipoda and Isopoda. Irish Nat., vol. xiii, p. 202, 1904.

PRAEGER, R. LL.—*Trichoniscus roseus* near Dublin. Irish Nat., vol. xi, p. 323, 1902.

- RICHARDSON, HARRIET.—Monograph on the Isopods of North America. Bulletin of the United States National Museum, No. 54, 1905.
- SARS, G. O.-Crustacea of Norway, vol. ii, Isopoda, 1896.
- SCHARFF, R. F.—The Irish Woodlice. Irish Nat., vol. iii, pp. 4–7 and 25–29, 2 plates, 1894.
- ---- Ligia oceanica on the Galway Coast. Irish Nat., vol. iii, p. 157, 1894.
- —— Porcellio pictus. Irish Nat., vol. iv., p. 166, 1895.
- The Woodlice of Co. Carlow. Irish Nat., vol. iv, p. 319, 1895.
- Notes on the Fauna and Flora of Clonbrock, Co. Galway: Isopods. Irish Nat., vol. v, p. 225, 1896.
- ---- Cylisticus convexus in Co. Fermanagh. Irish Nat., vol. vi, p. 281, 1897.
- Porcellio dilatatus at Dundrum, Co. Dublin. Irish Nat., vol. viii, p. 60, 1899.
- ---- The History of the European Fauna (Contemporary Science Series) 1899.
- ---- Trichoniscus viridus at Cappagh. Irish Nat., vol. ix, p. 158, 1900.
- ---- Armadillidium pulchellum, a Woodlouse new to the British Islands. Irish Nat., vol. x, pp. 109–110, fig., 1901.
- --- European Animals, 1907.
- Dublin Microscopical Club Proceedings. Irish Nat., vol. xvii, p. 124, 1908.
- Metoponorthus melanurus, a species of Woodlouse new to Ireland. Irish Nat., vol. xix, p. 92, 1910.
- SCOTT, T.—The Land and Freshwater Crustacea of the District around Edinburgh. Roy. Phys. Soc. Edinb., Proceedings, vol. xi, 1873.
- STANDEN, R.- On the Distribution and Habits of *Platyarthrus hoffmannseggii*. Lancashire Naturalist, vol. ii, pp. 239-242, plate, 1909.
- STEBBING, T. R. R.—On a Crustacean of the Genus Zia. Ann. Mag. Nat. Hist. (Ser. 4), vol. xi, 1873.

PACK BERESFORD AND FOSTER—The Woodlice of Ireland. 189

STEBBING, T. R. R.—History of the Crustacea (International Scientific Series), 1893.

----- Notes on Crustacea. Ann. Mag. Nat. Hist. (Ser. 6), vol. xv, p. 22, 1895.

TATTERSALL, W. M.—Handbook to the City of Dublin and Surrounding District (Brit. Assoc. Guide), Isopoda, pp. 182-184, figs. a, b, c, d, 1908.

THOMPSON, W.—Natural History of Ireland, vol. iv, p. 402, 1856.

UNWIN, E. E.—The Respiration of Land Isopods. British Assoc. Report, p. 236, 1908.

VERHOEFF, KARL W.-Über Isopoden. Archiv für Biontologie, vol. ii, 1908. WEBB AND SILLEM-The British Woodlice, 1906.

WELCH, ROBERT.-Trichoniscus roseus. Irish Nat., vol. v, p. 213, 1896.

- —— Rare Woodlice from Co. Dublin and Co. Down. Irish Nat., vol. xiii, p. 260, 1904.
- —— Some New Stations for Trichoniscus roseus. Irish Nat., vol. xiv, p. 198, 1905.

[DESCRIPTION OF PLATE VIII.

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# DESCRIPTION OF PLATE VIII.

#### FIG.

- 1. The dorsal surface of a Woodlouse—diagrammatic, giving the names of the various parts most commonly referred to in the tables for distinguishing the various genera and species.
- 2. Face view of head of Woodlouse-diagrammatic.
- 3. Metoponorthus melanurus Budde-Lund. A dorsal view; the darker metasome is very characteristic in this species.
- 4. Eluma purpurascens Budde-Lund.
  - A. Dorsal view.
  - B. Side view. The groove along the first lateral plate and the indentation at its posterior angle are shown.

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Plate VIII.



PACK BERESFORD AND FOSTER.-IRISH WOODLICE.

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# V.

# GLACIAL FEATURES IN SPITSBERGEN IN RELATION TO IRISH GEOLOGY.

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#### PLATES IX.-XVI.

Read MAY 8. Published JULY 29, 1911.

#### INTRODUCTION.

UNDER favourable summer conditions, the island-group of Spitsbergen is accessible to excursion-steamers, and hundreds of visitors have thus become generally acquainted with the aspect of a land where glacial features still prevail. Few strangers, however, have experienced such advantages as were offered by Professor Baron Gerard de Geer of Stockholm, in connexion with the International Geological Congress of 1910; and hence I venture, as a delegate to that Congress from the Royal College of Science for Ireland, to present the following notes on some of the phenomena observed. The scale of the landscapes in Spitsbergen, with mountains rising to heights of about 1,000 metres from the coast, with foregrounds of raised beaches and fluvio-glacial fans, and with the glacial agents still at work, down to the very shore-line, makes comparison with Ireland in the Ice Age apt and interesting, The recent Ice Age, however, is passing in Spitsbergen, as it is in every part of the world; and we may there realize the conditions of our own islands when the sea had again been admitted by subsidence to the fjords, while the ice still occupied the lowlands in the form of broad coalescing glaciers, which in places were beginning to stagnate. (Pl. IX., fig 1.)

Professor de Geer, through successive visits to Spitsbergen from 1896 to 1908, aided by a number of workers whom his enthusiasm has inspired, has drawn up a detailed map of the great Ice Fjord and its ramifications. On this the sea-depths are included, as determined by several thousand soundings. This map was issued for the Geological Congress on a scale of

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1:200,000, and the geological formations are shown in colour. Special maps illustrating glacial features were also given in the "Guide de l'excursion au Spitzberg," Stockholm, 1910.

The excursion was planned so as to include some seventy geologists, who were provided for, in a manner beyond all praise, within the narrow limits of the *Æolus*, a Baltic passenger-steamer of 870 tons. The very closeness of the quarters, and the constant and cheerful intercourse along the decks and passage-ways, contributed to bring the representatives of sixteen nations into the most friendly terms with one another. It must suffice to mention among the glacialists present, after our universally respected leader, the names of Lamplugh, Penck, Tarr, and Wahnschaffe. Yet it is hard to omit such geologists as Credner, De Margerie, Mattirolo, Reusch, Rothpletz, and Salomon, or such geographers as Cholnoky and Sapper, whose wide knowledge of other lands did so much to illustrate the special features seen in Spitsbergen. One would like to name at least twenty others to whom warm thanks are due for their helpful co-operation in the Arctic seas.

Though the actual visit to the Ice Fjord occupied only eight days, in such company any hour of the twenty-four might be turned to profitable account. In spite of considerable difficulties with fog, and with the abundant driftice set free from the polar pack in 1910, the great sea-inlet was entered on the night of August 2nd, after a voyage of five days from the Norwegian port of Narvik. The steamer had passed in sunlight close along the coast of Bear Island. The study of Spitsbergen was carried on under an almost cloudless sky; and the continuous daylight enabled expeditions to be made on shore at such times as a landing-place was at hand. One of the most successful excursions, that to the Nordenskiöld Glacier in Billen Bay, in latitude 78°40' N., was carried out while the *Æolus* was being floated off a fluvio-glacial mud-bank between 9 p.m. and 3 a.m.

The steamer, moreover, was brought out of the Ice Fjord just in time, when the pack-ice drove more thickly against the southern harbour-mouths. The movement of this sea-ice, the frequent contact with it during a sinuous and wary course, and the great roll of the open water when our way was once more free for Norway, formed memorable features in themselves. Phenomena of glacial weathering were conspicuous all down the Norwegian coast to Trondhjem, where the eighteen days at sea came to an end. On the way to Stockholm, the rocky mass of Åreskutan in Jämtland was ascended, a huge compound *roche moutonnée*, 4,000 feet above the lowland, and bearing evidence over all its slopes of the great ice-stream that once flowed across it, not from the neighbouring divide which forms the frontier, but from a snowdome farther north. Hence even here we were reminded of Ireland, with

the ice moving, as Maxwell H. Close showed,<sup>1</sup> from a region of maximum precipitation rather than from any tectonic feature.

#### FROST-WEATHERING AND SNOW-SLIDE ACTION.

The most striking fact about Spitsbergen, to one unaccustomed to Arctic lands, is the general appearance of aridity. The meteorogical conditions allow of precipitation, for the warm inlet of the Atlantic lies near at hand on the south-west, and the temperature on land remains near the freezing-point, even on a summer day. Hence snow falls, and frost-crystals are condensed out of the frequent mists that steal in from seaward. The melting of the snow-edges, however, is said to be balanced by a small precipitation, and broad glaciers are maintained in the lowlands in a country of comparatively little snow-fall. The typical weathering is due to frost and snow-slides, the action of which is evidently rapid. The present snow-line is as high as 1,500 to 1,800 feet.

The horizontal stratification of the rocks in the interior, away from the folded marginal ranges of the west, lends itself to the formation of broad plateaus. The winter snow lies on these as a protective covering; and the features of coalescing rivulets, and the localization of water-channels, occur only on the margins of the snow-fields.<sup>2</sup> Since the continuous daylight of summer is accompanied by sufficient warmth, the snow melts in Spitsbergen : but in most places it retreats only a short distance from the edge of the plateau, leaving patches and long streaks lingering in the grooves (Pl. IX., fig. 2). These grooves are eroded in the first instance where the melting edge of the snow allows water to soak into the ground. Frost at night, or even on a cloudy day,<sup>3</sup> solidifies this water, and splits the superficial layer of rock. A crumbling surface is produced, from which particles slide away at some points more than at others. At such points water accumulates more freely when melting next begins; the hollow becomes emphasized, like that of a rill started in the drainage-system of a high bogland. In time, snow gathers more thickly in the hollow than on the smoother portion of the windswept plateau-edge. This snow, alternately melting and freezing on its margins, carries on the destructive work. A snow-strip thus works its way down into the edge of the plateau. At times, so much snow is accumulated

<sup>&</sup>lt;sup>1</sup> "Notes on the General Glaciation of Ireland," Journ. R. Geol. Soc. Ireland, vol. i. (1867), p. 240. A. G. Högbom, "Wasserscheide und Eisscheide in Skandinavier," Geol. Rundschau, Bd. ii (1911), p. 131.

<sup>&</sup>lt;sup>2</sup> See E. J. Garwood, "Features of Alpine Scenery due to Glacial Protection," Geographical Journal, 1910, p. 311.

<sup>&</sup>lt;sup>3</sup> See W. Salomon, "Die Spitzbergenfahrt des internat. geol. Kongresses," Geol. Rundschau, Bd. i. (1910), p. 307.

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that melting gives rise to considerable slips. The groove is then intensified by snow-slide action on a large scale. The avalanches consist partly of snow and partly of muddy detritus, and represent a marked removal of the rock that has been broken up by frost. The heaps formed by snow-slides are conspicuous on the slopes of Triassic strata on the south shore of Sassen Bay (Pl. X., fig. 3). They also make mounds of angular blocks at the foot of the Carboniferous crags in the Smaland Ridge west of Green Bay, where they resemble dissected moraines along the mountain-side.

This action of penetrating water and repeated frosts along the margins of melting snow-patches leads to a rapid destruction of the rock. The process would naturally not be so effective in granite, with comparatively few joints to the square metre, as it is in schist or shale; but the burrowing downward of snow-patches into the ground, in a climate where alternate melting and freezing can take place, is a factor very clearly to be reckoned with.

The head of the snow-filled groove in which this action is taking place is naturally cirque-like. (Pl. X., fig. 4.) As water trickles into it from various sides, it becomes enlarged into a basin, open towards the descending mountainside. The snow in the floor of the basin receives infiltering water from above; it passes from the névé state, through névé-ice, into true glacier-ice. Α miniature glacier then occupies the basin that was primarily worked out by frost-action and by snow-slides. The opening of the normal cirque-stage has now been reached ; and glacial action assists in carrying off the detritus that is showered down from the growing cliffs above. Snow-slide action remains, however, an important factor, and works back the upper part of the basin in the mountain-wall. The cirque-cliff increases in height as it recedes towards the higher ground behind, while the floor at its foot is becoming lowered down the mountain-side through the denuding effect of the glacier and the running water under it. Comparatively small circues can generate considerable glaciers, and these, by removing the detritus and allowing new surfaces to be exposed, lead to the rapid enlargement of the hollow.

#### Illustrations of the Origin of Cirques.

A large part of the literature of cirques has been so well discussed by W. H. Hobbs<sup>1</sup> that it is unnecessary to review it here. Many persons, however, must have realized that the steep bounding wall in a cirque was formed by subaerial erosion, and mainly by frost-action, before the publication

<sup>&</sup>lt;sup>1</sup> "The Cycle of Mountain Glaciation," Geograph. Journ., 1910, p. 149. See also W. M. Davis, "Glacial Erosion in N. Wales," and printed discussion, Quart. Journ. Geol. Soc. London, vol. lxv (1909), pp. 281-350.

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of E. Richter's important paper in 1896. Richter' ably emphasized the fact that circues are associated with the horizontal working back of mountainwalls by frost-action, combined with the transporting action of glaciers generated in them, and are incompatible with the burial of a region under an ice-cap. They may, of course, also arise in any region where glaciation is local, and they are sometimes generated near the crests of dome-shaped or even peaked mountains, where frost-erosion has produced a hollow in which snow becomes sheltered through the year. The great circue on Nephin, Co. Mayo, is a familiar example. Mount Pyramid in Spitsbergen is excavated on the side towards Billen Bay by a single hollow formed by coalescing avalanche-grooves, which has escaped being a true cirque, through its inability to support a glacier on its steep and easily eroded floor (Pl. XI., fig. 5). F. Machaček<sup>2</sup> regards the glacier in the circue-floor as of the first importance. When this melts away, the cirque tends to become filled up; and the premature loss of the glacier leaves a cirque imperfectly developed. W. D. Johnson's view of the potency of the "bergschrund" in sapping the cirque-wall at its base is still much under discussion. It must be borne in mind that F. E. Matthes<sup>3</sup> and A. Penck<sup>4</sup> both ascribe the formation of the cliff mainly to the undermining action of frost within the bergschrund.

The origin of the hollow in which the snow begins to lie, so that the formation of a cirque becomes possible, was well recognized by Matthes,<sup>5</sup> who was the first to show clearly how snow-drifts may eat their way down into sloping ground. The passage from such "nivation" hollows to cirques has recently been studied by Hobbs.<sup>6</sup> He illustrates the hollows by photographs from the Yellowstone National Park, and accepts fully, in another of his thoughtful and systematic papers,<sup>7</sup> the subaerial origin of cirques. Sir Martin Conway,<sup>8</sup> who must, however, be numbered with those who question the efficacy of glacial erosion, supports the subaerial view of cirqueformation from his experiences in Spitsbergen. Maxwell H. Close,<sup>9</sup> moreover,

<sup>6</sup> Op. cit., Geograph. Journ., 1910, p. 154.

<sup>7</sup> W. H. Hobbs, "Characteristics of the Inland Ice of the Arctic Regions," Proc. Amer. Phil. Soc., vol. xlix (1910), p. 58.

<sup>8</sup> "An Exploration in 1897 of some of the Glaciers of Spitsbergen," Geogr. Journ, 1898, p. 142.

<sup>9</sup> "Some Corries and their Rock-basins in Kerry," Journ. R. Geol. Soc. Ireland, vol. ii (1870), p. 244.

<sup>&</sup>lt;sup>1</sup> "Geomorphologische Beobachtungen aus Norwegen," Sitzungsber. k. Akad Wiss. Wien, Bd. cv. (1896), Abt. 1, pp. 155, 163, &c., and "Geomorphologische Untersuchungen in den Hochalpen," Petermann's Mitt., Ergänz. Heft 132 (1900), p. 1.

<sup>&</sup>lt;sup>2</sup> "Geomorphologische Studien aus dem norwegischen Hochgebirge," Abhandl. d. k. k. geograph. Gesellschaft in Wien, Bd. vii (1908), p. 54.

<sup>&</sup>lt;sup>3</sup> "Glacial Sculpture of the Bighorn Mountains, Wyoming," 21st Ann. Rep. U. S. Geol. Survey (1900), Part II, p. 185.

<sup>4&</sup>quot; Glacial Features of the Alps," Journ. of Geol., vol. xiii (1905), p. 16.

<sup>&</sup>lt;sup>5</sup> Op. cit., p. 179.

long ago pointed out how corry-glaciers might be fed by snow drifted into pre-existing hollows.

The latest champion of the theory that circues have originated under ice-streams is E. C. Andrews,' who treats circues, however, merely as steps occurring in a glaciated valley-floor. He does not seem to have borne in mind the occurrence of cirques, almost as local accidents, cut out here and there on a wall moulded by general denudation. Yet this irregular distribution is a marked feature of the edges of our ancient plateaus and divides. The hollows of Upper and Lower Lough Bray are familiar instances near Dublin. In Spitsbergen, on sea-fronts where stepped valleys are out of the question, and on plateau-edges independent of any possible ice-stream, one may see the circues in process of development, each resembling a local centre of some corrosive malady. The remarks of E. C. Andrews, that "no observer appears to have seriously considered the possibility, or probability, that the cirque has been formed by activities now practically inoperative,"<sup>2</sup> is true enough. In the face of the circues that may be studied in glaciated regions in all stages of growth, it would be impossible to accept such a view seriously. It would be difficult, for instance, to regard those near the foot of the Matterhorn<sup>3</sup> as due to a past stage of Alpine glaciation.

In the plateaus of Spitsbergen some of the alcoves have originated on such steep slopes that they cannot have nourished actual glaciers. The frost has worked back the cirque-head, and snow-slides have carried away the detritus. The climber may sink in summer up to his knees in crumbled rock, sludgy with water, formed along the margin of the snow that gathers in their heads. But here and there, on gentler slopes, we may note the origin of cirques of more typical and basin-like form. Small or large, they are still developing as notches on the plateau-edge, and, by their recession, the plateau becomes ultimately cut up into arêtes. The protective snow-cap, so well emphasized by Garwood and by Hobbs, then ceases to be a possibility, unless precipitation becomes greatly increased. Such snow as now falls slips into the cirques, and generates localized glacial action.

The progress of the "cirque-disease," attacking a plateau from which the snow now recedes in summer, may be well seen in the interior of Dickson Land, as viewed from the heights above Cape Wijk (Pl. XI., fig. 6). In the view selected, numerous stream-grooves, formed by rills from melting snow, seam

<sup>2</sup> Op. eit., p. 265.

<sup>&</sup>lt;sup>1</sup> "An Excursion to the Yosemite, or Studies in the Formation of Alpine Cirques," Proc. Roy. Soc. New South Wales, vol. xliv (1910), pp. 302 and 305.

<sup>&</sup>lt;sup>3</sup> One of these is figured, from a photograph by W. F. Donkin, in G. Cole, "Open-Air Studies in Geology" (1895), Plate II.

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the wall of the plateau; and alluvium is carried in summer into the valleyfloor. The heads of three of these streams have notched the plateau a little more conspicuously than their neighbours. Nests of snow have been able to linger in them, and have worked out recesses year by year. The edge of the plateau is here viewed from a height of about 500 metres and a distance of 4 kilometres ( $2\frac{1}{2}$  miles). These incipient circues are already hollows of some magnitude. Behind them a much older cirque has penetrated the plateau, and has effectually reduced the area on which snow can gather during winter. As this erosive process goes on, arêtes and peaks will develop; and the plateau-landscape will give place to one of the Snowdonian or ordinary Alpine type.

A. Penck,<sup>1</sup> in his masterly survey of Alpine glaciation, looks back to a time when some regions were covered by continuous firm (névé) or glacier-ice, and here cirgues have not developed. He urges that cirgue-building requires a steep mass of rock above the snow-line, and rising high above the general field of névé. The névé, moreover, must be sharply divided by a marginal cleft. the bergschrund, from the wall of rock behind it. Penck, however, must have also had in mind the possibility of the development of a cirque-landscape, or "karling," on the edge of a great snow-dome or plateau-in fact, below the general snow-line of the district. The shelter given to snow as the cirque increases in depth, and the continued drift of snow into it from above, conspire to carry down the snow-line locally.

Richter<sup>2</sup> has contrasted the erosion-form of a niche originated by runningwater with that of one into which snow falls. He recognizes that true circues arise "in der Schneeregion oder ihr sehr nahe," and that the snow which collects in such hollows protects their floors from becoming funnel-shaped, like those of hollows eroded by running water. But he does not seem to consider the possibility that a funnel formed by summer-rills from melting snow may be converted into a cirque when snow slips into it from above, and that its winter type may ultimately prevail throughout the year, without the occurrence of a climatic change.

This seems to me to have been the case in Spitsbergen; and snow even now remains in hollows, when it has melted off the overlying plateau. Such snow is still developing the cirques.

#### ARID TYPE OF WEATHERING.

Where the plateau has not been dissected back from the margins of the Ice Fjord by any prominent stream of ice or water, the uniform type of weathering,

 <sup>&</sup>lt;sup>1</sup> Die Alpen im Eiszeitalter (1909), pp. 284-287.
 <sup>2</sup> Op. cit., Sitzungsber. k. Akad. Wiss. Wien, Bd. cv., Abt. 1, pp. 156 and 158.

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with denudation-grooves at fairly regular intervals, reminds one of the arid lands of Arizona (Pl. XII., figs. 7, 8). When the fringe of snow upon the plateauedge has melted back, the grooves run dry. Snow lies for a time in some of them, but is got rid of in many cases by a few sudden slides. Blocks loosened from the heights by frost, or even wind, occasionally fall down these grooves, raising clouds of dust, as if an explosion had occurred. It was delightful to find on an exposed plateau above Cape Wijk typical wind-etched stones, the " dreikanter" of desert lands. The surfaces of the talus-cones that reach back from the shore become also absolutely dry. The same is true of the surface of the tundra-land formed by the raised beaches, though the ground may be frozen, including plenty of solid water, at a depth of half a metre. The abundant vegetation on the cracked surface, including Salix polaris about half an inch high, and numerous flowering plants, obtains its moisture from the intermediate layer, into which a stick can be easily thrust, and along which a good deal of fluvio-glacial water finds its way in the neighbourhood of the delta-fans.

Here and there, on the arid mountain-walls, the coalescence of a few grooves has allowed of the formation of a larger hollow, the débris from which, as Richter pointed out in the case of circues in Norway, can be discharged over the surface of the névé in its floor.<sup>1</sup> Some of these, like the great hollow in Mt. Pyramid, may be clear from snow in summer (Pl. XI., fig. 5). If the hollow has been primarily excavated by the destructive action of a snow patch (p. 196), it may develop into a true cirque. On the seaward face of the Spitsbergen plateaus, such cirques resemble hanging valleys, not because the main fjord has been overdeepened, but because they have been worked back by frostaction faster than their floors could be eroded. As has been pointed out, they are still in process of formation, though the streams that run out of them in summer obviously tend to reduce their steep outer lips on the fjord-wall to ordinary valley-slopes, and to bring down their mouths to the local base-level of erosion. Some of these circues, occupied by glaciers in the Ice-Age, retain traces of ice-smoothing in the forms of their floors and outer lips, despite the action of the frost (Pl. XIII., fig. 9). As a rule, however, atmospheric weathering in Spitsbergen speedily removes such evidence.<sup>2</sup>

# Comparison of the Conditions of Erosion in Spitsbergen with those in Ikeland.

The conditions under which glacial and atmospheric erosion are taking place in Spitsbergen—a region where the Ice-Age is still passing—are very

 <sup>&</sup>lt;sup>1</sup> Compare G. H. Kinahan, "The Recent Irish Glaciers," Irish Naturalist, vol. iii. (1894), p. 236.
 <sup>2</sup> Compare E. J. Garwood, "Glacial Phenomena of Spitsbergen," Quart. Journ. Geol. Soc.

<sup>&</sup>lt;sup>2</sup> Compare E. J. Garwood, "Glacial Phenomena of Spitsbergen," Quart, Journ. Geol. Soc. London, vol. lv (1899), p. 688, and W. Salomon, op. cit., p. 307.

different from those that one would naturally associate with the waning of the Irish Ice-Age. Yet it is curious to reflect that the departure of our Ice-Age may also have occurred in a time of comparative aridity. We are aware that the uplift of north-western Europe generally, which ultimately allowed of the general growth of peat over regions now again submerged, brought continental conditions into lands at present modified by the proximity of the North and Baltic Seas. A high-pressure area maintained over the North Sea region and Friesland during winter would check the inflow of moisture-laden winds, Monsoon conditions on a mild scale would prevail, with rainfall over the British Isles limited mainly to the summer months, when the south-west winds would be admitted. This rainfall would maintain sufficient snow in the interior of Ireland to prevent the very rapid retreat of the glaciers from the lowlands, while the ice might have already vanished from the drier countries farther east. The total rainfall in Ireland might actually have been less than now, the peat being nurtured by the abundant waters soaking from glaciermargins into the extended tundra-land. This suggestion is merely put forward to show how difficult it is to reason as to meteorological conditions from the presence of extensive ice-masses or of a particular flora. It must be admitted that in the dry European epoch preceding the formation of the Ancylus-sea in the Baltic area, the climate of Ireland, if drier than now, must have remained oceanic in character when compared with that of Northern Germany (see also p. 207).

The dissection of the plateau-edges of Spitsbergen enables us to realize the dissection of the old plateau around Killary Harbour, where cliff-walls and cirques, now partly grass-grown and invaded by taluses, play so large a part in the features of the landscape. The cirque-walls remain still fresher in the Killarney region, and in the noble examples in the Comeragh Mountains in Co. Waterford. Such sculpturing may be referred to a late stage in our glacial epoch, extending in Ireland probably into times of human occupation. The immense part played by frost in the excavation of cirques in itself presupposes sun and warmth sufficient to melt the snow upon the mountain-domes and plateau-edges, and to allow of the penetration of water into the joint-planes of the rock.

It is interesting to remark that as far back as 1849—a very early date in the discussion of glacial phenomena in our islands—John Ball,<sup>1</sup> the explorer of the Atlas Mountains, read a paper before the Geological Society of Dublin, in which he observed that glaciers had occupied certain hollows in the Dingle Promontory and near Killarney. He concluded that these hollows had

 <sup>&</sup>lt;sup>1</sup> "Small Glaciers in Kerry," Journ. Geol. Soc. Dublin, vol. iv (1849), p. 151.
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remained as reservoirs for snow at a time when the climate was too mild to allow of more widespread glaciation. Such glaciation, moreover, if it had set in at a later date, would have removed their terminal moraines. "Whatever," he writes, "may have been the climatal condition of this country during any previous period, at the time when these small glaciers existed in Kerry, the mean temperature cannot have been excessively low." He thus, in effect, refers the cirque-glaciers to a late stage of what we now recognize as the glacial epoch.

#### BOULDER-CLAY.

The origin of boulder-clay has been much discussed, since Sir James Hall observed its relation to the striated rock-surfaces under it in 1812.<sup>1</sup> It has been generally agreed, however, in recent years that it represents material carried within the body of glaciers and pushed forward with the movement of the ice. The conception of a *moraine profonde*, ploughed up and dragged over the ground, has been considerably modified by observations in Greenland and elsewhere. Glaciers in Spitsbergen show, as Garwood and Gregory pointed out,<sup>2</sup> " a gradual passage from ice charged with morainic material into subglacial morainic material which has been saturated with water and frozen hard." The lower layers of a glacier of the arctic type may consist of stones and mud rather than of ice. Desiring, perhaps, to dissociate themselves from those who regard glaciers as powerful agents of erosion, the authors quoted seem to have gone to an opposite extreme. They attribute the intraglacial moraine to surface-materials pushed over at the end of an advancing glacier, and subsequently carried forward in the mass.

The enormous quantity of such material in the lower layers and its comparative absence from the surface would be enough to show that such an explanation could be applied only in special cases. A good deal of débris of course falls into marginal crevasses from hillsides and nunataks, and becomes at once taken into the lower part of the glaciers; but it is difficult to associate so limited a process with the darkening of these layers by stones and mud throughout a glacier several kilometres in width. The frostbroken rocks of Spitsbergen lend themselves admirably to glacial plucking. In many cases the ice has gathered into itself material that was already loosened on the preglacial valley-floor. In other cases one can hardly avoid the conclusion that blocks are being carried away wholesale from projections

<sup>&</sup>lt;sup>1</sup> "On the Revolutions of the Earth's Surface." Trans. Roy. Soc. Edinburgh, vol. vii (1815), p. 182.

<sup>&</sup>lt;sup>2</sup> "Contributions to the Glacial Geology of Spitsbergen," Quart. Journ. Geol. Soc. London, vol. liv (1898), p. 203.

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that still rise from a floor of rock. A glacier of the ordinary valley-type was visited during our excursions from the head of Advent Bay. It terminates between frost-weathered slopes under the south-east flank of Mount Nordenskiöld. On the surface, above its steep end-wall, the moraine-blocks are so abundant that one may cross the glacier without setting foot on ice. The arctic flora has actually invaded this moraine. A little higher up, the broad surface of the ice is almost free from stones, except for well-marked linear medial moraines. Though the blocks towards the melting ice-front are angular and cannot have travelled very far, it is difficult to believe that they all originated in material above the level of the ice. The crumbling hillsides of Cainozoic and Jurassic strata round about the glacier suggest how a true intraglacial moraine may arise from such rocks as the ice moves down and thrusts itself against and over them. F. Wahnschaffe<sup>1</sup> observes that the lower part of this glacier between Mount Nordenskiöld and Mount Hierta is "completely filled with coarse stratified detritus."

The abundance of intraglacial material in the broader glaciers is apparent on their melting margins. The great Nordenskiöld Glacier, which enters Billen Bay, may be studied from the raised beaches on which its south side has encroached. A stream arises here along the ice-front, while the more northern portion of the glacier enters the sea, where its margin becomes uplifted by flotation. The part of the ice-front exposed on land is dark with mud and stones, and in places the ice is concealed by a slope of huge boulders, falling over the face and banked up against it (Pl. XIII., fig. 10). These boulders are abundant on the surface above ; but they evidently appear there in large part through the melting away of the upper layers of the ice. The numerous blocks of granite, believed to be Archaean, have been derived, according to De Geer, from masses that are mostly concealed.<sup>2</sup> The melting along the glacier-edge must here be slow, and a large amount of material must be carried out into the bay, since no wall-like moraine is being constructed.

Since the ice in Spitsbergen breaks up readily on reaching the sea, "calving" in cascades of ice-blocks rather than in large icebergs, the submarine boulder-clays are no doubt deposited close against the shore. It is questionable if their characters, in that case, are very different from those deposited on land.<sup>3</sup> Small spiry icebergs arise from the Nordenskiöld Glacier, but they do not form a conspicuous feature of the bay.

<sup>&</sup>lt;sup>1</sup> "Die Exkursion des XL. Internationalen Geologen-Kongresses nach Spitzbergen," Zeitschr. d. Gesellschaft für Erdkunde zu Berlin, 1910, p. 649.

<sup>&</sup>lt;sup>2</sup> This moraine has been studied by E. J. Garwood, "Additional Notes on the Glacial Phenomena of Spitsbergen," Quart. Journ. Geol. Soc. London, vol. lv. (1899), p. 684.

<sup>&</sup>lt;sup>3</sup> Garwood and Gregory have raised questions as to this point. Op. cit., Quart. Journ. Geol. Soc. London, vol. liv., pp. 210 and 217.

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Admirable examples of the boulder-clays on land, stretching down into the sea, are now visible on either side of a former extension of the von Post Glacier (Pl. XIV., fig. 11). These boulder-clays in Tempel Bay, under noble cliff-faces of Carboniferous rock, have a remarkable similarity to those familiar throughout central Ireland. They result from the deposition of the intraglacial moraine as the glacier melted away, and they show how very differently various types of rock become abraded during the movement of the ice. The blocks of grev Carboniferous limestone have been rounded, and have received excellent striations. The sandstones show similar signs here and there, though many remain angular, and break up under atmospheric weathering along joints and bedding planes. The red granites, which are here probably derived from an unseen Archaean source, are rounded, but show no striations. Red shales are frequent, in flaky fragments, rounded in part and sometimes striated. They contribute, by their comminution in the ice, to a red clay which forms the basis of the moraines. Flints from the Carboniferous beds remain, however, completely angular. These features, as will be readily seen, are precisely those of the boulder-clay south of Dublin.

The recently deposited boulder-clay of Tempel Bay weathers into small spiky pinnacles and vertical cliffs, on the face of which the larger stones stand out (Pl. XIV., fig. 12). Some of the cliff-forms seem to result from frost-action along shrinkage-joints; others are the sides of kettle-holes, where the deposit has sunk, when some buried and residual ice-mass has melted away. These kettle-holes, now filled with water, are commonly associated with the moraines left by retreating glaciers, and have lately been discussed by R. S. Tarr<sup>1</sup> in examples where stagnating ice still remains. J. R. Kilroe<sup>2</sup> has aptly attributed certain lakelets in the glacial deposits of Ireland to the former presence of residual ice-blocks; and Lough Doo and the associated pools above Pomeroy, in the county of Tyrone, no doubt originated in the same manner, among gravels melted out of a glacier of the ice-sheet type.

The occurrence of fairly pure ice under a ground-moraine which has been thrust up over it is strikingly evident in Spitsbergen on Cora Island in Ekman Bay. As this ice melts, sinking occurs locally in the boulder-clay, and kettle-holes arise in it freely. These remain in places from which the ice has already vanished. The history of the mass of residual ice which now covers the west flank of Cora Island has been traced out by De Geer<sup>3</sup> from

<sup>&</sup>lt;sup>1</sup> "Some Phenomena of the Glacier Margins of the Yakutat Bay Region, Alaska," Zeitschrift für Gletscherkunde, Bd. iii. (1908), p. 94, and "Yakutat Bay Region, Alaska," U. S. Geol. Surv., Professional Paper 64 (1969), p. 63.

<sup>&</sup>lt;sup>2</sup> Memoir on the Geology of the District around Londonderry, Geol. Surv. Ireland (1908), p. 60, and *ibid.* around Belfast, 1904, p. 99.

<sup>&</sup>lt;sup>3</sup> Guide de l'excursion au Spitzberg, XI<sup>e</sup> Congrès Géol. internat. (1910), p. 16.

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1882 to 1908. The Sefström Glacier to the west—a sheet 6 kilometres broad at its sea-front-advanced between 1882 and 1896 so as to cover Cora Island and almost to reach the opposite shore of Ekman Bay. A slight recession had occurred by 1898. By 1908, a retreat of 2 km. had taken place in that part of the front which stretched south-west from Cora Island; but a large mass of residual ice remained resting on the island. This was accompanied by a moraine of reddish mud and marine shells, which originally must have been largely intraglacial-that is, picked up and pushed forward in the body of the ice. Though reduced in size, the "ice-island" remained conspicuous on the west side of Cora Island when we studied the locality under De Geer's guidance in 1910 (Pl. XV., fig. 13). The most noteworthy feature was the occurrence of much of the red moraine matter on the back of the tabular relic of clear ice. Shearing movements in the interior of the glacier during its advance must have carried up the intraglacial moraine over a part of the ice that was practically free from débris. Similar movements no doubt had brought the ice on to the low island, as an overthrust portion of the glacier, the base of which, in traversing the sea-floor, lay 50 metres (say, 25 fathoms) below the surface of the water. The shelly clay thus deposited on Cora Island is believed to have come from the sea-floor; but I cannot help thinking that it may equally well have been carried across from the raised beaches on the western shore of Ekman Bay. Similar red clay can be seen in places in the lower part of the raised beach at Cape Wijk in Dickson Bay, resting directly on Carboniferous limestone.

In any case, transport has been effected across an arm of the sea about 4 km.  $(2\frac{1}{2} \text{ miles})$  wide and the material has clearly been raised above the position that it occupied during transit. The hummocky boulder-clay now lies in part 30 metres above the sea. An uplift of mud, pebbles, and shells through a height of at least 200 feet was proved by Garwood and Gregory<sup>1</sup> in the case of the Ivory Glacier, which descends on to marine deposits in Agardh Vale in eastern Spitsbergen. The interesting occurrence on Cora Island has been discussed by G. W. Lamplugh before the British Association at Sheffield in 1910, and its main features are described by Wahnschaffe.<sup>2</sup>

The gravels with marine shells that are banked up to heights 1,500 feet above the sea against the spurs of the Dublin Mountains have been often attributed to subsidence of the land during the glacial epoch. I have myself urged<sup>3</sup> that they may represent the material of pre-glacial raised beaches

<sup>&</sup>lt;sup>1</sup> Op. cit., Q. Journ. Geol. Soc. London, vol. liv., p. 205.

<sup>&</sup>lt;sup>2</sup> Op. cit., Zeitschr. Gesell. Erdkunde, Berlin, 1910, p. 651.

<sup>&</sup>lt;sup>3</sup> "County Dublin, past and present," Irish Naturalist, vol. (1892), p. 94.

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affected by the subsequent invasion of the ice. But it becomes necessary to account for the absence of such beaches from the interior of the country, or at any rate of traces of them churned up with glacial detritus, and this can only be done by supposing that ice had already accumulated in the lowlands in sufficient quantity to bank out the sea during the epoch of submergence. Maxwell H. Close<sup>1</sup> justly insisted that the marine shells were brought along with the gravels, and that the animals to which they belonged lived and died somewhere else; and he invoked floating ice as the agent of their accumulation. British geologists, however, outside the south-east of England-that is to say, geologists working in areas where glacial phenomena are of high importance-have been more and more inclined to the view that such highlevel gravels with marine shells have been uplifted by movements of glacierice when it became pressed against rising ground. Whether the Irish Sea ice flowed, as is very probable, over a raised sea-floor, or whether it displaced the sea before it as it advanced, it must have gathered a considerable quantity of yielding material into its lower layers. Such an instance as that of Cora Island goes far to convince the observer as to the power of movements within the ice. If we witness even 100 feet of uplift in recent times, 1,000 feet seems nothing improbable during the climax of the Ice Age. Local subsidence may still be invoked to account for special cases, and the wellknown deposits under Macclesfield, now concealed, but occurring at a general height of 450 feet above the sea, may represent a raised mid-glacial beach over which ice subsequently rode.<sup>2</sup> The present height above the sea, moreover, of the deposits on the Dublin Mountains is not likely to be precisely that at which they were laid down out of the ice. The slope of the lowland may have been eased for the advancing glacier. Yet few who have been fortunate enough to visit Scandinavian and Arctic lands will see anything improbable in the views of P. F. Kendall, G. W. Lamplugh,3 and others, who have urged that the Irish glacial gravels with marine shells have been raised through the body of advancing ice.

On this view, which many of us have been slow to accept, the higher deposits would probably be of later date than those nearer the sea-level. The ice still remaining on Cora Island may be taken as a model; it reached the obstacle formed by the island, and the intraglacial material from lower levels was pushed up over its back.

The melting of the ice below has left this material, the red shelly

<sup>3</sup> "Geology of the country around Dublin," Mem. Geol. Survey (1903), p. 45.

<sup>&</sup>lt;sup>1</sup> "The Shell-bearing Gravels near Dublin," Geol. Mag., 1874, p. 197.

<sup>&</sup>lt;sup>2</sup> See discussion by T. J. Pocock, "Geology of the country around Macclesfield, Congleton, Crewe, and Middlewich," Mem. Geol. Survey, Eng. and Wales (1906), pp. 83-87.

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boulder-clay of the island, to settle down with the characteristic kettlehole structure (Pl. XV., fig. 14, and Pl. XII., fig. 7). Escaping streams have here and there washed the clay, leaving "glacial sands and gravels" as a residue. The limit reached by the ice on the low limestone surface of the island is marked by a distinct margin to the boulder-clay, and along this a stream runs, with pebbles in its floor (Pl. XVI., fig. 15). The clay itself has weathered like that of the von Post Glacier, and presents steep faces on its hummocky surface. In the Dublin district, the fragmental condition of the shells has always been appealed to as showing that they could not have originated in place. Yet here, on Cora Ireland, we have convincing evidence that a loose marine deposit may be moved forward, perhaps in a frozen state, with very little injury to the included shells. These shells include Mya truncata, Pecten islandicus, Saxicava arctica, Mytilus edulis, Astarte borealis, Tellina calcarea, and, more rarely, Mya ovalis, Modiola mytiloides, and Yoldia arctica. A few gastropods, mainly Buccinum, also occur. Perfect specimens of these shells abound, and hundreds of the bivalve molluscs may be collected in which the valves remain in their natural positions in regard to one another, even though the shell has gaped and become filled with clay. Lithothamnium forms a large portion of the deposit, just as it does in the post-glacial raised beaches, which rise to some 350 feet above the sea on the margins of the lce Fjord. In the moraine of Cora Island, the colouring of the shells is excellently preserved; but this is also true of many of the raised beaches of the Ice Fjord.

#### FLUVIO-GLACIAL DEPOSITS.

In all cases in the Ice Fjord in Spitsbergen where glaciers have retreated up their valleys, the deposits of the rivers that flow copiously from them form a stony alluvium, and in places large deltas extend over the raised beaches and out into the sea. A well-developed delta, with hooks and islets, thus forms the flat land at Cape Wijk in Dickson Bay. There is much to justify the view that extensive fluvio-glacial deposits may be forming at one point, while glacial advance is taking place at another, and that such deposits afford no clue as to general climatic conditions in the past (Pl. XVI., fig. 16).

Many of the stones in these deposits remain very angular, much as they have fallen from the ice or from the mountain side. The rivers that flow from the glaciers have occasionally cut ravines in the rock-floor since the retreat of the ice. A notable feature of this kind, accompanied by an older outlet-channel, which is now abandoned, occurs on the west shore of Green Bay.

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# TALUS-BANKS RESEMBLING MORAINES.

Owing to the extent of surface exposed to frost-weathering, enormous accumulations of tallen blocks occur on the lower slopes in Spitsbergen. Where a stagnant or retreating glacier occupies the hollow, these taluses become banked up against the ice, and are ultimately left as terraces, with a steep face towards the valley. The old Savoyards would have called these moraines. using the term in its original wide sense; but they owe their form merely to the accident that they were prevented from encroaching, like ordinary fantaluses, on the valley. Their material is derived from the crags above them. and has not been moved forward or modified by the ice. Such talus-terraces. when the ice has entirely passed away, may be mistaken for moraines, and may give an exaggerated idea of glacial activity in the district. Unlike lateral moraines, they may be formed on one side only of a valley, where the crags happen to be more continuous. An Irish example of this kind may be seen on the hillsides between Mallaranny and Achill Sound in Co. Mayo, where, in addition, ordinary moraines have melted out of the ice as it expanded over the lower ground. In Spitsbergen, a huge bank of angular blocks of sandstone, providing very troublesome walking, has gathered along the west slope of the valley between the American Coal-mine and Mount Nordenskiöld, south of Advent Bay. There is no doubt that the glacier referred to on p. 201 contributed to the regular grouping of this detritus, at a time when the ice formed an obstacle along the centre of the vale.

#### IRELAND AND INTERGLACIAL EPOCHS.

The advance or retreat of glaciers in Spitsbergen seems to depend on slight fluctuations in precipitation, in a country where the total snowfall is not considerable. The von Post and Sefström glaciers, moreover, have retreated, while the Wahlenberg glacier, also descending on the Ice Fjord, has simultaneously advanced. Under such circumstances, though the maximum of the ice-age has been passed in Spitsbergen, it would be impossible to assert that the region has entered on any general interglacial epoch. Were the mean annual temperature to rise, precipitation in the form of rain might aid in clearing away the ice, and "interglacial" or post-glacial conditions would be emphasized. On the other hand, if precipitation could be reduced by external changes, leading to a reduction in the supply, but leaving the temperature the same as it is at present, the loss of ice by melting in summer might soon outbalance its winter growth. Dry "interglacial" conditions would then set in.

In judging of the reality and extent of interglacial episodes in Europe, we

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must remember that the conditions in northern Germany and the Baltic region, owing to mere oscillations of level and consequent spread or reduction of the marine area, have probably changed more frequently during the glacial epoch than have those in Ireland, the European outpost against the Atlantic winds and waters. Owing to greater facilities for precipitation, ice may have been maintained continuously in Ireland by winter accretion, although it had retreated from areas farther to the east. A large "ice-island," a low-pitched dome of residual ice, may have remained across central Ireland, marking the epochs of oscillating temperature only on its margins. Hence it is quite possible that the evidence of interglacial epochs may be very slight in Ireland. The raised tundra-land, moreover, on which faunas and floras might have left their relics, has been submerged by the downward movements of the European margin in post-glacial times.

The best-established evidence of a pause in the glaciation of Ireland is of course to be found in those cases where the Scottish ice, or the Irish ice of the continental or ice-cap type, has retreated, while the same ground has been traversed by local glaciers afterwards. The rapid extension of glaciers arising from local mountain-groups cannot have occurred simultaneously with the withdrawal of the larger ice-masses. It seems difficult to find any name for such an interval, whether it was promoted by warmth or by mere dryness, than that familiar to continental workers. The conditions for the time were surely "interglacial."

#### DESCRIPTION OF PLATES.

(All the figures are from photographs by the author.)

#### PLATE IX.

#### Fig.

- 1. Typical glacial landscape of the Ice Fjord, Spitsbergen. The Kjerulf Glacier entering Safe Bay.
- 2. Edge of plateau above Cape Wijk, showing snow-line, with rill-grooves from melting snow passing into avalanche-grooves.

#### PLATE X.

- 3. Mounds of mingled snow and frost-broken detritus, formed by snowslide action. Raised beach below. Near Mt. Marmier, S. shore of Sassen Bay.
- 4. Head of alcove excavated by frost and snow-slide action. Triassic strata above Cape Wijk, Dickson Bay.

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# PLATE XI.

- Fig.
  - 5. Hollow excavated in Mount Pyramid, Billen Bay, with fan-talus covering raised beach at its foot.
  - 6. Incipient cirques forming in plateau in Dickson Land. Snow-flecked summer surface of the plateau in the distance.

# PLATE XII.

- 7. Arid type of weathering. Carboniferous strata on Mount Capitolium, from shelly moraine of Cora Island, Ekman Bay.
- Arid type of weathering. Carboniferous strata with gypsum, face of Mount Tempel, entrance to Sassen Bay.

# PLATE XIII.

9. Cirque in plateau edge, south of Advent Bay.

10. Intraglacial material in terminal face of Nordenskiöld Glacier, Billen Bay.

# PLATE XIV.

- 11. Boulder-clay left by recession of the von Post Glacier, Tempel Bay.
- Details of boulder-clay left by recession of the von Post Glacier, Tempel Bay.

# PLATE XV.

- 13. Residual ice and moraine left on Cora Island, Ekman Bay, by recent recession of the Sefström Glacier. The dark shelly moraine is seen resting on the island on the right and on the ice-mass on the left.
- 14. Shelly boulder-clay with kettle-holes, Cora Island. The Sefström Glacier fills the background.

#### PLATE XVI.

- 15. Edge of the shelly boulder-clay abutting on the Carboniferous limestone ground of Cora Island, with formation of small outwash deltas. Mount Capitolium behind.
- Fluvio-glacial delta, Cape Wijk, Dickson Bay. A melting snow-patch lies in the foreground.



Fig. 1 The Kjerulf Glacier entering Safe Bay.



Fig. 2. Edge of plateau above Cape Wijk. Cole. Glacial Features in Spitsbergen.

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Fig. 3. Mounds produced by snow-slide action, Sassen Bay.



Fig. 4. Head of alcove above Cape Wijk. Cole, Glacial Features in Spitsbergen.

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Fig 5. Hollow excavated in Mount Pyramid, Billen Bay.



Fig. 6. Incipient cirques on plateau in Dickson Land.

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Fig. 7. Arid type of weathering, Mount Capitoluim, from Cora Island.



Fig. 8. Arid type of weathering, Mount Tempel.

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Fig. 9. Cirque in plateau-edge, south of Advent Bay.



Fig. 10. Intraglacial material in Nordenskiöld Glacier.

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Fig. 11. Boulder-clay left by the von Post Glacier.



Fig. 12. Boulder-clay left by the von Post Glacier.

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Fig. 13. Residual ice and moraine on Cora Island.



Fig. 14. Shelly boulder-clay with kettle-holes, Cora Island. The Sefström Glacier beyond.

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Fig. 15. Edge of boulder clay against limestone ground, Cora Island.



Fig. 16. Fluvio-glacial delta, Cape Wijk Cole. Glacial Features in Spitsbergen.

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### VI.

# ON SOME IRISH MALDANIDAE. By IVAR ARWIDSSON. PLATES XVII-XIX.

#### Read MAY 8. Published SEPTEMBER 4, 1911.

IN 1909 I received, through Mr. R. Southern, of Dublin, a small collection of Irish Maldanidae, belonging to the Irish National Museum, for description. The collection contained only a few determinable species—those which are hereafter discussed. Amongst these are two which, though not quite unknown before, have not been previously described. In addition, the collection contains Praxillura sp., from the south coast of Ireland (Station R. 30; 8, p. 127); Petaloproctus sp., from the west coast (W. 115; 10, p. 170); a species which is possibly near akin to Isocirrus, from the same locality as Praxillura; Leiochone sp. [clypeata?], from the west coast (W. 115; 10, p. 170, and L. 296-L. 300; 6, p. 41) and the east coast (S. 166; 6, p. 69); Leiochone sp. [cirrata-borealis-group], from the south-west coast (S. R. 172; 6, p. 84, and S. R. 590; 9, p. 156); Praxillella sp. [gracilis-group; cf. 5, p. 190], from the the south-west coast (S. R. 16; 10, p. 165); Euclymene sp. [a large species], from the south coast (R. 30 and R. 31; 8, p. 127); and in addition to these, at least four species, all belonging to the Tribus Euclymenini (R. 31; 8, p. 127; S.R. 5; 6, p. 64; S. 273; 7, p. 102; Kingstown-Dalkey, 14.6-22m. [20/7, 1907]).

### Nicomache (Nicomache) maculata n. sp.

(Plate XVIII., figs. 13–19; Plate XIX., figs. 27–30.)

"Nicomache lumbricalis" (Fabricius)," Cunningham and Ramage (1, p. 678, fig. 41), and Michaelsen (4, p. 39); cf. 5, pp. 99 and 95.

Specific Diagnosis.—The anterior part more or less distinctly speckled; especially conspicuous is one rounded spot outside each nuchal organ, and one or more transverse bands of colour on the back of the fore-part. Ocelli are present. Twenty-two setigerous segments and one (as a rule quite) achaetous posterior segment. The cup-shaped section at the hindmost extremity is short, and but little longer on the ventral side than on the back. The anal cirri are not characterized by different sizes. Nephridia in setigerous segments 6-9. The front part of the body is not particularly strong in glands—at any rate not the hinder part of the segments in this region; on the hinder segments R.I.A. FROC., VOL. XXIX., SECT. B. [2 G]

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distinct glandular bands on the back between the parapodia, which bands more and more completely encircle the body towards the hinder part, and also on the posterior achaetous segment. Straight spines on the three foremost setigerous segments. Uncini of the setigerous segments 4-5 (- 6) considerably reduced, and without or with only very weak hair. The fully developed uncini, whose inner and under contour is not bent out, have some hairs and up to seven teeth. The anterior capillary setae have from the very first setigerous segment weak side-teeth, which towards the hinder part increase somewhat in strength. The long under setae, which have only traces of side-teeth, exist (in individuals which are not, or in any case not fully, sexually developed) from one to three in number on the fourth to the twentysecond setigerous segments. The posterior capillary setae chiefly with rather broad borders—which on the whole, however, grow smaller towards the rear—and not particularly long points. Tubes rather thin, and somewhat flattened and closed up.

Colour.—The anterior part as far as the third setigerous segment is more or less strongly speckled with brown, but further behind the spots decrease rapidly; and moreover, the same segments on the ventral side, at least towards the posterior region, are speckled extremely little or not at all. The more or less varied distribution of the spots is shown in figs. 13-15. Especially conspicuous are the transverse bands and the strongly marked spot outside each nuchal organ. In a very light-coloured individual from Blacksod Bay there are only these last-named two spots, and a band of colour on the posterior part of the head. Another individual from the same locality has the anterior part of the head very light-coloured. Here are found the two spots on the side, but else only one in the middle of the anterior part; this latter can be distinguished as a rule in the more strongly coloured individuals.

Cunningham and Ramage (1) write as follows concerning this species, which they have obviously seen:—" The dorsal surface of the first few somites is abundantly spotted with red and white." (Pl. 47, fig. 41.)

*External Structure.*—As in my earlier descriptions of Nicomache-species (5), which are of course very much like one another in many cases, I can express myself very briefly as regards the external structure of the body. Rather few ocelli are found on either side of the front upper part of the head, and they are seen best on the more faintly coloured individuals (fig. 15). The nuchal organs, which can be clearly seen in fig. 13 (here drawn in a somewhat different way from that adopted in my earlier figures), are rather long and distinctly bent.

The seven complete individuals observed have all 22 setigerous segments and one posterior achaetous segment. Of the 15 other posterior portions observed, 11 are normally developed, while the remaining 4 have capillary

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setae on either side of the hindmost segment, which is usually free from setae (fig. 16). On three individuals capillary setae are developed on the left-hand side, and on one on the right-hand side; one of the first set comes from Blacksod Bay, while all the rest are from Howth.

The cup-shaped section at the hindmost extremity is rather short, and but little longer on the ventral than on the dorsal side (fig. 16). The majority, at least, of the anal cirri are like fingers, and are of approximately the same length; but they appear to be somewhat shorter towards the dorsal side. Besides these, however, there occur, except in the case of the largest individuals (fig. 18), one or more smaller cirri between the larger ones. Of these smaller cirri those are particularly noticeable which are almost always found developed upon both sides or upon only one side of the ventral nervecord; often these are merely indicated by a little fold; in the individual represented in fig. 18, even these are absent. The numbers of cirri found in all the individuals investigated are set forth in the following table :---

Nos. 1-8 (all small ones) are from Blacksod Bay, the others are from Howth.

No.	Number of cirri, with the exception of the smaller ones near the ventral nerve-cord.		Number of cirri adjacent to
	(a) Medium size.	(b) Distinctly small ones are among the larger.	the ventral nerve-cord.
1.	18	1	2
2.	20	traces of 1	traces of 2
3.	16	traces of 1	2 (very small)
4.	18	. 2	traces of 1
5.	17	1	traces of 2
6.	16 <sup>1</sup>	—	1
7.	171	—	2 (very small)
8.	181		traces of 1
9.	19	—	2 distinct ones
10.	18	2 of medium length	l of medium length to the left
11.	16	1 (small)	2 (one being quite short)
12.	19	—	2 rather long ones
13.	c. 19	—	1
14.	17	-	
15.	18		1 (short)
16.	17	2 (small)	1 (short)

<sup>1</sup> In these three individuals, in particular, the highest cirri are small on the whole.  $[2\ G\ 2]$ 

The area within the cirri does not appear to lie very deep, and is, moreover, only slightly oblique. Nephridia occur in the sixth to the ninth setigerous segments.

Epidermal Glands.1-The anterior part as far as the fourth setigerous segment is plentifully furnished with glands (fig. 19). Especially noticeable are the rings in front of the parapodia,<sup>2</sup> and the glandular spots on the underside of the first setigerous segment, which occur as usual in a long-extending form, but are here (because of some other system of preservation ?) faint, and a well-marked protracted glandular spot immediately within each nuchal organ, and a smaller spot outside the foremost part of the same organ (fig. 17). On the fourth to the seventh setigerous segments chiefly are to be found anterior glandular rings, which, however, decrease in strength backwards. On the ventral side of the fifth to the eighth setigerous segments, immediately beneath and in front of the lowest uncini, are to be found small and highly characteristic round bundles of glands most distinctly on the sixth setigerous segment (fig. 19). On the eighth and following setigerous segments, the glands round the parapodia, and especially between those on the dorsal side, are weak. Towards the posterior parts these glands increase, and gradually (distinctly from about the twelfth setigerous segment) there appears a distinct glandular ring in the hindmost part of the segment. It increases backwards, and is found even on the hindmost segment, which is usually free from setae (fig. 16). The outer side of the posterior cup-shaped section is to some extent furnished with glands, especially towards the posterior parts, while the inner side is only slightly provided with glands. Finally, such are entirely lacking on the cirri and on the area within the cirri.

Setae.—The spines on the foremost three setigerous segments are straight and rather coarse (fig. 27). As a rule, they occur singly in each parapodium; but double ones have sometimes been observed on either side of the second and third setigerous segments.

On the fourth setigerous segment begin the uncini, which here and on the adjoining segments are moderately open (fig. 28). The number of uncini on the fourth to the twentieth setigerous segments of a large individual from Howth, which has received special investigation in the matter of setae, is as follows: 4, 5, 7, 8, 12, 13, 16, 15, 14, 13, 12, 10, 12, 12, 12, 13, 14. On another large individual the nineteenth to the twenty-second setigerous segments have the following number of uncini: 15, 15, 16, 16. The number of teeth

<sup>&</sup>lt;sup>1</sup> All observations about epidermal glands refer exclusively to such as have been coloured with iodine green; cf. Arwidsson (5).

<sup>&</sup>lt;sup>2</sup> In a number of individuals, probably those preserved in some other way, it is precisely the glands on the posterior part of these segments that are most conspicuous, particularly on the under state.

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in fully grown individuals<sup>1</sup> is  $2-3^{4-5}$ ,  $(3-)4^6$ ,  $5-6^{7-10}$ ,  $6^{11-19}$ ,  $5-6^{20-22}$ ; a seventh tooth can be traced on the fourteenth segment and perhaps on the adjoining segments.

On the fourth and fifth setigerous segments the upper uncini at least lack bristles; and accordingly it is not till the fourth seta reckoned from above, that bristles appear on these segments in the large individual investigated. On the seventh setigerous segment no uncinus lacks bristles, but even on the sixth setigerous segment the two or three uppermost uncini lack bristles, or have only very feeble ones.

The fully developed uncini (fig. 29) have their lower contour perfectly even.

The points of the anterior capillary setae have, even so early as the first to the third setigerous segments, distinct though slight side-teeth; and these afterwards increase somewhat, although they never perhaps become quite as large as in Nicomache minor Arwidsson, whose setae they greatly resemble. The long capillary setae underneath, which may be found in the fourth to the twenty-second setigerous segments, have all but imperceptible traces of sideteeth; but so much of them one can see that one can determine that they stand somewhat more closely towards the outer point of the setae. On the fourth setigerous segment, for instance, two such setae have been observed, and on the sixth and seventh setigerous segments three, one in each case being particularly long. The posterior capillary setae have, on the three foremost setigerous segments, rather broad borders, often of the same size on each side; towards the posterior regions one border at least may diminish quite distinctly, but, as fig. 30 shows, there may be found here also two rather broad borders of equal size. The points of these setae do not appear to be particularly long: in any case such have not been observable in the material at the disposal of the writer. As usual, the points are shortest on the foremost segments.

Size.—The largest individual from Howth attains a length of 45 mm., as compared with a breadth of 1.2 mm. The largest individuals from Blacksod Bay are considerably smaller.

Sexual Maturity.—The large individual just mentioned is a 3, taken 6th October, 1909, and then at least near sexual maturity.

Tubes.—Tubes observed from Blacksod Bay are formed chiefly of small, light-coloured grains of sand, amongst which may sometimes occur the shells of small mussels. These are—partly at least—closed up, somewhat winding, somewhat flattened tubes, and are provided with grains of sand all the way round. The outer diameter of a measured tube is 2.6 mm. as compared with an inner diameter of 1.0 mm.

<sup>&</sup>lt;sup>1</sup> For the system of notation used see my earlier treatise (5).

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Notices of Finds.—Stella Maris Bay, Howth, East Ireland, at least 10 individuals, of which 3 are perfect. Feorinyeeo Bay, Blacksod Bay, Station No. W. 116 (10, p. 170), West Ireland, at least 11 individuals, of which 4 are complete.

Information about Earlier Finds.—Evidently Cunningham and Ramage (1) have taken this species in the Firth of Forth. They write as follows about it: "Commonly found among Laminarian roots, also occasionally under stones" (see also 5, p. 99). But also the new species which I formerly (5, p. 95) thought I could establish from Heligoland in accordance with Michaelsen's description (4, p. 39) is plainly identical with Nicomache maculata.

Regeneration.—Howth: 1 anterior setigerous segment: 2; 2 anterior ditto: 1; and 1 posterior ditto: 1 individual. Blacksod Bay: 1 anterior setigerous segment: 2; 8 posterior ditto: 1 individual.

#### Leiochone sp.

From Galway Bay, in the West of Ireland, or, more precisely, Station A. 124 (7, p. 94), or S.W. of 2nd buoy of Margaretta Shoal, 18 m., comes an individual, small, complete, but regenerated in both its anterior and its posterior regions, which, so far as one can gather from the investigation of such scanty material, approximates very closely to *Leiochone polaris* (Théel) (5, p. 150). The purely Arctic distribution of the latter species, however, which is not known even from the most northerly parts of Norway (5, p. 155), renders it improbable that the present species is identical with the one mentioned. The investigation of fuller material is the necessary preliminary to settling this question.

The individual in question, like *L. polaris*, possesses 19 setigerous segments and probably 3 hinder achaetous segments. At any rate, two of the last-named can distinctly be observed, and behind these there is room for one more. The ventral anal cirrus is distinctly developed. The regenerated anterior region embraces 3 setigerous segments and is  $2\cdot4$  mm. long; the fourth to the eighth setigerous segments are normally developed and measure  $4\cdot5$  mm.; the regenerated posterior region measures 4 mm. in length. No ocelli can be discerned, which of course does not preclude the possibility of their being found in the fully developed head. The epidermal glands, on the whole, resemble those in *L. polaris* (5). The following divergences, however, have been noticed. The stronger glands forwards on the fourth to the sixth setigerous segments diminish more rapidly behind the parapodia, whereas the more faintly coloured ones (cf. 5) in the hinder part of the segments are quite close together, especially on the fourth setigerous segment, in the hinder part of which they form a distinct band; the seventh setigerous segment, on the other

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hand, is quite free from glands at the back. The two obliquely extended spots of glands on the front upper part of the eighth setigerous segment (5, fig. 118) are here very straight, which may of course be connected with the fact that, in the individual in question, this segment is much extended and also of more even breadth, only tapering off somewhat in the very front part. The number of uncini on the 19 setigerous segments, of which, however, only the fourth to the eighth are fully developed to the normal extent, is as follows: 1, 2, 2, 4, 4, 4, 3, 3, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2.

In connexion with this Leiochone species it may be mentioned that one individual of the Leiochone species earlier cited, which is near akin to or is identical with *L. clypeata* Saint-Joseph, possesses a fully projecting proboscis, a thing which I for my part have never before had the opportunity of observing in any species of this genus. This completely visible proboscis now shows that the papilliferous part is developed all round, although it is shorter forwards, it is true; Saint-Joseph (**3**, p. 140), speaking of *L. clypeata*, says: "une trompe globuleuse très vasculière." In an earlier paper (**5**, p. 143), chiefly with regard to the conditions prevailing in *L. borealis* (p. 157)—in which, however, as mentioned, I have never had occasion to notice a completely projected proboscis—I have conceived the papilliferous part of the proboscis as almost vanishing in front of the mouth within the limits of the tribus Leiochonini: this conception, therefore, needs a certain amount of modification. Possibly in respect of proboscis-structure, as in several other respects, the various Leiochone species are essentially dissimilar.

### Praxillella affinis (Sars) Arwidsson.

Of this species—formerly known only from Scandinavia (Kattegat and the Bergen region)—there are two mutilated individuals from the south coast of Ireland, or, more precisely, Station R. 31 (8, p. 127), or 6 miles S.E.S. of Mine Head, 53 m. Of one individual there remain the third to the eighth setigerous segments, of the other the third to the seventeenth. Besides these there is a posterior extremity, possibly belonging to one of the foregoing. All the parts correspond very exactly with Scandinavian individuals (5). Amongst other things are found the specially developed capillary setae on the tenth and the eleventh setigerous segments.

#### Genus Caesicirrus n. gen.

Generic Diagnosis.—Nuchal organ of medium length. Distinct head borders. The papillae of the proboscis are low or altogether absent. Segment with collar is absent. The parapodia of the eighth setigerous segment in the hinder part of the segment. There are distinct posterior achaetous

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segments, and behind these a callus-shaped ring and at the hindmost extremity a cup-shaped section. The ventral cirrus, which is the longest, and the longer cirri, which are symmetrically arranged among the other anal cirri, have undivided tips; the shorter intermediate cirri have a lobate point. The anal cone, the anal papilla of which is drawn out like a finger, is low and lies in the bottom of a funnel-like depression. The cephalic plate has distinct glands, and the anterior segments distinct glandular bands. The uncini of the first to the third setigerous segments are not particularly strong, and lack bristles, and are, moreover, more or less transformed and usually stand singly in each parapodium: the neck of the fully developed uncini is inwardly distinctly constricted: the bristles join together under the big tooth. The anterior capillary setae have borders that are either faint or vanishing and a distinctly marked pencil of bristles. The posterior capillary setae have quite narrow borders and smooth points. Tubes free, straight, and rather thin.

Cunningham and Ramage (1, p. 679) figure, under the name of Axiothea catenata, a species which has not hitherto been at all well known. In an earlier treatise '5, p. 220) I have considered the possibility that the authors named have, in figuring the species in question, left out a segmental limit somewhere just before the parapodia of the eighth setigerous segment, and have thus found a certain resemblance to the Euclymene drochachiensis (Sars) described in detail by me. In the Irish collection now under consideration, however. I have certainly rediscovered Cunningham and Ramage's species, which exhibits such very remarkable phenomena that I will not increase the indefiniteness of the genus Euclymene Verrill by attributing the above species to this genus, which is assuredly very indefinite in its range, but must for this species establish the above-named new genus Caesicirrus. This new genus, however, is quite certainly nearly related to Euclymene: in other words, my diagnosis of Tribus Euclymenini must be widened so as to include forms with a long eighth setigerous segment, having parapodia situated in its hinder part. When I tried to define the Tribus named, no such form was known : in this connexion may be compared the species which I mentioned, but did not name (5, p. 243), from East Greenland, which species seems to lack a limit between the seventh and the eighth setigerous segment. That species also, as I then took occasion to observe, falls outside the Tribus Euclymenini as then defined by me, though it stands very near it of course. Perhaps it may be closely related to the species now under discussion, since its eighth setigerous segment seems to have more in common with the posterior long segments than with the anterior short ones.

The most distinctive characters of the genus Caesicirrus are plainly the

appearance of the eighth setigerous segment, the division of the anal cirri into long undivided ones, and short ones lobate at the point, and the prolonged anal papilla.

The nephridial pore is somewhat under the rows of uncini, and in a line with or slightly in front of these. The neck of the developed uncini is a little striated in an oblique fashion.

### Caesicirrus neglectus n. sp.

(Plate XVII., figs. 1-9; Plate XVIII., figs. 10-12; Plate XIX., figs. 20-26.) "Axiothea catenata Malmgren," Cunningham and Ramage (1, p. 679, fig. 42).

Specific Diagnosis.- The anterior point of the head rather short. The borders of the head are low, almost with faintly indicated lateral notches; the hinder notch between the borders is also faint. Ocelli numerous, in front of the mouth. The parapodia of the seventh setigerous segment situated somewhat in front of the posterior third. Nineteen setigerous segments and three posterior achaetous segments. Of long anal cirri there are three pairs. besides the ventral cirrus; the short anal cirri are found in each interval to the number of from one to four. Nephridia in setigerous segments 7-9. Anterior glandular bands are found on the first seven setigerous segments ; on the fourth setigerous segment this band occupies the half of the section behind the parapodia; the posterior portion of the seventh setigerous segment is completely, though somewhat sparsely, covered with glands on its upper portion. The second setigerous segment has, on the whole, glands very much scattered, chiefly in the front of the parapodia; and the third is thinly covered with glands, for the most part all over it. The eighth setigerous segment possesses a somewhat distinct glandular band between the middle and the parapodia. From the middle of the seventh setigerous segment the glandular bands follow the ventral nerve-cord, being most strongly marked on the ninth to the fourteenth setigerous segments. More or less faint longitudinal glandular bands are found to the front and to the back of the uppermost uncini in the direction of the neighbouring capillary setae from the eighth to the twelfth (or thirteenth) setigerous segments inclusive (especially in the larger individuals). The uncini on the first three setigerous segments have a rather long inner section, and three or four teeth. The fully developed uncini have six teeth as a maximum. The anterior capillary setae are especially numerous on the eighth and the ninth setigerous segments; in a great many of the posterior capillary setae on the middle and posterior segments the bases of the points are more or less distinctly enlarged.

Colour.—As I have seen no living individuals, the accounts of Cunningham and Ramage (cf. 1) may appropriately be repeated here : "Colour pinkish, paler

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towards the anterior end, with broad bands of deep-red surrounding the body at intervals (pl. 47, fig. 42)."

*External Structure.*—The forward point of the head is rather short and at the base but little removed from the cephalic plate (fig. 5). The borders are low, on the whole (fig. 7), though most distinctly so on the sides of the head; towards the hinder regions they diminish somewhat in strength and meet here in a fairly definite angle, when the cephalic plate is more or less extended. A lateral notch on each border can be seen at any rate on individuals with strongly compressed cephalic plates.

Numerous ocelli (fig. 4; cf. 1, fig. 42A) are to be found in front of the mouth in a rather broad band, which extends some distance up, on the underside of the anterior point of the head, and which divides into two bands, as it were, at one place in either side, fusing again near the median line. The ocelli are distinctly reddish-brown, although the colour is fainter in youngish individuals; and similarly the number of ocelli in these individuals is not so large as in older ones, especially towards the middle. The proboscis could not be closely investigated in the material at my disposal. This much, however, can be said about it, viz. that it is perfect all round and has no extended papillae. Moreover, no papillae whatever could be observed on the faint ridges that run along the outer side of the proboscis—ridges which to the number of 24 are to be seen in fig. 1. The nuchal organs are not especially long and are separated by a rather broad but low keel (figs. 5 and 7).

The front edge of the first setigerous segment is slightly bent forwards in front of the parapodia. The length of the anterior setigerous segments diminishes pretty evenly as far as the fifth setigerous segment, after which the sixth and the seventh segments show a slight increase. On the last-named the parapodia are situated somewhat in front of the posterior third. The eighth setigerous segment is considerably longer than the one immediately before it, and its parapodia, like those in the segments that follow, lie far to the rear. These segments, to begin with, increase in length backwards; and the fifteenth and the sixteenth setigerous segments, in particular, are very long, the sixteenth being the longest. The hindmost setigerous segments diminish rapidly in length; there are 19 setigerous segments in all. After them there follow—very rapidly decreasing in length—3 achaetous segments (figs. 8 and 9), of which the last in particular is very short, with slight remains of parapodia. The foremost of these segments at least has a distinct posterior limit (fig. 8). Thereafter follows a callus-shaped ring which in certain positions is markedly defined towards the rear (figs. 8 and 9); in individuals that are not contracted at the commencement of the section that thereafter follows, which is rather short and cup-shaped, the ring in

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question is not very sharply defined. The anal cone is low and barely perceptible; the anus is surrounded by several wrinkles, which, towards the anal opening itself (which is obviously not completely closed in fig. 8), has faint, slightly pointed elevations; the ventral anal papilla proper is prolonged finger-fashion. In fig. 12, where the intestine is shown in a somewhat projected position, these formations can be seen excellently. Whether the ventral nerve-cord can be seen between the large ventral anal cirrus (on the edge of the cavity) and the anal papilla cannot be determined, because of the smallness of the posterior ends at my disposal.

The anal cirri (on the edge of the cavity, cf. figs. 8–12) consist not only of the large ventral one, which is somewhat longer than half the diameter of the posterior funnel-like cavity, but also of three pairs of long ones and of short ones interposed among these. The longer ones, which are equal to half or more than half of the large ventral cirrus, taper, like this last, pretty evenly towards the slightly rounded point. The position of the three pairs mentioned is displayed in the figures. The small intermediate short cirri have distally short finger-like lobes, which vary slightly in number and position. If the seven intervals between the long cirri, beginning from that which lies nearest to the left of the ventral cirrus, are numbered continuously from 1 to 7, the following table shows at a glance the number of the short cirri in the six individuals investigated (the individuals depicted in figs. 12 and 10 being Nos. 1 and 2 respectively). The individuals are as far as possible arranged in order of magnitude, beginning with the larger ones :—

> No. 1<sup>1</sup>, 3, 2, 2, 3, 4<sup>2</sup>, 2, 2, cirri ,, 2, 3, 1, 4, 2, 4, 3, 3, , ,, 3, 2, 3, 4, 2, 2, 2, 3, , ,, 4<sup>1</sup>, 3, 2, 3, 4, 3, 2, 3, , ,, 5<sup>1</sup>, 2, 1, 1, 1, 2, 1, 1, , ,, 6<sup>1</sup>, 3, 2, 0, 2, **1**, 1, 4<sup>2</sup>, ,

If in the last-named individual, or No. 6, the small lobate cirri are taken one after another, beginning to the left of the large vent ral cirrus, they have the following number of lobes: 3, 2, 1; 4<sup>3</sup>, 2; 3, 2, 3; ?<sup>4</sup>, 2, 4, 1<sup>6</sup>; 4, 2<sup>6</sup>, 3; 2<sup>6</sup>, 3; 2<sup>6</sup>, 2, 3.

The three complete individuals at my disposal have all the same number of

<sup>3</sup> First divided into two, with 3 and 1 lobes. <sup>5</sup> Narrow. <sup>6</sup> Rather deeply divided. <sup>4</sup> Broad, divided into two, at first; lobes?

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<sup>&</sup>lt;sup>1</sup> The posterior part is regenerated, though on the whole fairly perfect; this is especially the case with No. 1.

<sup>&</sup>lt;sup>2</sup> The middle ones are not completely separated; in No. 6, moreover, they are of somewhat unequal length.

setigerous segments and of posterior achaetous segments; and three other individuals investigated exhibit the same structure of the hind part as the first-named.

Nephridia are found in the seventh to the ninth setigerous segments, cf. fig. 3, which show the orifices on the ninth setigerous segment, whereas on the other segments these do not here appear, but there can be seen beneath the uncini a little field free from glands, which surrounds each orifice. The number of the nephridia has been determined by dissection.

Epidermal Glands.-The cephalic plate (fig. 5) possesses distinct glands, which are strongest on the anterior point and on the outer ends of the nuchal organs. The anterior region is thinly covered with glands as far as somewhat behind the parapodia of the first setigerous segment (figs. 1, 2, 5). The ventral nerve-cord, however, under the parapodia of the same segment is free (fig. 1). Towards the rear there are, on the whole, only some very few glands on the sides at about the middle of the segment (fig. 2). The second to the seventh setigerous segments, but the second to the fourth in particular, possess a free edge anteriorly; the second setigerous segment has, in front of the parapodia, a band of sparse but large glauds (figs. 1 and 2). Behind these there is a number of very scattered glands straight behind the parapodia, some on the ventral side and very few on the dorsal side anteriorly. The hindmost part of the segment is free, or, in the larger individuals, it has glands to a faint and scanty extent all through; the same is the case with the preceding segment. The third setigerous segment, like the preceding one, has sparse glands in front of the parapodia, but also over nearly the whole segment (fig. 2), most thickly in the smaller specimens) in a streak straight behind the seta. The fourth to the seventh setigerous segments have-with the exception of the free interior edges just mentioned, which moreover diminish backwards-close-packed glands in front of the parapodia. On the fourth setigerous segment, moreover, these extend almost as far behind the parapodia as to the front of them, but with some indication of a break on the dorsal side behind the parapodia; on the two following segments the glandular band diminishes behind the parapodia, so that, especially on the last segment, it scarcely surrounds the parapodia, and at the same time the break mentioned on the dorsal side becomes more distinct. On the ventral nerve-cord, however, there remains a number of glands, even further back; and on the sixth setigerous segment these join a faintly marked glandular ring round the hinder part of the segment (fig. 2). On the hindmost parts of the fifth to the seventh setigerous segments there are also, especially on the upper side, a number of very thinly distributed glands. The seventh setigerous segment is thickly studded with glands in front of the parapodia, with the exception,

however, in a number of individuals, of the region round the orifices of the nephridia (as always on the eighth setigerous segment, fig. 3). The hinder part of the segment is free underneath, with the exception of sparse glands on the ventral nerve-cord, but the upper side is covered pretty evenly with rather dense glands (fig. 6). Straight behind the topmost part of the row of uncini these glands are somewhat more powerful; and this string of glands continues into the eighth setigerous segment, which otherwise in its anterior part possesses only some scattered glands in the middle of the dorsal side, faintly marked ones along the ventral nerve-cord, and a number of scattered ones in the neighbourhood of this last. From the middle and to the setae the same segment is surrounded by a ring of pretty dense glands, which, however, are rather faintly marked in comparison with the glandular rings of the preceding segments. In front of the upper uncini there are a number of glands that are more strongly marked; in other words, a trail of glands seems here to go between the seventh and the eighth setigerous segments. Further, there are on the eighth setigerous segment a number of glands in a triangle behind the parapodia, in the same way as in the seventh setigerous segment, and at least the ninth and tenth setigerous segments, whilst further back this group diminishes more and more. In addition, there are on the posterior part of the segment in the larger individuals, a number of delicate dispersed glands, as is also the case on the following segment. The glands of the ventral nerve-cord, which proceed over the glandular band in front of the parapodia, are slightly interrupted immediately behind the same band, but afterwards continue posteriorly. On the following segment these glands form narrow but powerful bands along the ventral nerve-cord; they diminish abruptly in the fifteenth setigerous segment, and shortly afterwards disappear altogether. From the ninth to the seventeenth setigerous segment at least there is a spot without glands on the ventral nerve-cord immediately in front of the uncini. In the larger individuals, moreover, there is to be seen, on the eighth to the twelfth (or thirteenth?) setigerous segment, a fine glandular streak running between the somewhat extended upper point of the collection of glands behind the parapodia and the next parapodia behind. The glands in front of and behind the parapodia join over the capillary setae on either side; and these glands further join by means of bridges transversely over the dorsal from the fourteenth or the fifteenth setigerous segment; these bridges increase backwards as far as the eighteenth setigerous segment, inclusive, and thereafter diminish; but they are nevertheless still visible on the three achaetous segments (figs. 8 and 9). Then follow fairly strong glands on the callusshaped ring, and also on the outside of the cup-shaped section (with the exception of the posterior under part), and of the large cirri. In the larger

individuals there can be seen a strongly marked glandular ring near the edge of the cup-shaped section; the inside thereof, like the inside of the cirri, lacks glands.

Setae.—The following notes on the setae are, for the most part, based on the two largest individuals.

The uncini on the first to the third setigerous segments are usually single in each parapodium. In some individuals, however, two uncini have been observed on one side of the third setigerous segment. These uncini are very strongly transformed; they have the great tooth, especially on the first setigerous segment, only slightly bent, lack bristles, and possess a highly thickened proximal portion (figs. 20–21). The number of the teeth is  $3^1$ ,  $4^{2-3}$ . Under the great tooth there is on the very first setigerous segment a distinct little boss, corresponding to the attachment for the bristles in the developed uncini; like the bent form of the great tooth, the boss increases on the two following segments.

So early as on the fourth setigerous segment there are fully developed uncini, all with bristles; the topmost uncini of the segment, on the other hand, have the great tooth rather blunt-headed (fig. 22). Moreover the uncini on the more anterior of these segments are more faintly developed in their outer part; posteriorly, they acquire an outer part which is greatly extended, and in comparison with the inner portion considerable. The attachment of the bristles forms against the base of the great tooth a little circle which is extremely characteristic in shape (fig. 25). The number of the uncini on setigerous segments 4–19 of the large complete individual is: 9, 9, 10, 11, 12, 12, 14, 14, 14, 13, 11, 10, 10, 6, 5—the last two segments not being completely regenerated. Number of teeth is 5<sup>4-5</sup>, 6<sup>6-13</sup>, 5–6<sup>14–19</sup>. One individual, whose anterior region, as far as the eighth setigerous segment inclusive, attains a length of 10<sup>-5</sup> mm, possesses on these segments the following number of uncini: 1, 1, 1, 7, 7, 8, 9.

The anterior capillary setae have faint borders which towards the hinder parts of the body almost disappear. The point of these setae is long; from the tenth setigerous segment onwards the point bears a very distinct pencil of bristles (fig. 26), which is broadest (c.  $14 \mu$ ) near the base, where it does not always finish off simultaneously on both sides. On the seventh setigerous segment the pencil of bristles is rather faint, and further forward it disappears all but completely; but nevertheless traces of it have been observed on the third and on the second setigerous segments. On the eighth and ninth setigerous segments this pencil of bristles is excessively fine, extended, and of even breadth; its breadth in the case of large individuals is only about  $4 \mu$ . At the same time the number of anterior capillary setae on these two segments is

very considerably increased, and these capillary setae are in every respect very fine.

The posterior capillary setae possess comparatively short points on the first three setigerous segments; the borders-both of the two or only oneare here pretty broad (fig. 23). Towards the hind part of the body the borders diminish gradually; but one is always broader than the other, and even on the hindmost segments of no inconsiderable breadth. The points themselves increase in length backwards, to begin with; nevertheless the narrow extreme point on a number of the bristles is comparatively short, since the point at the base is, so to speak, somewhat enlarged. These broadened points begin on the sixth setigerous segment, after which they are distinct in the seventh to the ninth setigerous segments. On the next segment no such points have been observed; but on the eleventh and on the twelfth setigerous segments they again begin to assume this form, which is most strongly developed on the next segment (fig. 24). On the fourteenth setigerous segment these broadened points diminish; and, from the fifteenth setigerous segment onwards, many of the upper setae seem to lack them altogether.

It would seem as if the posterior setae on the eighth and the ninth setigerous segments—that is to say, where the anterior capillary setae are especially fine and numerous—are not so numerous as on the other segments. The material at my disposal, however, has not permitted a definite settlement of this question.

Size.—The two largest individuals investigated by me were taken in Blacksod Bay, Station W. 115; the one which is complete, and which has been preserved within its tube, measures 85 mm. in length; its posterior region, however, in particular, is drawn together, not to say folded up. Its greatest breadth is 1.2 mm. The forward end of the second large individual measures, up to its twelfth setigerous segment, 48 mm. in length; this individual is somewhat larger than the former.

Sexual Maturity.—The two individuals just mentioned, which are both  $\Im$   $\Im$  and which were taken on 16 September, 1909, are fairly full of eggs which are still of different sizes; in the first  $\Im$  the largest eggs attain a magnitude of  $0.22 \times 0.28$  mm.

Tubes.—The tubes are rather thin and brittle, and seem in all localities to be composed, besides the inner light-coloured membrane, of a layer of fine grains of sand, chiefly light in colour. That one of the two largest individuals just named, which is complete, possesses a tube whose external diameter 1s 1.7 mm. For further particulars about the tubes see "Information about Earlier Finds," Notices of Finds.—The individuals before me are all from the West Coast of Ireland :—

Elly Bay, Blacksod Bay, Station W. 115, 16/9 (10, p. 170): seven individuals.

Elly Bay (N. Shore), Blacksod Bay, Station W. 119 (10, p. 170): five individuals.

From one of the following stations:-L. 296-L. 300 (6, p. 41): one individual.

S.W. of second buoy of Margaretta Shoal (Galway Bay), Station A. 124 (7, p. 94), 18 m.: two individuals.

Information about Earlier Finds.—Cunningham and Ramage (1, p. 679) procured this species in the Firth of Forth. They write as follows about it :— "Got in great numbers inhabiting fine tubes buried in the sand, with only their upper ends protruding. The tubes often have a branch in the lower part of their course, and extend down to a depth of six or eight inches. The upper end is quite plain and open. The worms lie in their tubes with either their head or their tail uppermost indifferently, so that they can evidently turn in them. The locality whence our specimens were got was the flat sands for two or three hundred yards to the west of the Birnie Rocks, where the upper ends of the tubes form a sort of miniature forest all over the surface. Length three or four inches when fully extended, but when contracted, it is much less."

Hornell (2, p. 155) knows the same species as Cunningham and Ramage's "*Axiothea catenata*" from Liverpool Bay, where it occurs extremely commonly. The fact that he has observed the seven longer anal cirri shows that he refers to *Caesicirrus neglectus*. When he reports the existence of four posterior achaetous segments, he is obviously counting in the posterior callus-formed ring.

Regeneration.—Elly Bay: 1 individual: 7 anterior segments; 1 individual: 2 and 1 individual: 11 posterior setigerous segments. Station A. 124: 2 individuals: 11 posterior setigerous segments.

#### Heteroclymene robusta Arwidsson.

From the West Coast of Ireland—more precisely Station L. 245 (6, p. 38) or Fahy Bay, Channel and Bar, 1.8–5.5 m.—comes a small individual which is complete, and which, like the first and hitherto only known complete individual (5, p. 227), possesses nineteen setigerous and five posterior achaetous segments. The anterior region is regenerated as far as the first setigerous segment inclusive, and the posterior region from the ninth setigerous segment inclusive. The length of the second to the eighth setigerous segments, which are normally developed, is 9.5 mm.

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The species is hitherto only known from the warmer parts of the west coast of Norway, where it attains a considerable size. It very easily breaks to pieces, however, in dredging—a process which in Norway usually only gives you the hindmost part, easily recognizable, however. The complete individual previously known was also very small.

#### BIBLIOGRAPHY.

- 1. 1888. CUNNINGHAM, B.A., and G. A. RAMAGE:
  - The Polychaeta Sedentaria of the Firth of Forth, in : Trans. Roy. Soc. Edinburgh, vol. xxxiii., p. 3.
- 2. 1892. HORNELL, J. :

Report on the Polychaetous Annelids of the L. M. B. C. District, in : Fauna Liverpool Bay, vol. iii.

3. 1894. DE SAINT-JOSEPH:

Les Annélides polychètes des côtes de Dinard.—3. Partie, in : Ann. Sc. nat., Zool. (7), vol. xvii.

- 4. 1896. MICHAELSEN, W.:
  - Die Polychaetenfauna der deutschen Meere einschliesslich der benachbarten und verbindenden Gebiete, in: Wiss. Meeresunters. Komm. wiss. Unters. deutsch. Meere. Kiel, Biol. Anst. Helgoland (N.F.), vol. ii., Heft. 1.—Abt. 1.
- 5. 1907. ARWIDSSON, IVAR:
  - Studien über die skandinavischen und arktischen Maldaniden, nebst Zusammenstellung der übrigen bisher bekannten Arten dieser Familie, in : Zool. Jahrb. Abt. f. Syst. Suppl., 9. Heft. 1.

LIST OF STATIONS.—Biological Collections, in : Agric. Techn. Instr.<sup>7</sup> Ireland.—Fish. Branch.

- 6. 1905. Part 1. 1899-1904.
- **.7.** 1906. Part 2. 1905.
- 8. 1907. Part 3. 1906.
- 9. 1909. Part 5. 1908.
- 1910. Part 6. 1909.
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## DESCRIPTION OF PLATES XVII.-XIX.

The specimen of *Caesicirrus neglectus* used for figs. 1, 2, 5-7, are from Station A. 124; for figs. 3, 4, 12, from Station W. 115; and for figs. 8-10 from Station W. 119. The material of *Nicomache maculata* that has supplied the basis for the figures dealing therewith is from Stella Maris Bay, Howth.

The ciphers standing to the left of the figures give the numbers of the setigerous segments; the ciphers to the right give the magnification.

"Glands" indicates that the epidermal glands, coloured with iodine green, are given in the figures referred to.

#### PLATE XVII.

Caesicirrus neglectus n. sp.

Fig.

- 1. Anterior region seen from beneath. Glands. 27:1.
- 2. Anterior region. Glands; the same individual as the preceding. 16:1.
- 3. Setigerous segments 7-10, seen from beneath. Glands. 9:1.
- Section in front of the first setigerous segment, from beneath, with ocelli 20:1.
- Anterior region seen from above. Glands. Same individual as fig. 1. 27:1.
- Setigerous segments 7-8, seen obliquely from above. Glands. Same individual as fig. 1, 22:1.
- Head from the side; sketch without colour. Same individual as the foregoing. 27:1.
- 8. Posterior region seen from the left side. Glands. 27:1.
- The same section as in the preceding figure, seen from above. Glands. 24:1.

### PLATE XVIII.

### Caesicirrus neglectus n .sp.

Fig.

10. Rear end seen from behind; same individual as preceding figure. 27:1.

11. Detail of the preceding figure. 83:1.

12. Rear end with anal opening turned inside out, seen from behind. 27:1.

### Nicomache (Nicomache) maculata n. sp.

13. Head, seen from the front. Natural colour. 14:1.

14. Anterior region from the right side. Natural colour. 10:1.

- 15. Anterior region as far as the third setigerous segment inclusive, seen from the left side. Natural colour. 15:1.
- 16. Posterior region from the twentieth setigerous segment inclusive, seen from the left side; the hindmost segment, which is usually achaetous, here has capillary setae. Glands. 12:1.
- Section in front of the first setigerous segment, seen from the right side. Glands. Natural colour exclusively. 16:1.
- Rear end seen from behind. Glands. + indicates the position of the ventral nerve-cord. 16:1.
- 19. Anterior region as far as the eighth setigerous segment inclusive, seen from beneath. Glands. 10:1.

# PLATE XIX.

Caesicirrus neglectus n. sp.

20. Uncinus from the first setigerous segment. 500:1.

21. Uncinus from the third setigerous segment. 390:1.

- 22. Uncinus (second from above) from the fourth setigerous segment. 440:1.
- 23. Posterior capillary seta from the third setigerous segment. 440:1.
- 24. Point of the posterior capillary seta from the thirteenth setigerous segment. 500:1.
- 25. Uncinus (thirteenth from above) from the tenth setigerous segment. 530:1.
- 26. Anterior capillary seta from the seventeenth setigerous segment. 670:1.

### Nicomache (Nicomache) maculata n. sp.

- 27. Spine from the second setigerous segment. 85:1.
- 28. Uncinus (fourth from above, from the fourth setigerous segment. 390:1.
- 29. Uncinus (eighth from above) from the eleventh setigerous segment. 415:1.
- 30. Posterior capillary seta from the eleventh setigerous segment. 350: 1.

Fig.



G. Liljevall del.

Cederquists Graf. A.-B., Sthlm.


<u>10</u> 1



11



13



14







15





19

x

G. Liljevall del.

Cederquists Graf. A.-B., Sthlm.





B.Wissler del.

Cederquists Graf. A.-B., Sthlm.



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## VII.

# REPORT ON THE "DINGLE BED" ROCKS IN THE DINGLE PENINSULA, CO. KERRY.

#### BY ALEXANDER MCHENRY, M.R.I.A.,

Geologist, Geological Survey of Ireland (retired).

## PLATES XX, XXI.

[Read JANUARY 22. Published FEBRUARY 20, 1912.]

THE question as to the true geological horizon of the "Dingle Beds" in the Dingle peninsula, is one that has engaged the attention of many geologists for over fifty years, and, so far, without any definite opinion having been arrived at.

Amongst those who have dealt with these rocks were Sir R. Griffith, Professor Jukes, Professor Hull, John Kelly, A. B. Wynne, G. V. Du Noyer, G. H. Kinahan, and the Geological Survey of Ireland generally. It will be seen from the papers of the writers mentioned, and the publications of the Geological Survey, that all considered the "Dingle Beds" to be either the highest beds of the Upper Silurian, or portion of the Devonian or Lower Old Red Sandstone formations.

Sir R. Griffith regarded the beds as belonging to the Silurian system, but did not state their position in the series.<sup>1</sup> Professor Jukes, in his various papers, considered the "Dingle Beds" to be connected with the Upper Silurians; and in the Geological Survey maps, published under his direction, they are provisionally placed above the fossiliferous Ludlow rocks.<sup>2</sup> Professor Hull regards the "Dingle Beds" as being above the Ludlow rocks, and the highest portion of the Upper Silurian series.<sup>3</sup> John Kelly, in his paper on the "Greywacke Rocks of Ireland," gives an account of the "Dingle Beds," and puts them among the Upper Silurians; but he did not state in which particular division he would locate them.<sup>4</sup> The late G. H. Kinahan, M.R.I.A., in his paper read at a Scientific Meeting of the Royal Dublin Society.

[2 K]

<sup>&</sup>lt;sup>1</sup> Journal Geol. Soc. of Dublin, vol. ii, p. 28 (1843); vol. viii, p. 2 (1858).

<sup>&</sup>lt;sup>2</sup> Journal Royal Geol. Soc. of Ireland, vol. i, p. 105 (1867).

<sup>&</sup>lt;sup>3</sup> Quarterly Journal Geol. Soc., vol. xxxv, pp. 669-723 (1879).

<sup>&</sup>lt;sup>4</sup> Journal Geol. Soc. of Dublin, vol. vii, pp. 276-290 (1860).

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May 18th, 1885, refers the "Dingle Beds" to the Lower Old Red Sandstone and Lower Devonian, the "Smerwick Beds" to the May Hill Sandstone (Llandovery) or "passage-beds" between the Ordovician and Silurian (Upper Silurian), and the "Annascaul Beds" to the Caradoc-Bala group-Professor Reynolds and Mr. Gardiner, in their very exhaustive paper on the fossiliferous Silurian beds of Clogher Head, Dingle district, do not deal particularly with the "Dingle Beds." They merely allude to them, and leave them in the position provisionally assigned to them by the Geological Survey, as probably belonging to the Lower Devonian. They, however, say that the "Smerwick Beds" "are undoubtedly the oldest beds in this area, and that they are probably of Llandovery age, as they are conformably overlain by the fossiliferous Wenlock Rocks,"<sup>1</sup> and with this I quite agree.

Having had some opportunity of studying these rocks while I was attached to the Geological Survey of Ireland, and recently, with the aid of a grant from the Royal Irish Academy, of making further investigations in the Dingle peninsula of the so-called "Dingle Beds," and the rocks adjoining them, I have arrived at the conclusion that, with the "Smerwick Beds." they form the lowest portion of the Upper Silurian Series in this area, and that they are probably of Llandovery age: and, furthermore, that they rest unconformably on the Lower Silurian (Ordovician) rocks, provisionally called "Annascaul Beds" on the Survey map, and that their seeming conformable overlapping on the fossiliferous Wenlock and Ludlow Beds of West Dingle, on the south, is lue to inversion and overthrusting of the strata from the south, as is shown on the accompanying diagrammatic section.

Fossiliferous Wenlock and Ludlow rocks of West Dingle at Ferriter's Cove, Clogher, and Dunquin, have been fully described in the Geological Survey memoirs on the district in 1863, and later, by Professor Reynolds and Mr. Gardiner, as already mentioned. Extensive lists of fossils are given in those publications, which fully prove the geological horizons of the Wenlock and Ludlow Rocks.

A series of rocks to the north of Ferriter's Cove Wenlock beds are admittedly in their normal position, underlying the Wenlock beds in regular order. These are shown on the Geological Survey map as "Smerwick Beds," and separated from the "Dingle Beds" in the peninsula. Having recently examined those "Smerwick Beds," I have no doubt that they belong to the "Dingle Bed" series, and should not have been separated from them, as they are identical with them in every respect. Du Noyer noted on his field-map, when surveying the district over fifty years ago, with regard to the "Smerwick

<sup>&</sup>lt;sup>1</sup> Quarterly Journal Geol. Soc., vol. lviii, pp. 226-266 (1902).

Beds" at Sybil Head, that they are "quite the same in mineral aspect as those forming Black Head, south of Dingle," which form the "Parkmore Conglomerate" zone of the "Dingle Beds."

All round the areas of Wenlock and Ludlow Beds on the north, and northwest, the "Dingle Beds" occur rising from beneath them. But on the south margin they appear to overlie the Ludlow and Wenlock strata. This is due, I hold, to inversion of the strata, as suggested in the accompanying section.

So far no direct fossil evidence has been forthcoming to prove the possible Llandovery age of the "Dingle Beds"; but it is an important fact that in the conglomeratic beds, towards the lower portions of the "Dingle Beds," rolled pebbles of fossiliferous Lower Silurian limestone and grit are found in considerable abundance, in what has been named, by the Geological Survey, "Parkmore Conglomerate." Those limestone pebbles have undoubtedly been derived from the Annascaul rocks lying to the south along their margin, and on the north from similar rocks now overlapped and concealed by Old Red Sandstone, as shown on the diagrammatic section : and they were deposited amongst the overlying and succeeding "Dingle Beds" (probably Llandovery) during their deposition on the eroded and worn-down surface of the Lower Silurian rocks. (See Survey memoir, pp. 16, 17, 33.) The limestone, which belongs to the "Annascaul Beds," is to be seen in situ at a couple of places high up on the western slope of Caherconree mountain. It is identical in its characters with the Lower Silurian limestones of Portraine and Lambay, County Dublin, the Chair of Kildare, County Kildare, and Tourmakeady, County Mayo, and contains similar fossils, a list of which is given in the Survey Memoir, p. 12. The occurrence of the Trilobite Acidaspis Jamesii and other Silurian forms in this limestone is alluded to by Professor Jukes, as "seeming to indicate that the rocks belonged to the Bala group, a part of the Lower Silurian series" (Survey Memoir, p. 12). Specimens of this fossiliferous limestone, and of the fossiliferous limestone pebbles out of the "Parkmore Conglomerate" of the "Dingle Beds" are in the Geological Survey Collection, in the National Museum.

The belt of rocks ranging from Minard Bay, by Annascaul to Caherconree mountain, have been provisionally designated "Annascaul Beds (Bala or Llandovery rocks)" on the Geological Survey map. From their close resemblance to the Bala limestone and black graptolitic shales and other rocks of Ordovician types in Counties Dublin, Kildare, and Mayo, I have no doubt they are of similar age, *i.e.*, Lower Silurian. When this region was being surveyed over fifty years ago, and subsequently re-examined in 1878, the great importance and effects of inversion and overthrusting were not realized to their full extent. Had it been, I have no doubt the true geological reading

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of the district would have been understood. Indeed Du Noyer saw that there was inversion of the strata on the south, as his notes on the field-map show and he alludes to it in the Memoir, pp. 18, 22, 38.

A great number of pre-Old Red Sandstone faults and overthrusts exist in the Dingle district. The boundary between the "Dingle Beds" and "Annascaul Beds" lying to the south of them, is evidently an overthrust fault that extends the whole way, and probably along, or close to, the original zone of unconformability between the two series of rocks. Du Noyer notes that this line is either a fault or an unconformability, and that the "Dingle Beds" are inverted close to their junction with the Annascaul rocks.<sup>1</sup>

As already stated, I consider the line to be an overthrust fault-boundary along or near the zone of unconformability. The junction zone shows evidence of great crushing and movement wherever the two sets of rocks come in contact or close together, as north of Annascaul, at Bull's Head, and at Minard Bay, and elsewhere along the line of junction.

As already mentioned, the conglomerates of the "Dingle Beds" to the north, at the Smerwick Harbour, being so exactly like those of Parkmore Point, and containing similar derived pebbles of fossiliferous limestone and grit, points to their being in their proper position, towards the base of the series. Du Noyer mentions this in the Survey Memoir, pp. 20, 29. It will be seen in the diagrammatic section how the conglomerates with derived pebbles come in both on the north and south of the fossiliferous Wenlock and Ludlow beds. Many minor folds and faults are proved amongst the Wenlock and Ludlow rocks, striking generally east and west, as well as others ranging northwards. The line of boundary between the fossiliferous Silurians and the "Dingle Beds," a little south of Dunquin, on the west, is a fault or overthrust.

On the coast to the east of Clogher Head, a small area of Old Red Sandstone, resting unconformably on the Ludlow Beds, has been faulted down amongst the Ludlow rocks. This Old Red Sandstone has been noticed by Professor Reynolds and Mr. Gardiner, who also allude to the abundant evidence of overthrusting and overfolding throughout the Silurian inlier. Du Noyer alludes to this Old Red Sandstone in the Survey Memoir, p. 22, but refers to it as being a "portion of the Dingle Beds, resting unconformably on the Ludlow rocks." I agree with Professor Reynolds and Mr. Gardiner, that it belongs to the Old Red Sandstone formation, faulted into its present position.

Folding and contortion have also occurred amongst the "Dingle Beds" as well as in the Silurians above them. A well-defined synclinal fold is noticeable along the coast from near Slea Head to Ventry Harbour, and was traced

<sup>&</sup>lt;sup>1</sup> Geol. Survey Memoir to sheets 160, 161, 171, and 172, p. 33 (1863).

by Du Noyer for over three miles. On the high ground of Brandon Mountain folding and undulation of the strata are very apparent. The thickness of the "Dingle Beds" is given in the Survey Memoir as being 10,000 feet. I think this is excessive by a few thousand feet.

The "Smerwick Beds," which come in regular order below the "Dingle Beds" on the north, on both sides of Smerwick Harbour, and which I include amongst the "Dingle Beds," are stated in the Survey Memoir as being 2,000 feet thick.

There is abundant evidence that overfolding and overthrusting also took place in this region, and in the south-west of Ireland generally, in post-Old Red Sandstone and post-Carboniferous times. The high angles at which the Old Red Sandstones lie where they rest on the upturned and eroded edges of the "Dingle Beds" at Sybil Head, and Ballydavid Head, show this; while the great east and west overthrust fault running from near Headford Station along the Blackwater valley, by Millstreet and Kanturk, clearly indicate a post-Upper Carboniferous overthrust of considerable extent.

The effect of this overthrust has overridden the lower beds of the Old Red Sandstone on to the Carboniferous limestone and Coal-measures at Millstreet and Kanturk.

Professor Reynolds and Mr. Gardiner refer to the evidence of crushing and movement along the line, and in the vicinity of the junction between the "Dingle Beds" and Silurians, to be seen on the coast near Dunquin. This line, as already mentioned, I take to be an overthrust fault junction. Having a fair general knowledge of the Old Red Sandstone of Counties Kerry and Cork, to the south of Dingle Bay, I do not know of any series of rocks there that correspond with the "Dingle Beds" in general characters; nor is it conceivable that it could be possible to have so vast an unconformability within the limits of the Devonian and Old Red Sandstone series as that which exists in this area. Even were it possible to admit the Devonian age of the "Dingle Beds," and knowing that we have in the Dingle peninsula at least 4,000 feet thick of Old Red Sandstone, which includes a great portion of the lower division of the series, the possibility of their being Devonian is hardly tenable.

I therefore venture to suggest that my reading of the question, as stated above, is the most natural solution, and that the true position of the "Dingle Beds" is below the Wenlock rocks, and that they are probably of Llandovery age. A strong point in favour of inversion is the following :—The "Smerwick Beds," which are admittedly in their true order below the Wenlock rocks, are undoubtedly part of the "Dingle Beds." In a stream-cutting running from Brandon Mountain to the sea at Doonmore, west of Tiduff, a continuous rock-

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section is laid bare across the Dingle and Smerwick beds, both having exactly the same lithological characters, and regular southerly dips. Admitting for a moment that the "Dingle Beds" do lie conformably on the Wenlock and Ludlow rocks on the south, we should, of necessity, expect to find the Wenlock and Ludlow strata on the north-east of Smerwick Harbour, between the "Smerwick Beds" and "Dingle Beds." But no such rocks occur there, although the thickness of the Wenlock and Ludlow, immediately to the south-west, is at least 4,000 feet. The absence of the fossiliferous Silurian rocks here is conclusive that the Smerwick and Dingle rocks are of the same age.

The accompanying map (Plate XX.) shows, in a general way, the geology of the Dingle peninsula. The boundary-lines of the Silurian and Old Red Sandstone are copied from the Geological Survey map.

The section (Plate XXI.) shows, in a diagrammatic way, my reading of the "Dingle Bed" question, in which it is for the first time put forward that the "Dingle Beds" are the lower strata of the Upper Silurian series, probably Llandovery.













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## VIII.

## ON HIGHER TERTIARY ALCOHOLS DERIVED FROM PALMITIC AND STEARIC ESTERS.

## BY HUGH RYAN AND THOMAS DILLON, University College, Dublin,

Read JANUARY 22. Published FEBRUARY 23, 1912.

SOME discrepancies between theory and experiment with regard to the composition of beeswax, which have been indicated in a previous communication, and the difficulty of accounting satisfactorily for these as well as for the nature of the unsaponifiable portion of montan wax<sup>2</sup> in any way other than by assuming the existence of secondary or tertiary alcohols in beeswax and montan wax, have made an investigation of the properties of the higher tertiary alcohols very desirable.

Since, however, with the single exception of the dimethyl-pentadecyl carbinol obtained by Ipatieff and Grawe<sup>3</sup> by the action of zinc methyl on palmityl chloride, higher tertiary alcohols were unknown, we were obliged to prepare them by synthetical methods before a study of their properties could be accomplished.

The original method devised by Butlerow<sup>4</sup> for the synthesis of tertiary alcohols, which was that followed by Ipatieff and Grawe in the preparation of the alcohol mentioned above, is, owing to the spontaneous inflammability of zinc methyl in air, too troublesome for extensive use in the laboratory.

The fact that the alkyl-magnesium halides of Grignard<sup>5</sup> react with esters to form tertiary alcohols led us to believe that, even in the case of an acid, like stearic, of high molecular weight, the Grignard reagent might interact with the ester to form a tertiary alcohol. We found that from palmitic and stearic esters, by interaction with alkyl-magnesium halides, satisfactory yields of tertiary alcohols were in all cases obtained with the single exception of a-naphthyl-magnesium bromide whose product of interaction with methylstearate was a ketone.

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<sup>&</sup>lt;sup>1</sup> Ryan, Sci. Proc. R.D.S., xii (1909), p. 210.

<sup>&</sup>lt;sup>2</sup> Ryan and Dillon, Sci. Proc. R.D.S., xii (1909), p. 202.

<sup>&</sup>lt;sup>3</sup> Journ. Russ. Phys-Chem. Soc., 1900, p. 33.

<sup>&</sup>lt;sup>4</sup> Annalen, cxliv, p. 1. <sup>5</sup> Comptes Rendus, cxxviii (1899), p. 110.

Contrary to our expectation we experienced little difficulty in the preparation of the pure esters of palmitic and stearic acids. Some of these esters had been obtained in the course of researches on esterification by Berthelot,<sup>1</sup>. Heintz,<sup>2</sup> Hanhart,<sup>3</sup> and Duffy,<sup>4</sup> who in all cases prepared the esters by the somewhat troublesome method of heating the acid with excess of alcohol in a sealed tube.

It was found by us that in every case a yield of more than ninety per cent. of the theoretically obtainable quantity of the ester could be obtained in a few minutes by adding a few cubic centimetres of concentrated sulphuric acid to a hot solution of the acid in an excess of the alcohol. The ester separated as an oily layer on the surface of the mixture. Steric hindrance, which, with acids of such high molecular weight, might be expected to materially retard the formation of esters, is here prevented from controlling the reaction by the separation of the ester from the solution of the alcohol and the acid as a distinct liquid phase, the solubility of the ester in a given quantity of alcohol and sulphuric acid being less than the quantity which would be in equilibrium with free acid and alcohol at the concentrations of the experiment.

The methyl, ethyl, and propyl esters of palmitic and stearic acids were prepared by this method. They were oily liquids or wax-like solids of moderately low melting-point and possessed a faint ester-like smell. They were easily soluble in chloroform, ether, and petroleum ether.

For the synthesis of a tertiary alcohol, the Grignard compound of the alkyl or aryl halide was prepared in the usual way, and, when the solution of the magnesium was complete, the ester, which had usually been kept for about twenty-four hours in a vacuum desiccator, was slowly added in small fragments. As each piece was dropped in, a slight effervescence occurred; and the ester was dissolved in about one minute. Time was given for each fragment to dissolve before the addition of another, the addition of the ester usually occupying about half an hour. When the contents of the flask had been left standing for about twelve hours, the magnesium compound was decomposed with ice-cold water, hydrochloric acid was added to dissolve the basic magnesium compound which separated, and the organic substances were extracted with ether from the mixture in the flask. Finally, the alcohol was freed from unchanged ester by evaporating with alcoholic potash and extracting with petroleum ether. In the earlier experiments, the addition of the ester was effected by dropping a solution of the compound in dry ether into the Grignard reagent ; but the method described above was found to be more

<sup>&</sup>lt;sup>1</sup> Jahresbericht, 1853, pp. 447 and 502. <sup>3</sup> Ibid., 1858, p. 301,

<sup>&</sup>lt;sup>2</sup> Jahresbericht, 1853, p. 447.

<sup>&</sup>lt;sup>4</sup> Annalen, lxxxviii, p. 292.

rapid and more satisfactory. This is probably due to the fact that the reacting mixture is diluted too much by the addition of the ether solution, since there appears to be an optimum concentration, not only for the formation of the Grignard compounds, but for their reaction with other bodies.

The general equations for the reaction of a Grignard compound with an ester are as follows :---

	m OMgBr
(1).	$R \cdot COOMe + Mg(Br)R' = R \cdot \dot{C} \cdot OMe$
-	$\dot{\mathbf{R}}'$
	OMg. Br OMgBr
(2).	$\mathbf{R} \cdot \mathbf{\dot{C}} \cdot \mathbf{OMe} + \mathbf{Mg}(\mathbf{Br}) \mathbf{R'} = \mathbf{R} \cdot \mathbf{\dot{C}} \cdot \mathbf{R'} + \mathbf{Mg}(\mathbf{Br}) \mathbf{OMe}$
	Ŕ'Ŕ'
	OMgBr OH
(3).	$\mathbf{R} \cdot \mathbf{\dot{C}} \cdot \mathbf{R'} + \mathbf{H}_2 \mathbf{O} = \mathbf{R} \cdot \mathbf{C} \cdot \mathbf{R'} + \mathbf{Mg} (\mathbf{Br}) \mathbf{OH}.$
	Ŕ' Ŕ'

In our experiments the esters used were those of palmitic and stearic acids, and they were treated with magnesium halide compounds of the methyl, ethyl, propyl, and phenyl radicles. Tertiary alcohols were, therefore, obtained in which radicles containing fifteen and seventeen carbon atoms were attached, together with various small groups, to the carbinol residue. The compounds are oily liquids or solids with melting-points ranging from about 20° to 50° C., and crystallizing in plates or prisms of a white or slightly yellowish colour. They are readily soluble in chloroform, ether, petroleum ether, and hot alcohol.

The melting-points of the tertiary alcohols show a curious variation, their values depending less upon the number of carbon atoms in the molecule than upon their method of arrangement. Thus tertiary butyl alcohol melts at  $25^{\circ}$  C.,<sup>1</sup> while dimethyl-ethyl-carbinol, prepared by Popow<sup>2</sup> from zinc alkyl and acid chloride, is a liquid at ordinary temperatures, its melting-point being –  $12^{\circ}$  C. Of the compounds prepared by us, those containing the pentadecyl group melt about 10° C. lower than the corresponding heptadecyl derivatives. Amongst those in which the large radicle is the same, the diethyl and dimethyl compounds have very nearly the same melting-point; while the dipropyl compound melts about 14° C. lower and the diphenyl compound about 14° C. higher than the dimethyl and diethyl derivatives.

The preparation of esters of these alcohols presented some difficulty. Menschutkin<sup>3</sup> has observed that ester-formation takes place much less readily with tertiary alcohols than with primary, and that when the former

<sup>2</sup> Annalen, exlv, p. 292.

<sup>&</sup>lt;sup>1</sup> Butlerow, loc. cit.

<sup>&</sup>lt;sup>3</sup> Annalen, cxcvii, p. 193. [2 L 2]

compounds are heated to 154°C. with acetic acid, the main products of the reaction are unsaturated hydrocarbons. The alcohols prepared by us reacted with acetyl chloride, forming esters. These were oily liquids which solidified when placed in iced water.

We also studied the action of acetic anhydride and sodium acetate on two of the alcohols, namely, dimethyl-pentadecyl-carbinol and diethyl-heptadecylcarbinol; and it was found that in both cases the product was a mixture of esters and unsaturated hydrocarbons. While the quantity of unsaturated hydrocarbon in the reaction product, as determined from the "Hübl-Waller iodine number" appeared to be about the same in both cases, the quantity of ester formed was much greater in the case of the dimethyl compound. Thus the products of reaction of the latter substance gave an ester number representing about 77 per cent. of dimethyl-pentadecyl-carbinyl acetate; while the corresponding figure for the diethyl-heptadecyl alcohol was equivalent to only 13 per cent. of ester. The iodine numbers indicate the presence of 10 per cent. of unsaturated hydrocarbon in the dimethyl derivatives, and 6 per cent. in those of the diethyl compound. The total reaction was therefore greater with the dimethyl compound; while the ratio of unsaturated hydrocarbon to ester formed was greater in the case of the diethyl compound.

These facts are in complete accord with Bischoff's <sup>1</sup> dynamic hypothesis of steric hindrance. That hypothesis assumes that the open chain compounds are more or less cyclic in structure and that the curvature of the chain is such that the fifth or sixth carbon atom in the series approaches the first. It is also postulated that the products of a reaction will be such as to give freest scope for the vibrations of the carbon atoms, and hence molecules with branching chains will not readily form compounds in which one atom is placed in the one-five or "critical" position with respect to several others.

Now, if we compare the formulae of the esters of the two alcohols under consideration, it will be seen that the hypothesis affords an explanation of the difference between the two reactions.

 $\begin{array}{ccccccccc} I & II \\ & & C^4H_3 & C^5H_3 \cdot C^4H_2 \\ C_{13}H_{27} \cdot C^8H_2 \cdot C^4H_2 \cdot \dot{C}^{3} \cdot O^2 \cdot C^1O \cdot CH_3 \\ & \dot{C}^4H_{39} & C_{15} \cdot H_{31} \cdot C^5H_2 \cdot C^4H_2 \cdot \dot{C}^{3} \cdot O^2 \cdot C^1O \cdot CH_3 \\ & & C^5H_3 \cdot \dot{C}^4H_2 \end{array}$ 

In Formula I (dimethyl-pentadecyl-carbinyl acetate) only one carbon atom is placed in the one-five position with respect to the CO group; whereas in Formula II (diethyl-heptadecyl-carbinyl acetate) three atoms are so placed.

<sup>1</sup> Berichte, xxiv. (1891), p. 1087.

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Hence the latter compound should be more difficult to form; and the reaction between the alcohol and acetic acid should give rise to a larger proportion of unsaturated hydrocarbons. This is in accordance with the facts.

We have already seen that the tertiary alcohols form unsaturated hydrocarbons under conditions where esters might be expected, and Wolkoff and Bougaieff<sup>1</sup> have found that the lower members of the series split off water when heated in a sealed tube to 240-250° C., in presence of a trace of hydriodic acid or methyl iodide. It might therefore be surmised that the formation of unsaturated hydrocarbons would take place easily when the higher tertiary alcohols are heated with potash-lime. We have found, however, that below 250° C. no such change occurs ; but when the temperature was raised to 300° C., the production of unsaturated bodies but no evolution of hydrogen was observed.

In considering the anomalous behaviour of beeswax towards potash-lime in the light of these facts, we must bear in mind that the formation of unsaturated hydrocarbons from tertiary alcohols might take place more readily when these bodies are in the form of esters than when they are in the free state. If, therefore, the so-called hydrocarbons obtained by the action of potash-lime on beeswax should prove to contain appreciable quantities of oxygen, it might be inferred that tertiary alcohols were present; but if oxygen was found to be absent, the hydrocarbons might still be due to the decomposition of such alcohols under the conditions of the experiment.

## EXPERIMENTAL PART.

Preparation of Esters. Methyl Palmitate.—20 grammes of Palmitic acid and 100 c.c. of methyl alcohol were warmed in a beaker on the waterbath until the alcohol had begun to boil. Concentrated sulphuric acid was added slowly drop by drop from a pipette. When three or four c.c. of acid had been added, oily drops began to appear in the liquid and these collected to form a layer on the surface of the alcohol. When 10 c.c. of the acid had been added the beaker was replaced on the water-bath for a few minutes. It was then cooled; the solid cake of ester was separated from the liquid layer, and dissolved in ether. The ether solution was washed with water, then with dilute sodium bicarbonate, and finally again with water. It was then dried over sodium sulphate and the ether was evaporated off. The yield of ester was 20 grammes.

Methyl palmitate is a white wax-like solid, which crystallizes in needles,

<sup>&</sup>lt;sup>1</sup> Journ. Russ. Chem. Soc., 1885, p. 276.

easily soluble in ether, chloroform, and petroleum ether. It melts at 28°C. It was previously prepared by Berthelot.

Ethyl Palmitate and Propyl Palmitate.—These were obtained in the same way as that described above for the methyl ester. Ethyl palmitate was prepared by Heintz. It crystallizes in long needles and melts at  $24.2^{\circ}$  C. The yield obtained by our method was 81 per cent. of the theoretical.

*N-Propyl Palmitate* crystallizes in needles, and melts at  $18\cdot8-19\cdot2^{\circ}$  C. In the preparation 7 grammes of palmitic acid and 25 c.c. of N-propyl alcohol were treated with  $2\frac{1}{2}$  c.c. of sulphuric acid. As the ester separated, the solution became first brown and then violet. The yield of ester was 5.5 grammes.

Methyl Stearate.—I0 grammes of stearic acid and 50 c.c. of methyl alcohol gave 9 grammes of ester. The compound crystallizes in needles, and melts at 38° C. It was previously prepared by Hanhart.

*Ethyl Stearate.*—10 grammes of stearic acid and 100 c.c. of Ethyl alcohol gave a theoretical yield of ester, crystallizing in needles and melting at 31°C. It was previously prepared by Hanhart.

*N-Propyl Stearate.*—7 grammes of stearic acid and 25 c.c. of N-propyl alcohol treated with  $2\frac{1}{2}$  c.c. of sulphuric acid gave 6.5 grammes of ester. As the ester separated, the solution became first brown and then violet.

Propyl stearate is a white wax-like solid crystallizing from petroleum ether in large prisms and melting at 28.6° C.

## PREPARATION OF TERTIARY ALCOHOLS.

Dimethyl-Pentadecyl-Carbinol. - 15.3 grammes of methyl iodide, 2.5 grammes of clean magnesium ribbon, and 30 c.c. of dry ether were taken in a conical flask attached to a reflux condenser which carried a calcium chloride tube. A trace of iodine was added, and a vigorous reaction immediately set in, so that it was necessary to cool the flask with water. When the effervescence had ceased, the flask was warmed for a few minutes on the waterbath to complete the reaction. Twelve grammes of methyl palmitate were then added in small pieces, time being given for each fragment to dissolve before the addition of another. A slight evolution of heat took place on the addition of the ester; and the flask was cooled by immersion in ice-water. When all the water had been added, the flask was stoppered and left standing overnight. Next day grey prismatic crystals had separated from the solution. Water was then added drop by drop with cooling, and the basic magnesium compound which separated was dissolved in dilute hydrochloric acid. The liquid was extracted with ether, and the extract after evaporation of the ester was treated with an excess of alcoholic potash and evaporated to dryness on a

sand-bath. The residual solid matter was extracted with ether and the tertiary alcohol thus obtained was recrystallized several times from petroleum ether. Yield, 8.2 grammes. The following are the results of the analysis of the compound :—

0.231 gramme gave 0.6806 gramme of CO<sub>2</sub> and 0.2914 gramme of H<sub>2</sub>O, corresponding to carbon, 80.35 per cent.; and hydrogen, 14.01 per cent.; 0.197 gramme gave 0.5802 gramme of CO<sub>2</sub> and 0.2509 gramme of H<sub>2</sub>O, corresponding to carbon 80.31 per cent.; hydrogen 14.15 per cent.; C<sub>18</sub>H<sub>38</sub>O requires: carbon, 79.91 per cent.; hydrogen, 14.17 per cent.

Dimethyl-pentadecyl carbinol is a white solid crystallizing in needles and melting at 35° C. It is soluble in alcohol, and very soluble in benzene, acetone, chloroform, ether, and petroleum ether.

The details of the preparation of the other alcohols were exactly similar to those described above for dimethyl-pentadecyl carbinol.

Diethyl-Pentadecyl Carbinol.—15 grammes of ethyl iodide, 2 grammes of magnesium ribbon, 30 c.c. of ether, and 9 grammes of ethyl palmitate gave 3.8 grammes of tertiary alcohol.

On an analysis, 0.1672 gramme of the compound gave 0.2112 gramme of H<sub>2</sub>O, and 0.493 gramme of CO<sub>2</sub>, corresponding to carbon, 80.42 per cent., and hydrogen, 14.13 per cent.

 $C_{20}H_{42}O$  requires: carbon, 80.44; hydrogen, 14.19.

Diethyl-pentadecyl Carbinol is a white solid crystallizing from petroleum ether in fine curved needles. It melted at  $34-35^{\circ}$  C.

Diphenyl-Pentadecyl Carbinol.—This compound was prepared from brombenzene (20.3 grammes), magnesium (3.15 grammes), ether (40 c.c.), and Methyl Palmitate (14 grammes). The reaction between the ester and the magnesium-phenyl bromide was a vigorous one; and a gelatinous solid immediately separated from the ether solution. The alcohol having been freed from unchanged ester in the usual manner was distilled with steam. By this means a quantity of diphenyl formed during the reaction was removed, the alcohol remaining behind in the flask. The latter was taken up with ether; the ether solution was dried over sodium sulphate; and the compound was recrystallized from petroleum ether until its melting-point was sharp. Yield: 8 grammes.

0.2174 gramme of the compound gave 0.2077 gramme of H<sub>2</sub>O, and 0.677 gramme of CO<sub>2</sub>, corresponding to carbon, 84.92 per cent.; hydrogen, 10.69 per cent.

C28H42O requires: carbon, 84.77 per cent.; hydrogen, 11.18 per cent.

Diphenyl-pentadecyl carbinol was obtained as a nearly colourless solid crystallizing in prisms from petroleum ether, in which medium it was very soluble. It also dissolved readily in ether, chloroform, benzene, and acetone, but was not very soluble in cold alcohol. It melted at 47-48° C.

Dimethyl-Heptadecyl Carbinol.—3 grammes of magnesium, 23 grammes of methyl iodide, 50 c.c. of ether, and 15 grammes of methyl stearate gave 10.5 grammes of tertiary alcohol.

- 0.212 gramme of the compound gave 0.626 gramme of  $CO_2$  and 0.268 gramme of  $H_2O_2$ , corresponding to carbon, 80.53 per cent.; hydrogen, 14.14 per cent.
- C<sub>20</sub>H<sub>42</sub>O requires: carbon, 80.44 per cent.; hydrogen, 14.19 per cent.

Dimethyl-heptadecyl carbinol crystallizes from petroleum ether in needles. It dissolves easily in ether, benzene, and chloroform. It melts at 44-45° C.

Diethyl-Heptadecyl Carbinol crystallizes from alcohol in clusters of needles and melts at  $44-45^{\circ}$  C. It is easily soluble in benzene, chloroform, ether, and petroleum ether.

0.1889 gramme of the compound gave 0.5596 gramme to  $CO_2$  and 0.2388 gramme of  $H_2O$ , corresponding to carbon, 80.79 per cent.; hydrogen, 14.146 per cent.

C<sub>22</sub>H<sub>46</sub>O requires : carbon, 80.89 per cent.; hydrogen, 14.2 per cent.

Dipropyl-Heptadecyl Carbinol.—3 grammes of magnesium, 7 grammes of N-propyl iodide, 50 c.c. of ether, and 15 grammes of methyl stearate gave 8.5 grammes of tertiary alcohol.

0.2325 gramme gave 0.2931 gramme of  $\rm H_2O$  and 0.6975 gramme of CO\_2, corresponding to carbon, 81.8 per cent. ; hydrogen, 14.008 per cent.

C<sub>24</sub>H<sub>50</sub>O requires : carbon, 81·261 per cent.; hydrogen, 14·2 per cent.

The compound crystallized in needles, and melted at 28-30° C.

Diphenyl-Heptadecyl Carbinol.—The details of the preparation of this compound are similar to those of the corresponding pentadecyl alcohol. The alcohol melted at 58° C., and crystallized from alcohol in long curved needles. It is easily soluble in petroleum ether, and very soluble in chloroform, acetone, and benzene.

0.2146 gramme gave 0.207 gramme of  $\rm H_2O$  and 0.6692 gramme of  $\rm CO_2$ , corresponding to hydrogen, 10.8 per cent. ; carbon, 85.04 per cent.

C<sub>30</sub>H<sub>46</sub>O requires : hydrogen, 10.98 per cent.; carbon, 85.23 per cent.

ACTION OF METHYL STEARATE ON MAGNESIUM AND NAPHTHYL BROMIDE.

2.7 grammes of magnesium, 34.5 grammes of bromnaphthalene, and 50 c.c. dry ether were taken in a conical flask fitted with a reflux condenser. Three or four drops of methyl iodide and a trace of iodine were added, and the mixture was warmed. After about two hours a reaction set in, and when the magnesium had all dissolved, 15 grammes of methyl-stearate were added. The ester began to react with the Grignard compound after about five minutes; and the change was soon completed, leaving a green gelatinous mass in the flask. This was left standing over-night, and in the morning was warmed on the water-Water was added with cooling, though the evolution of heat was less bath. than in the reactions previously described. The mixture was made acid with hydrochloric acid, the ether was evaporated off, and the oily organic layer, which did not solidify on cooling, was separated from the water and distilled with steam. The distillate consisted of naphthalene and unchanged bromnaphthalene. The residue in the flask was treated in the usual manner for the removal of unchanged ester and extracted with benzene. The benzene extract was then dissolved in alcohol, the solution was decolorized with animal charcoal, and the product was recrystallized from alcohol.

The compound was a yellowish-white solid melting at 55° C.

0.1831 gramme gave on analysis 0.572 gramme of  $CQ_2$  and 0.1757 gramme of  $H_2O$ , corresponding to carbon, 85.6 per cent.; hydrogen, 10.73 per cent.

 $C_{10}H_7$ . CO.  $C_{17}H_{35}$  requires : carbon, 85.2 per cent.; hydrogen, 10.73 per cent.

## PREPARATION OF DIETHYL-HEPTADECYL-CARBINYL ACETATE.

1.01 gramme of alcohol was dissolved by gently warming with 4 c.c. of acetyl chloride, hydrochloric acid being evolved during the process. The solution was left standing in a closed flask for two days, and was then poured into water. The oil which separated was extracted with ether; the ether solution was washed with diluted sodium carbonate, dried over sodium sulphate and evaporated. The residue was dissolved in benzene and filtered. On evaporation of the benzene, 0.8682 gramme of an oily liquid was obtained which solidified on cooling in iced water.

The ester number was determined by boiling with excess of potash.

0.8682 gramme required for hydrolysis 4.73 c.c. of  $\frac{N}{2}$  alcoholic potash, corresponding to ester number, 152.5.

The ester number of  $CH_3$ . CO.  $OC_{32}H_{43}$  is 152.17.

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[2 M]

## Proceedings of the Royal Irish Academy.

## ACTION OF ACETIC ANHYDRIDE AND SODIUM ACETATE ON DIMETHYL-PENTADECYL CARBINOL.

0.5 gramme of dimethyl-pentadecyl carbinol, 0.5 gramme of anhydrous sodium acetate, and 2 c.c. of acetic anhydride were taken in a flask with a reflux condenser, and heated in a sand-bath for one-and-a-half hours. Excess of water was added, and the mixture was extracted with ether. The ether solution was washed, first with sodium carbonate, next with water, and was then evaporated. To remove acetic anhydride it was necessary to warm the product gently with water, and again extract with ether. In this manner we obtained 0.416 gramme of an oily liquid which did not smell of acetic anhydride, and which on cooling in iced water crystallized in small stars.

0.416 gramme of the substance required for hydrolysis 2.057 c.c. of  $\frac{N}{2}$  alcoholic potash, corresponding to ester number 137.9.

The ester number of  $CH_3COOC_{17}H_{35}$  is 179.

When the ester number had been determined, the contents of the flask were evaporated to dryness and extracted with petroleum ether; and the Hübl-Waller iodine number of the extract was determined. 0.1484 gramme of extract absorbed 0.01257 gramme of iodine. The iodine number was therefore 10.16.

The iodine number of  $C_{18}H_{36}$  is 100.

## ACTION OF ACETIC ANHYDRIDE AND SODIUM ACETATE ON DIETHYL HEPTADECYL CARBINOL.

1 gramme of the alcohol was treated with 1 gramme of sodium acetate and 4 c.c. of acetic anhydride in a manner similar to that described for pentadecyldimethyl carbinol. A solid product was obtained which required 0.7 c.c. of  $\frac{N}{2}$  alcoholic potash, corresponding to an ester number of 22.

The ester number of  $CH_3CO \cdot OC_{17}H_{35}$  is 152.17.

The iodine absorption was also determined as previously described.

0.5051 gramme of substance absorbed 0.02627 gramme of iodine, corresponding to an iodine number, 5.2.

The iodine number of  $C_{22}H_{44}$  is 81.9.

ACTION OF POTASH-LIME ON DIMETHYL-HEPTADECYL CARBINOL.

I. 0.7665 gramme of the alcohol was melted on the water-bath, and an equal weight of powdered potash was stirred into the liquid. The solid mass

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obtained on cooling was mixed in a mortar with about ten times its weight of finely-powdered potash-lime, and the mixture was introduced into a hard glass test-tube. The tube was connected with a Töpler pump, exhausted of air, and heated in a mercury bath. The temperature was slowly raised to 220°; and at this temperature a considerable quantity of water came of from the mixture. After half an hour the temperature was raised to 250° C.; and the heating was continued for another half hour. No gas was evolved. The tube was then allowed to cool, and the contents were extracted with ether. 0.6 gramme of extract was obtained, which melted at  $34-35^{\circ}$  C. (the melting-point of the original alcohol) and did not decolorize bromine water.

II. 1.208 gramme of the alcohol was treated as above; but the temperature was raised to  $300^{\circ}$  C., and the heating was continued for several hours. The ether extract yielded 0.2 gramme of a yellowish oil, which decolorized bromine water.

ACTION OF POTASH-LIME ON DIPHENYL-HEPTADECYL CARBINYL.

About 1 gramme of the alcohol was mixed in a mortar with powdered potash and potash-lime, and the mixture was introduced into a hard glass test-tube. The tube was heated to 300° C. in a metal bath. On extraction of the residue with alcohol a product was obtained which decolorized bromine water.

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## IX.

## PRELIMINARY NOTICE OF SOME NEW FOSSILS FROM BRAY HEAD, COUNTY WICKLOW.

#### BY REV. W. J. RYAN, S.J., AND T. HALLISSY, B.A., M.R.I.A.

#### PLATES XXII-XXIV.

#### Read FEBRUARY 12, Published MARCH 8, 1912.

THE object of the present preliminary paper is to call attention to the discovery, in the formation known as the Bray and Howth series, of fossil organic remains, constituting new records for this formation, and representing species possibly new to science.

Considerable difference of opinion has hitherto existed among geologists with regard to the stratigraphical position of the Bray and Howth rocks in the geological series. The older geologists, including Professor J. Beete Jukes, referred them to the Cambrian system, basing their conclusion mainly on the supposed existence of an unconformity between these rocks and the Silurian beds with which they are in contact. Some former officers of the Geological Survey-notably Mr. A. McHenry-on the other hand, deny that such an unconformity exists, and regard the Bray and Howth rocks as of Upper Silurian age. In the Geological Survey Memoir to accompany Sheet 112 (Drift series), Mr. G. W. Lamplugh questions even the Lower Silurian age of the altered slates adjoining the granite in Sheet 112, and calls attention to the similarity in character of the so-called Cambrian and Lower Silurian rocks of the east of Ireland to the Skiddaw Slate series of the Lake district and to the Manx series of the Isle of Man; he thinks it highly probable that these may all form detached portions of the same ancient rock-group.<sup>1</sup> Although the general consensus of opinion inclines to the views of the earlier observers, it has been impossible, in the absence of well-recognized type-fossils from the supposed Cambrian formation, and because of the obscurity of the stratigraphical field-relations of the rocks of the district, to settle the question definitely. Hence the additional fossil evidence which we now bring to bear on

<sup>&</sup>lt;sup>1</sup>Geol. Survey Memoir to accompany Sheet 112 (Drift Series), p. 8,

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the problem will, we venture to hope, have a very great interest for Irish geologists and for British geologists generally.

On May 10th last year, one of the authors of this paper, searching for Oldhamia near the well-known Brandy Hole, at the southern end of a shingle beach at Bray Head, noticed on a huge boulder that had fallen from the cliff face, the markings shown in fig. 3, Plate XXIII. The boulder was from a mass of rock brought down in the previous February by a snow-slide. A minute description of this fall of rock was given us by a Dublin and South-Eastern Railway linesman on duty thereabouts, who, from the crash, was afraid injury had been done to the permanent way, and making a hurried search was relieved to find no harm had resulted. In the morning (the fall had taken place at night) he saw what had happened—several tons of the cliff face had been carried away by the weight of snow that piled above it. The original site of the stone block from which we were able, happily, to detach the fossil uninjured, was easily traceable. It is represented in position by one of the bands of hard green slate, just out of reach, which alternate with similar bands of purple slate rich in Oldhamia, the whole forming a picturesque inset to the hard green grits above and below. In thickness the slaty bands taken together vary from 10 to 20 feet, thinning out as they dip about 45°N.W. towards the Smugglers' Cave or Brandy Hole. Above, they disappear beneath the Boulderclay, through which, here and there, the purple slates protrude. At the northern end of the shingle beach a similar thickness of purple slate is interbedded with the grits, but, judging from the dip and other field observations, it is unconnected with the beds that we have worked. All the rocks here possess a more or less well-marked slaty cleavage, and bear abundant evidence of having undergone considerable crushing and movement.

The specimen illustrated in fig. 3, Plate XXIII, was sent to Mr. F. R. Cowper Reed, of the Sedgwick Museum, Cambridge, who very kindly gave a provisional opinion on it, and with equal kindness allows us to make use of that opinion in our paper. "I believe," he says, "that both objects on the slab are portions of the head-shield of a large trilobite. One seems to be able to detect the glabella, a wide preglabellar portion, the marginal furrow, and a broad flattened border. Whether a facial suture is present is rather doubtful, but it is certainly suggested on one side of the specimen. The glabella seems to be unfurrowed, and if the real base of the head-shield coincides with the termination of the specimen, the glabella would be about three-fifths the length. There is a curious concentric depression in the preglabellar area, but not so sharp as the marginal furrow. The ornamentation consists of small punctae, which are in some relation to the curious radial striation, which latter, however, seems to be a secondary structure and not original." It suggests to him a resemblance to Walcott's *Solenopleura howleyi* from the Cambrian of Conception Bay, Newfoundland,<sup>1</sup> but he is not certain that it is referable to even that genus.

Another specimen illustrated in Plate XXIII, fig. 5, and Plate XXIV, fig. 6, was found by us on our second visit to Bray. This was also sent for identification to Mr. Reed, who reported to us that it was confirmatory of his opinion about the previous specimen. Regarding fig. 7, Plate XXIV, the same authority compares the fossil parts represented therein with the appendages of Walcott's Middle Cambrian merostomatous species, *Sidneyia inexpectans.*<sup>2</sup> The authors of this paper, however, have been struck with the resemblance of this Bray fossil to *Louisella pedunculata*, illustrated and described by Walcott, and suggest that it may be identical with that species.<sup>3</sup> Mr. Reed concludes his description of the fossils submitted to him in the following words:—"I must suspend judgment till more material is available, and until then you must consider my views only preliminary and provisional in both cases."

Mr. Reed has not had the opportunity of examining the markings in fig. 8, which, with those of figs. 5 and 6, and many more fragments found in one or other of our eight visits to Bray Head, show a striking similarity to Walcott's recently described Holothurian *Eldonia ludwigi*, a figure of which we reproduce (Plate XXIII, fig. 4) from Walcott's paper for comparison.<sup>4</sup> Indeed, our geological and biological friends in Dublin, to whom we have shown the specimens, are convinced of the similarity. In fragments other than those illustrated the characteristic central ring and the beautifully marked radial canals are more evident. In figs. 5, 6, and 8 the typical shape, markings, and size of *Eldonia ludwigi* are at once apparent. Generic identification with Walcott's type may therefore be safely assumed.

The type species described by Walcott was found in the fine-grained silicoargillaceous shales of the Stephen formation at Burgess Pass, east of Mount Burgess, and on the west slope of Mount Field and the ridge extending to Wapta Peak, British Columbia. He supposed it to have been a free-swimming Holothurian of the order Actinopoda, with a medusa-like umbrella-shaped radially lobed body. Its conspicuous features are the alimentary canal arranged in an open spiral, situated in the umbrella midway between the

<sup>1</sup> Ibid.

<sup>&</sup>lt;sup>1</sup> " Olenellus Fauna," U.S. Geol. Survey, 10th Annual Report, p. 657. 1888-89.

<sup>&</sup>lt;sup>2</sup> "Middle Cambrian Merostomata," Smithsonian Misc. Coll., vol. lvii, No. 2, plate iv, fig. 3.

<sup>&</sup>lt;sup>3</sup> "Middle Cambrian Holothurians and Medusae," Smithsonian Misc. Coll., vol. lvii, No. 3, plate xiii, fig. 4.

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centre and the margin of the disk, a concentric muscular system in the subumbrella surface, and a system of radial canals extending from a central ring-canal to the margin of the umbrella. A large specimen found in these beds measured 12 cm. across the disc, but the majority were of smaller dimensions. In the later specimens obtained by us, which are about 7 cm. diameter, one seems to recognize the same general structure as above described; and we venture provisionally to class them under the genus Eldonia, giving them also a provisional specific name, antonii,<sup>1</sup> till later comparison of these or better specimens with Walcott's compels us to change.

As Walcott found a Crustacean fauna associated with the Holothurians in the same beds of the Middle Cambrian of British Columbia, we are content, pending better specimens, to abide by Mr. Reed's opinion, that the fossil represented by fig. 3, Plate XXIII, is part of the head-shield of a large trilobite. The difficulty, of course, is in the curious radial striation adjudged by Mr. Reed a secondary structure.

Given that the fossils represented in figs. 5, 6, and 8 are similar to Walcott's from the Middle Cambrian—and in this we have much support—and seeing that other fragmentary specimens found by us at Bray Head also point to a fauna like that obtained from the Burgess Shale deposits of British Columbia, there is at least a high degree of probability that the green and purple slates of Bray must be referred to the same horizon of the Middle Cambrian.

#### BIBLIOGRAPHY.

BAILY, William Hellier (1857):

Explanatory Memoir to accompany Sheets 121 and 130. Mem. Geol. Survey of Ireland, p. 16 et seq. 1869.

Cole, G. A. J. (1901):

Recent Observations on Oldhamia and Histioderma. Irish Naturalist, vol. x, p. 81.

----- (1908):

General Geology and Scenery (round Dublin). British Assoc. Handbook to the Dublin District, p. 5.

DU NOYER, G. V. (1867):

Explanatory Memoir to accompany Sheets 121 and 130. Mem. Geol. Survey of Ireland. 121 and 130, p. 23 et seq. 1869.

FORBES, Edward (1848):

On Oldhamia, a New Genus of Silurian Fossils. Journ. Geol. Soc. Dublin, vol. iv, p. 20.

<sup>1</sup> After a friend of one of the authors.

JUKES, J. Beete (1869):

Explanatory Memoir to accompany Sheets 121 and 130. Mem. Geol. Survey of Ireland, 121 and 130, p. 9 et seq. 1869.

KINAHAN, G. H. (1886) :

Oldhamia. Journ. R. Geol. Soc. of Ireland, vol. vii, p. 166.

KINAHAN, J. R. (1858):

On Oldhamia, a Genus of Cambrian Fossils. Proc. R. I. Academy, vol. vii, p. 34.

The Genus Oldhamia, its Character, probable Affinities, modes of Occurrence, and a description of Localities in which it occurs in the Cambrian Rocks of Wicklow and Dublin. Trans. R. I. Academy, vol. xxiii, p. 547.

— (1857-60).

On the Organic Relations of the Cambrian Rocks of Bray and Howth, with Notices of the most remarkable Fossils. Jour. Geol. Soc. Dublin, vol. viii, p. 68.

Lamplugh, G. W. (1902):

Explanatory Memoir to accompany Sheet 112 (Drift Series). Mem. Geol. Survey of Ireland, 112, p. 6. 1903.

MCHENRY, A. (1902):

Explanatory Memoir to accompany Sheet 112. Mem. Geol. Survey of Ireland, 112, p. 74. 1903.

Oldham, T. (1844):

On the Rocks at Bray Head. Journ. Geol. Soc. Dublin, vol. iii, p. 60.

Sollas, W. J. (1894);

On *Pucksia Mac Henryi*, a new Fossil from the Cambrian Rocks of Howth. Sci. Proc. R. Dublin Soc., vol. viii, p. 297.

---- (1900):

On Ichnium Wattsii and on Oldhamia. Quart. Journ. Geol. Soc., vol. lvi, p. 273.

WALCOTT, Charles D. (1888-89);

Olenellus Fauna. U.S. Geol. Survey, 10th Annual Report, p. 657.

Middle Cambrian Merostomata. Smithsonian Misc. Coll., vol. lvii, No. 2. —— (1911):

Middle Cambrian Holothurians and Medusae. Smithsonian Misc. Coll., vol. lvii, No. 3.

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## DESCRIPTION OF PLATES XXII-XXIV.

## PLATE XXII.

Fig.

- 1. A general view of the rocks at Brandy Hole, Bray Head.
- Shows the fossiliferous green and purple slaty bands of the same locality. The exact position of the beds in which the fossils were found is indicated in both figures by a white ×.

## PLATES XXIII, XXIV.

3. The supposed trilobite resembling, Solenopleura howleyi (Walcott).

- Eldonia ludwigi (Walcott), showing outlines of the stomach and large central canal; the fig. is a reproduction from Walcott's "Middle Cambrian Holothurians and Medusae," Smithsonian Misc. Coll., vol. lvii., No. 3, plate 10, fig. 2.
- 5, 6, and 8. Eldonia antonii.
- 7. Fossil resembling Sidneyia inexpectans (Walcott) or Louisella pedunculata (Walcott).

NOTE.—All the figures, with the exception of fig. 4 (which is copied from Walcott's paper), are reproduced from photographs of the actual fossils as found.



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PLATE XXII.



Fig. I.



Fig. 2. Ryan and Hallissy.—Fossils from Bray Head.

PLATE XXIII.



RYAN AND HALLISSY .- FOSSILS FROM BRAY HEAD.


RYAN AND HALLISSY .- FOSSILS FROM BRAY HEAD.

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## PROCEEDINGS

OF THE

# ROYAL IRISH ACADEMY

## VOLUME XXIX

## SECTION C-ARCHÆOLOGY, LINGUISTIC, AND LITERATURE.



DUBLIN: HODGES, FIGGIS, & CO., LTD. LONDON: WILLIAMS & NORGATE

1911 - 1912

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p. 63, § 28, 1. 3. For Erain read Érainn

p. 75, note 2. For Lupais read Lupait

p. 78, col. 1. Delete ? in line 5 from bottom

p. 79, col. 3. For Dál Niath Cor read Dál Niath Corb

,, col. 2. For Neth Semon' read Neth Semon'

p. 81, § 49. After husband of add or son of

p. 82, l. 1. For o be read to be

, § 53, last line. For Ireland before the Norman Invasion read ancient Ireland

p. 83, l. 11. For Hui read Hui

., l. 16. For Bress read Bressl

p. 85, § 68, l. 4. For Sinaig, Sinach read Sinaig, Sínach

p. 86, l. 4. For Sinaig read Sinaig

p. 88, § 82, l. 11. Before permanent read the

,, ,, l. 18. Before Ui Cennselaig read Ui Dúnlainge and

p. 102, l. 1. For ancestors read ancestor

p. 130, col. 2, l. 11. For sleep real find room

p. 150, col. 1, 1. 28. For 77 read 7

,, ,, 1. 29. For ais read ass

,, col. 2, l. 35. For there came out two filaments of milk read draws it out again ,, at foot. Omil <sup>7</sup> Supply dollotar.

p. 162, col. 2, ll. 28-30. Read when the monks of Cluain mac Nois kindled the fire

p. 163, col. 2, l. 8. For Eocha read Eochu

p. 166, note on 130, 10. For tuilim read tallaim

### PROCEEDINGS

OF

## THE ROYAL IRISH ACADEMY

#### PAPERS READ BEFORE THE ACADEMY

I.

# THE GOSPELS OF MAC REGOL OF BIRR: A STUDY IN CELTIC ILLUMINATION.

#### BY THE REV. SAMUEL HEMPHILL, LITT. D.

#### PLATES I-V.

#### Read November 14, 1910. Published JANUARY 21, 1911.

THE town of Birr, in the territory of Ely O'Carroll, was the seat of a monastery founded by St. Brendan, who died A.D. 571. He was a contemporary of his namesake of Clonfert; and they had been fellow-students at Clonard under St. Finian. He was reckoned the prophet of Ireland,<sup>1</sup> and also enjoyed in an especial manner the friendship of St. Columba. Indeed there is an ancient tradition that it was he who first advised Columba to select Iona for his retirement.<sup>2</sup> The Elijah legend recounted in *The Annals of the Fonr Masters*, that Brendan of Birr (A.D. 553) was seen ascending in a chariot into the sky, sufficiently indicates the great reverence for this saint.

Of the Monastery of Birr there are no visible traces; but the old well of St. Brendan still bubbles up out of a shelf of rock within a couple of feet of the river Camcor; and some ancient foundations were recently struck quite near it, when the electric plant was being prepared for the lighting of Birr Castle; so that one would not be surprised if the cells of Brendan's monks were once in great numbers on that pleasant site, or if the shrubs and trees now clothing the place had their roots growing out of the habitations, and perhaps the bones, of those holy men of old.

<sup>1</sup> Ussher, Works, iv, p. 473. <sup>2</sup> Ibid., p. 240. R.I.A. PROC., VOL. XXIX., SECT. C [1]

That Birr Monastery was relatively famous may be inferred not only from the glory of its founder, but from the evident precedence often accorded to the abbot or bishop of Birr in the list of deaths of ecclesiastics recorded under their proper year in *The Annals of the Four Masters*. Indeed it is borne in upon the mind of the discerning student that this now extinct monastery must have been for several centuries amongst the greatest missionary centres in Ireland. Dr. O'Donovan's excellent Index to *The Annals* helps us to make the subjoined list of the heads of the Church at Birr. I give the date of death after the name of each person.

Mac Neamnaill, abb Biorrae (745);

Folachtach MacSarfaelada, abb Biorra (760);

Leargal MacNemit, abb Biorair (774);

Joseb UaFaeláin, abb Biorair (780);

Seanchan, abb Cille Achaid Drummota & Biorair (791);

MacRiagail UaMaglena, Scribneoir, epscop and abb Biorair (820);

Baethlocha, abb Biorair (824);

Dodiu, epscop Biorra (842);

Flaitniad MacCongaile, epscop & abb Biorair (851);

Ailill Banban, abb Biorair (857);

Cartac, abb Biorair (885);

Morán UaBuide, abb Biorra (891);

Baoithine, abb Birrae (926);

Corbmac MacCongaltaigh, Comarba Brénainn Biorra (989);

Ceallach Reamhar, Comarba Brénainn Biorra & Ciaráin Saigre (1079).

Of the above, Leargal is called "a wise man"; Dodiu was bishop when Birr and Saigre were plundered by the foreigners of the Boinn, that is, the Danes who had their headquarters at Rosnaree; Moran "died after a good life at an advanced age"; and MacRiagail, as we see, was a "scribe" (*scribneoir*) as well as a bishop and abbot<sup>1</sup>; it is of the last-named that I now treat.<sup>2</sup> The title "scribe" was a very honourable one. We notice how, as in MacRiagail's case, it takes precedence of other titles in the case of some of the occupants of the See of Armagh; so honourable was it then considered to

 $\tilde{2}$ 

<sup>&</sup>lt;sup>1</sup> Δοιη Chiort ocht ccéo a pice. Δη τρεαγ βλιαδαίη το Chondobap. Μας Riažail Ua Mazlena, repibneóin, eprcop. 7 Abb Diopain... τόςc.

<sup>&</sup>lt;sup>2</sup> From the fact that five other great ecclesiastics from the same neighbourhood are associated with MacRiagail as having died this year I infer a massacre. These others are the Bishop of Clonfert, the Bishop and Abbot of Lusmagh, the Abbot of Clonfert, the Abbot of Aghabo, and the Abbot of Kilmanagh; or else all these good men died of the unusually severe cold of that year.

#### HEMPHILL-The Gospels of Mac Regol of Birr.

write out the very words of the Gospels; and famous indeed must have been the artists who turned out such magnificent books as the Gospels of Durrow and Kells, with several others of equal textual but less artistic merit, as the Books of Armagh, Mulling, aud Dimma. Now the great majority of the Celtic-Latin Gospels were written in Ireland. The Books of Lindisfarne and St. Chad are of course amongst the notable exceptions; and perhaps the angelic<sup>1</sup> Book of Kells was written in Iona; but the others named above were all written in Ireland. In *The Annals of the Four Masters* occur the names of many scribes; but, alas, owing to the ravages of the Northmen, and the decay of time, we possess no specimens of their handwriting. In the case of MacRiagail we are more fortunate, for the sumptuous copy of the Gospels exhibited in the Bodleian Library under the notation *MS. Auct. D. ii.* 19, is a product of his skill and patience. On the verso of its 169th leaf, it contains this subscription :—

	${ m Et\ intellegerit}$
" Macregol depin	istam narratio
Cxit hoc evange	nem orat pro
lium : Quicum	Macreguil scripto
que legerit	ri."2

The honour of having vindicated the penmanship of this splendid MS. for that MacRiagail who was the scribe as well as the bishop and abbot of Birr and died A.D. 820, belongs to his distinguished fellow-countryman, the Rev. Dr. Charles O'Conor, who, in 1814, published at Buckingham, at the expense of its munificent Duke, his great work on ancient Irish writers.<sup>3</sup> Up to that time the MS. was supposed to have been written in England, like the Book of Lindisfarne, which it so much resembles; and many English writers, such as Thomas Astle,<sup>4</sup> Humphrey Wanley,<sup>5</sup> and J. O. Westwood,<sup>6</sup> praised it as one of the most precious of their national monuments! Of course the word-for-word Anglo-Saxon interlineation gives to this MS. the greatest value as an authority for the origin of the English language, second only indeed to the Book of Lindisfarne. This neat interlineation of MacRegol's stately lines was executed by two English scribes, Farman and Owun, who were apparently inmates of the Monastery of Harewood, on the marches of the kingdoms of Mercia and Northumbria, at the end of the tenth century. From their

<sup>&</sup>lt;sup>1</sup> Giraldi Cambrensis Opera, v, p. 123.

<sup>&</sup>lt;sup>2</sup> MacRegol's knowledge of Latin was limited.

<sup>&</sup>lt;sup>3</sup> Script. Vet. Hibern., i, ccxxxi.

<sup>4</sup> The Origin and Progress of Writing, p. 99; also Tab. xvi, p. 100.

<sup>&</sup>lt;sup>5</sup> Librorum Vett. Septentrionalium qui in Angliae Bibliothecis extant (Ox., 1705), pp. 81, 82.

<sup>&</sup>lt;sup>6</sup> Facsimiles and Miniatures of Anglo-Saxon and Irish MSS. (Lond., 1868), p. 53.

time to the end of the third quarter of the seventeenth century, when John Rushworth, Deputy Clerk to the House of Commons during the Long Parliament, presented it to the Bodleian, its history is a blank; and, as the products of the Irish school of scribes in Ireland were not up to that date differentiated from their products in England, as also no one who was unacquainted with *The Annals of the Four Masters* could be expected to know anything about MacRegol. it was assumed that he was an Englishman. Dr. O'Conor, however, gives various acute reasons from the internal evidence of the Ms. itself, which, with cumulative force, drive home the conclusion that it was written. not in England, but in Ireland; and humorously adds:—

#### " Hos ego versiculos feci, tulit alter honorem."

Passing to the intrinsic features of the book itself, the 169 leaves of thick and coarse vellum measure 14 by 101 inches. It is thus, according to Sir John T. Gilbert,1 "the largest sized of the old Irish Gospel books." Its present binding, which is very strong and tight, and does not permit of a completely adequate photograph being taken of any of the interior pages, is in the usual Bodleian style of about the beginning of the nineteenth century. The contents are (I) the four Gospels according to St. Jerome's Vulgate.<sup>2</sup> in a text which, as Dr. Abbott thinks,3 is very like that of the Book of Kells: (II) illuminated portraits of SS. Mark, Luke, and John prefixed to their respective works: (III) a bungling variety of the traditional hexameters on the four evangelists,4 together with the subscription already mentioned. These occupy the last page, which has been divided into six equal spaces with a rude border<sup>5</sup>; and, (IV) the Northumbrian and Mercian interlineation, together with a pen-and-ink sketch of St. Mark on the blank page 51 recto, and thirteen quaint figures mostly at the bottom of the pages on which they occur. All these, being the work of the interlineators, may be dismissed from further notice here.

It is evident that the portrait of St. Matthew, with probably a quantity of the usual prefatory matter, has been lost, amid the many vicissitudes through which the MS. passed before it fortunately came into the possession of Rushworth. Indeed it bears traces of having been very roughly handled, and of having been out in all kinds of weather.

<sup>&</sup>lt;sup>1</sup> National MSS. of Ireland, vol. 1, p. xiii. His three lithographs are full-sized.

<sup>&</sup>lt;sup>3</sup> Codex B. <sup>3</sup> Celtic Ornaments from the Book of Kells.

<sup>\*</sup> Found in the following Codices, Fuldensis, and Gospels of Beneventum (Brit. Mus. MS. Add. No. 5463).

<sup>&</sup>lt;sup>5</sup> Reproduced by Gilbert, plate xxiv. of the above-named work.

#### HEMPHILL—The Gospels of Mac Regol of Birr.

It may be convenient to take first the three surviving pictures of evangelists, and dismiss them in few words. They with their borders, which resemble those on the initial pages which follow, are in four colours only; red, yellow, green, and purple (black is additional). The pigments were mixed with a gummy substance, and have not peeled off, but retain almost their pristine brightness. There is not a trace of gold, nor could gold wire have been used in the drawing of the spirals, which are, it must be confessed, painfully rough. A photograph of St. John's portrait is included as Plate 91 in the first volume of the Palæographical Society, showing the curious vellow disk upon the top of the head, which has been variously interpreted as a skullcap, the evangelist's hair, and the Roman tonsure. Plate 16 of Westwood's Facsimiles and Miniatures, containing the same, is the only existing reproduction in colours of any of these MacRegol portraits. None of the three portraits has a nimbus; but St. John's has a rainbow. The hair and facial appearance generally of SS. Mark and Luke differ greatly from St. John, and also from one another. The predominant feature of St. Mark is his light yellow hair with wavy red stripes; and of St. Luke, his large forked beard. It is also interesting to note the ink-pot, with a very long stem fastened to the right-hand side of St. Luke's chair, into which the Evangelist is in the act of dipping his pen. We may compare with this Dr. Keller's reproduction, from a St. Gall MS., of a portrait of St. Matthew in precisely the same attitude. It is noticeable that the symbolic animal painted over each evangelist is represented by MacRegol as contourné. This has been implicitly corrected by the Saxon interlineator in his pen-and-ink sketch of St. Mark already mentioned.

Before passing to what is to me the special feature of the book, the four initial pages, which ought, perhaps, according to strict logical sequence, to be described here immediately after the portraits, I must refer parenthetically to the general body of the text. A photograph of one page, 110 *recto* (Luke xvi. 25-xvii. 6), appears as Plate 90 of the first volume of the Palaeographical Society; and Sir E. Maunde Thompson gives therewith a valuable detailed analysis of the style of writing, to which the student is once for all referred. For the sake of illustration, I have thought it well to include in this paper another page, 92 *recto* (Luke iii. 8-17), which is a sufficient sample of the general style of the penmanship. This page contains two small initials surrounded with the red dots<sup>1</sup> which are so characteristic of Irish scribes.<sup>2</sup>

<sup>&</sup>lt;sup>1</sup> Some of the dots have a kind of silvery substance mixed with the pigment.

<sup>&</sup>lt;sup>2</sup> A page of the Genealogy of St. Luke is lithographed by Gilbert in *The National MSS. of Ireland*, vol. i., plate xxii.

I now return to the four initial pages which it is my particular object to describe to you. One feature common to them all, and of very special interest and importance, is the set of uncial letters in that peculiarly elongated and angular epigraphic hand, which appears on certain pages of the Book of Kells. in the Books of St. Chad and Lindisfarne, in one of the St. Gall manuscripts, in the beginning of the Book of Armagh, and, more especially, in the celebrated inscription, consisting of the names of the Apostles, round the rim of the Ardagh Chalice. This was noticed in the paper read by Lord Dunraven before this Academy on February 22, 1869, and published in the Transactions.<sup>1</sup> But the occurrence of this remarkable uncial script in the MacRegol Gospels is more interesting than in any of the other sources, except the Ardagh Chalice, because the letters come out with remarkable clearness in yellow on a light purple ground; whereas, in the Book of Kells, the colouring is so dark, and the wealth of ornament so profuse, that it is less easy to distinguish particular characters: and in the Book of Lindisfarne the letters are much more rounded. MacRegol has also this advantage that an entire alphabet of this uncial script can be constructed from his initial pages.

I deal first with the initial page of St. Matthew (leaf 1 recto). Its inferiority is attested by the clumsiness of the spirals, the coarseness of the faces at the top,<sup>2</sup> and the blunder by which the scribe did not leave himself room for the last four syllables of "generationis," but was obliged to add them in an illformed annexe outside the square border. The place of honour on this page is given to the contraction IHU (the genitive of Jesus). It has a rectangle of zoomorphic interlacing above, and of ribbon-work below. I may notice once for all that the ribbons in MacRegol have no borders, as they have in the Books of Durrow, Lindisfarne, and Kells.

The arrangement of the colours is vermilion alternating with yellow, for the ribbonwork, the step pattern, and the Chinese puzzle; the narrow borders are green; the others a dull purple. A foundation of black like Indian ink is found in some few places. Notice also the lower section of the left-hand border, consisting of a Chinese pattern in yellow and vermilion; and, beneath it, as well as at two other corners, a square of step-work, as in the Lindisfarne Book. The sections of the right-hand border are the same as those of the other side, but in inverse order. The external embellishments of the border are rather rough, but at the left corner, at bottom, there is a curious and interesting interlacing of two birds with big claws like hands, touching one another, and very well drawn.

<sup>&</sup>lt;sup>1</sup> Vol. xxiv, p. 433. See also a separate publication by Margaret Stokes.

<sup>&</sup>lt;sup>2</sup> Unless one hold that these were added by a later hand. They look very like a subsequent effort to improve on MacRegol; especially as the border would be perfect without them.

#### HEMPHILL—The Gospels of Mac Regol of Birr.

The great "I" of "*Liber*" is made up of five sections, of which the third is a curious little dark pattern with fine lines of yellow, perhaps to imitate gold thread. This may be exemplified also from the Book of Lindisfarne. Notice also the two rectangular pieces of ornamentation, the upper consisting of an interlacing of eight birds. It has a groundwork of black, the interlacing, and especially the birds' heads, being very well done; and there are some beautifully fine yellow lines, which seem to be characteristic of MacRegol.

The lower rectangle contains an interlacing of four lacertine animals with faces like dogs. It also has a groundwork of black.

We now pass to 52 *recto*, the initial page of St. Mark. The three corners of the frame have a chaste square of black with yellow lines, similar to some found in the initial page of St. Mark in the Lindisfarne Book.

The left side of the border consists of three divisions. The upper contains a very clever red worm with mouth entirely encircling its own body, like the fish-like dogs in the Book of Durrow, A fine piece of interlacing is associated with this lacertine animal; and the whole is surmounted by a more natural dog's head with his tongue and his pigtail both curled up as in the grotesque figure in the corresponding place in the initial page of St. John.

The second or intermediate division of the left side of the border contains the introduction of human faces which have a family resemblance to the grotesque figure just mentioned in the initial page of St. John. The beards and queues are yellow, and cleverly intertwined. The legs and hands are very peculiar. Each of these men has one hand to his mouth, and the other stretching down with very elongated fingers.

The lower division of this left side is a piece of excellent interlacing.

The right-hand side of the frame is similar, but in inverse order.

The lower side of the frame has two sections; the left is a very elaborate interlacing cleverly carried out, and four small birds' heads are visible. The right is a beautiful interlacing of the finest white thread on a vermilion ground on quite a different principle from any hitherto depicted, and its treatment brings out five Maltese Crosses, which may be symbolical of the five sacred wounds, and are in any case the first crosses made in Birr that have come down to our time. A similar cross is found in the stem of the great Q of the initial page of St. Luke in the Lindisfarne Book; and we shall see several other instances in our own MS.

This leaf has suffered much from the binder, as also has the beginning of St. Matthew, but not, fortunately, those of SS. Luke and John.

Of interior ornaments, not connected with the writing, there are three

rectangles. The large square under N of "Initium" consists of four serpents with dogs' heads grasping the bodies. The small square under M consists of two birds' heads opposite to one another, with some of that characteristically fine yellow interlacing on black ground, as in the beards and queues already described. The long horizontal border under "Evangelii" contains three worms with heads, of which that to the extreme left resembles in some slight degree the storks' heads in the border of the "Quoniam" page of the Book of Lindisfarne.

The great initial N, as also in the corresponding page of the Book of Lindisfarne, contains a wonderful piece of interlaced ribbon of yellow and red.

Passing to 85 recto, the initial page of St. Luke, this is the famous "Quoniam," at which the MS. is usually kept open in the glass case in the Bodleian. Though the "Quoniam" has been copied by Westwood,<sup>1</sup> it is worth a fresh study. The Q shares with that of Lindisfarne the honour of being among the largest on record. The other letters are the usual epigraphic uncials in yellow on a light purple ground which have been already mentioned.

It is scarcely necessary to describe all the ornamentation; but we ought to notice the unusual breadth of the system of interlacing of yellow and red, forming the lower section of the left-hand border, and the upper section of that on the right hand. Under this on the left, and in the corresponding corner on the right, we have a square consisting of four smaller ones, the handsome blacks and the yellow and red step-patterns.

The entire of the bottom of the frame is one large piece of zoomorphic interlacing, consisting of four large worms (two purple and two red), black background, small yellow interlacings as before, heads of worms of whitish yellow. These last are well drawn.

Special attention must be called to the top of the frame, which consists of a stiff pattern, evidently copied from stone. It is of yellow and red, and bears some distant resemblance to the pattern on the lower section of the west face of the great Cross of Killamery.<sup>2</sup> Notice at left top corner, as an outer embellishment of the frame, two wavy worms in an angular position, with faces nearly touching one another, and the usual yellow interlacings on black ground. Similar wavy worms occur on the initial page of St. John.

The shaft of the Q consists of five compartments, of which the fourth is a very fine piece of yellow thread interlacing on black ground, exquisitely done and introducing two Maltese Crosses, with halves of two others. Compare the corresponding Q in the Book of Lindisfarne, where one such Cross is

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<sup>&</sup>lt;sup>1</sup> Palaeographia Sacra Pictoria: London, 1843-45.

<sup>&</sup>lt;sup>2</sup> Figured by Margaret Stokes, Trans. R.I.A. vol. xxxi, Plate xlviii.

#### HEMPHILL—The Gospels of Mac Regol of Birr.

found. The round of the O, as distinguished from its interior, also consists of five compartments, of marked inferiority to the interior of the Lindisfarne Q.

The outside angles, at the upper left and lower right of Q, are the nearest approach to trefoil which MacRegol exhibits. These are in lines of black on red.

All the divisions of Q have green lines, but none of these divisions calls for special mention. I may, however, say that the spirals are disappointing.

The letters other than Q are in the usual yellow on light purple with red borders; the only one of them calling for remark is s of "sunt," which is the clearest instance of the epigraphic shape.

Of the three interior rectangles, that under *dem* of "*quidem*" is very well done, and consists of four bird-worms, in which the claws are the most remarkable feature. They are yellow on black ground, and do not come out in Westwood. I look on this as one of the finest pieces of work in the MS.

It is necessary to add that Westwood's engraving of this great Q leaves very much to be desired, as he puts in a great deal too much black shading, giving the page a sombre appearance foreign to the truth.

We now come to 127 *recto*, the rich "*in Principio*" page. This has been lithographed as Plate XXIII. in the first volume of *the National MSS. of Ireland*. But it is necessary to state simply in the interests of truth, and without any reflection on the scholarship of the editor, that, since the advent of photography, all such lithographs have been superseded.

Looking at this page in MacRegol we see sharp definition and plenty of contrast in the colours.

The left of the frame is surmounted by the upper part of a man quaintly drawn; his yellow beard and queue in MacRegol's best style of interlacing, the beard coiling twice round the right arm, the fingers spread out with the thumb to the nose,<sup>1</sup> and, fantastically interlaced with the fingers, a vocal reed through which the man is playing a tune; while a worm-dog, with a heraldic tongue, looks on in amazement *vis-à-vis* with the musician.

Below this four birds are cleverly interlaced, and their claws come out with great distinctness, the design being repeated in the inverse position on the right of the frame.

At the top of the right of the frame is a man with his arms raised as if in blessing; and as outer embellishments to the lower corner of the right of the frame are two venerable faces looking sadly into space.

The Maltese Cross pattern occurs in two places, the lower section of I and the upper of P, in the usual red, but is rather indistinct.

R.I.A. PROC., VOL. XXIX., SECT. C.

<sup>&</sup>lt;sup>1</sup> Compare Ezekiel, viii. 17, for the earliest instance of this.

The drawing of "PRINCIPIO" is the most fantastic thing in the whole MS. The initial is in the conventional B-shape, the "R" is in the upper loop, the "I" in the outside valley made by the convergence of the loops, and the "N" (resembling our capital H) in the lower loop. Contiguous to this is a tall rectangle like a cupboard divided into three shelves; the upper shelf contains "CI," the middle contains the Greek " $\Pi$ " with "I" inside it like a monogram, and the lower contains "O." Thus is made up the word "Principio," which no one could possibly read if he did not know what to expect. In fact, it is a most intricate puzzle, and can hardly, I should think, be paralleled in any other MS.

It only remains that I should express my deep obligation to Bodley's Librarian, Mr. Nicholson, for his considerate kindness in allowing me to examine the Ms. for several days, and to take photographs; and to Mr. Madan, Sub-Librarian, for valuable help generously given; also that I should acknowledge the excellence of the photographs taken by Mr. Maynard, the capable operator of the Clarendon Press.

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PROC. R. I. ACAD. VOL. XNIN., SECT. C.



Liber Generationis Ihu Xri Filii Dauid Fili Abraham.

securdam Matheum.

Incipit cuangeli





Initium Euangelii Ihui Xri Filii Di sicut scriptum est. Incipit enangelium secundum Marcum.

MACREGOL.

OF

-GOSPELS

HEMPHILL







HEMPHILL.-GOSPELS OF MACREGOL.





 $\bigcirc$ 

HEMPHILL.—GOSPELS OF MACREGOL.



PROG. R. I. ACAD. VOL. NNIN., SECT. C.

PLATE V.

61 + <u>ک</u> 2 5 5 란 5 0 entratione directives quici even have aver area pointered in the providence of the p marin couptible 7 on 1971 printes in Sould the sould be the printer of the printe The state of the state of the personal the open of the open is the state of the sta poemanaa uente aaraen pokaok meganus hon FULTURE CULCEN INCERROGUE CINCURS CICENCES contain entire societais acoraciones arabertan puesa ur ét omme ergo arbori nonpatiens prigim bo ans neque calumnicum puodus coornaria clao UTICE puccenus and a contraction mentanon gapage ZOREITOUR te tapence uenzas gufamentas curtam populto o COGULARINGUS OINIJOUS INCORCIÓUS SUIS CICIÓN "nonderte a rete haved min alle soet prine. DICETS DTITIOLE " Some of partie Struke of toph de delapicibus ilas ensaren pun abrilant Frion 10h suum Goorgelgubic eracum suum inorreums AT - UNCOS INTRIC COMPUS CONFORMATIN AC UODIS unne netouzoe to se ese con parte pondito to hannis uendadorum numany ente Courganic arean 101 Sarrole codinals and priate 2 Dacampo D'aller. The REPUBLIC TUTIEN GOUPLICON NO DUCINA DE DUCINA Jonne くして formend him . 7.20 mutage of at to preteriana St feed of Jop Furn & mid Sir pothot boab Scarp Tpinze 2377 Lanya Burn barne the g slost ally rondon acapt too.1 9. Harra Prost ropidan 2734430 Print and Lingrad overb" The fad with \* robles coas 12637 Sober 1

triticum suum in orreum .-- Luc. iii., 8-

.

Ds de lapidibus istis .

HEMPHILL.-GOSPELS OF MACREGOL.





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Plate VI.



FIG. 1.-Dunnamo, south end of wall and fosse.



FIG. 2.-Dun Kilmore, outer wall and fosse. Westropp.-Cliff Forts of Co. Mayo.

### [ 11 ]

#### Π.

#### NOTES ON THE LARGER CLIFF FORTS OF THE WEST COAST OF COUNTY MAYO.

#### BY THOMAS JOHNSON WESTROPP, M.A.

#### PLATE VI.

#### Read NOVEMBER 30, 1910. Published JANUARY 21, 1911.

THE recent examination of Clare Island, and the other islands south of Achill, in county Mayo, under the auspices of the Academy, required that the antiquities of these remote spots should be carefully examined and recorded. I was accordingly asked to explore much that was virtually new ground to antiquaries; this, in its turn, necessitated more study than had been previously given to the antiquities of the nearer mainland. Early racial and historic considerations made this very necessary, for a great gap isolated (save at Westport) all the seaboard of Mayo from the inland parts, and still more from the district from Galway, to the south coast of Munster, which had been more fully studied. The result was richer than I could have hoped; some even of the chief remains were unmarked on the Ordnance Survey maps, and absolutely unnoticed by previous writers. Considering the results of two summers' work, it is evident that, though much lying outside the special district ought to be given, I should overload the report by including it there. It seems well, therefore, to clear the ground by describing fully several of the more complex remains of the Mayo coasts to form a preface to the account of the southern cliff-forts in the more delimited paper intended to form part of the general report.

It is wonderful that so little is attainable about these forts. The great beauty of the shores and bold mountains of the west coast of Mayo has drawn many travellers to them, even when less accessible than at present; but writer after writer came and went, and the forts remained undescribed, with one exception. The great fort of Dunnamo, since 1752, attracted attention; first Dr. Pococke noted it as a modern fortification of the time of Elizabeth. Trotter, in 1817, saw and described it before the destruction of the abattis; O'Donovan and the Rev. Caesar Otway described it at (for them) unusual length : yet there is no complete description or detailed plan published to the present time. Dun Fiachra was for the first time noted

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(but only noted) by Dr. Charles Browne in these Proceedings; Porth was mentioned, in a rather misleading way, by Caesar Otway; the greatest and most complex of all, the Dun of Kilmore in Achillbeg, was accidentally found in last August. To describe the remains of these four great duns is the object of this paper.

#### THE DISTRICT.

There is the less reason at present to study at any great length the topography of the districts in which these forts lie that O'Donovan has given us his vast stores of knowledge in "The Tribes and Customs of Hy Fiachrach," and Mr. Hubert T. Knox has again gone more fully and with the aid of the Anglo-Norman records over the facts in the Journal of the Royal Society of Antiquaries of Ireland, and in his still recent "History of the county Mayo, to the close of the sixteenth century."

The district<sup>1</sup> was essentially Domnonian, or, to use the more popular but also more vague ethnological term, "Firbolg." Mr. Knox notes that the term comprised Danonians; but it was more properly restricted to the Fir Domnon, Fir Gaileoin, and Fir Bolg; the last, in a definite sense, he inclines to equate with the Bolg Tuath, who, with the Gabraighe, Cathraighe, and the Cruithne of Croghan, are given by Mac Firbis as the tribes of Genann.<sup>2</sup> We may yet again recall the record of the Gann-Genann tribes on the Atlas of Ptolemy as the "Ganganoi." The Fir Gaileoin were regarded as "Cruithne," and were identified by some with the Tuatha de Danann, which seems to remove them into absolute myth. The Nemedians revived as the Firbolgs, who invaded Ireland under the sons of Dela, and allotted Connacht to Genann; they have the repute of having been the first to establish Tara as the royal seat. Avoiding the nets of legendary origins, we find at the dawn of history the kingdom of Irrus-Domhnon, comprising the Clan Umoir tribes, spread over northern Connacht; the last echo of its name seems heard in the baronial name "Erris." In this division lie the forts of Dunnamo, Dun Fiachra, and Porth. The Gamanraighe and Clan Morna branches of Irrus Domhnon were probably the source of the race whose monarchs Fiachra Foltshnathach and Amalgaidh have left their mark on our maps in the baronies of Tireragh and Tirawley. It is not impossible that the mighty

<sup>&</sup>lt;sup>1</sup> See "Tribes and Customs of Hy Fiachrach" (O'Donovan); "History of County Mayo" (Mr. Knox); and articles by the latter in Roy. Soc. Antt. Ir. Journal, vol. xxxi., p. 24, p. 365; xxxii., p. 132, by Sir John Rhys; *ibid.*, vol. xxviii., p. 233; and Mr. J. MacNeill's "Study of Oghams" in Proc. R.I.A., vol. xxvii., p. 332; Sir S. Ferguson, "Ogham Inscriptions," pp. 58, 59; Mr. R. A. S. Macalister, "Irish Epigraphy," part i., pp. 73-75: see also Sir S. Ferguson, Proc. R.I.A., ser. ii., vol. ii., p. 201.

<sup>&</sup>lt;sup>2</sup> See " Book of Leinster," Todd Lecture series, vol. iii., No. 830, p. 149.

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hero Fiachra, riding on the famous "water-horse," the builder of Dun Fiachra, may be the great tribal ancestor of the Ui Fiachrach. The Clan Umoir plays a much greater part in the Connacht legend than in that of Mac Liag, a North Munster poet of about A.D. 1000, whose poem on their settlements we had recently to study in connexion with Aran. In the latter poet, they are a small family settled at Cruach Oigle, or Cruachan Aigle,<sup>1</sup> at or on Croagh Patrick, whose huge blue peak is the central feature of all the scenery south of Achill, with which our later paper is concerned. All we can take out of the legend here is that a tenth-century bard told how, about the beginning of our era, their names attached to Aigle and Modh, the great group of some three hundred islets in Clew Bay. I find no evidence to support the suggestion connecting the name of Modh with Dunnamo. The name means more probably "Fort of the cattle," as forts named from animals are of frequent occurrence in Ireland.

In the fourth century, we touch firmer ground in the history of the north of Mayo. Eochu Mughmheadoin, High King of Erin, about A.D. 358, married Mongfionn. Her attempt to secure the kingship for her sons by poisoning her brother, the High King Crimthann mac Fidach, about 377, failed,<sup>2</sup> but it put its mark on southern history in giving part of the present county Clare as an "eric" to Crimthann's foster-son Connall Eachluath, the ancestor of the Dalcassian Princes.<sup>3</sup> Fiachra was a mighty warrior. He again and again overran this "monstrous cantle" assigned to Munster out of his ancestral province. He penetrated the old territory of Thomond as far as Kenry and Cahernarry; but he fell in the former district in a pitched battle at the moment of victory. His body was brought away and buried, the Munster hostages being buried alive round his grave.

From him, in Christian times, tribal genealogists derived the chiefs, and later writers the entire races of Ui Fiachrach and Tir Fiachrach (or Tireragh), and from his son Amhalgaidh, the Tir Amhalgadha (or Tirawley). Amhalgaidh had a son Corb, or Corbri, probably commemorated on the oldest written record of the clan, the great pillar stone of Breastagh, erected to a "son of Corbri, son of Awley," "Maqu Corrbri Maq Ammlongatt."<sup>4</sup>

<sup>&</sup>lt;sup>1</sup> See Mr. Knox, Roy. Soc. Antt. Ir. Journal, xxxi. p. 35. Tirechan distinguishes the "cruachan" from the "high hill over it. Murrise Aigli is the shore district below it.

<sup>&</sup>lt;sup>2</sup> "Book of Ballymote"; see Silva Gadelica (S. H. O'Grady), vol. ii., p. 373.

<sup>&</sup>lt;sup>3</sup> Some regarded Lugad and his son Conall Eachluath as Kings of the Ui Catbar and Ui Corra already settled in the later county Clare; but the idea of "Clare" being rent from Connacht and the "Lugad" tales colour all belief in Munster and Southern Connacht from the earliest times. They even originate a tabu of the King of Connacht, in the "Book of Rights": "to the heath of Luchaid let him not go in a speckled cloak." The event lay so close to the introduction of Christianity and written records as to be essentially historic.

<sup>&</sup>lt;sup>4</sup> Journal Roy. Soc. Antiqq. Ir., vol. xxviii., p. 272, and plate. The son's name is possibly Eolaing (gen. Iuleng), "Ulengenqu."

Aicill seems to have been a district at both sides of Clew Bay, including the present Achill. The latter name, now derived from the "eagles," is found as "Eccuil" in its first record, in 1235, and later on, "Eacuill," or "Acuill";<sup>1</sup> it evidently included the Curraun peninsula, to Bellacragher to the east of it, over which the ancient parish of Achill extends, now, as in Petty's time.<sup>2</sup> To us it seems very probable that down to comparatively late historic times<sup>3</sup> the island of Achillbeg was joined to its great neighbour by a bank of boulder-clay, where the Blind Sound is now open, and that probably Achill Island itself was also a peninsula.<sup>4</sup>

Giolla Iosa Mac Firbis about 1417 wrote a poem which tells us a few facts about the forts, then, as in much later times, used for residence. "Dunfloinn, which none durst invade . . . a white-walled edifice" at Buninny. "Each cruach (round hill, or perhaps fort) is protected by a wattle fence" near Balla. The "splendid lime-white doorways" show that the custom in Kerry of whitewashing a broad band round the door and windows then prevailed.<sup>5</sup>

The later history of the districts sheds very little light on their forts. The Burkes and Barretts in the Mullet, and the O'Malleys farther south, are traditionally connected with some of the structures. I see no reason to doubt the making of such obvious places of refuge in even very late times. As I have shown in a recent survey of the Promontory Forts of Northern Kerry, we have at least two such forts—one, Dunanoir, made in 1579; the other, at Ballingarry, in 1637.<sup>6</sup> Certainly there is evidence for extensive rebuilding at Dunnamo, which legend connects with the Burkes, and Pococke considered Elizabethan, and for the Dangan of Kilmore, where, as at Dunvinalla,<sup>7</sup> a mortar-built wall was constructed over apparently far older works. On the other hand, Porth and the rest of Kilmore give evidence of early occupation, as we shall see, while the impressive sense of age which the two great cliff forts of Cahercarbery, on Kerry Head, suggest,<sup>6</sup> is at least not weakened when we find that the recent excavations in the Welsh fort of Pen

<sup>&</sup>lt;sup>1</sup> O'Donovan refuses to decide if its name is derived from the eagles or the Nangles (Ord. Survey Letters, Mayo, vol. i., p. 340). It is Eaccuil, or Eccuill, 1235; Eacuill and Acuill, *circa* 1570; Aukilles, 1574; and Ackill in 1584. A dialogue of Fintan and the ancient eagle of Eacuill is given in the Book of Fermoy (Irish Texts, R. I. Acad.), vol. xv., p. 43.

<sup>&</sup>lt;sup>2</sup> "Hibernia Delineata," 1683, and "Down Survey," 1655.

<sup>&</sup>lt;sup>3</sup> The breaking of Inis Fitae, in Co. Clare by the sea, in about 800 (799-802), and the cutting by the sea of the narrow neck which joined Dunros in Tirawley to the land in 1393, are recorded the latter by Mac Firbis (note A. F. M., 1393). There is much evidence of submergence on the west coast of Ireland.

<sup>&</sup>lt;sup>1</sup> The fortifications of Dunnaglass are against a now non-existent approach from the west.

<sup>&</sup>lt;sup>5</sup> See "Hy Fiachrach," pp. 265, 285, 195, 255.

<sup>&</sup>lt;sup>6</sup> Journal Roy. Soc. Antiqq. Ir., vol. xl., pp. 115 and 193.

<sup>&</sup>lt;sup>7</sup> Dunbhinneala (O'Donovan), Doonminulla (Otway).

<sup>&</sup>lt;sup>8</sup> Journal Roy. Soc. Antiqq. Ir., vol. xl., p. 123.

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y Corrdon<sup>1</sup> reveal the peculiar form of rampart occurring in both the Cahercarbery forts, and, so far as I am aware, nowhere else on the Irish coast, which probably gives that type of structure a considerable antiquity.

#### PROMONTORY FORTS OF MAYO.

The northern coast of Tirawley and Erris has not been fully explored by antiquaries'; but it possesses two cliff forts of different types, and both probably of great age. The early ecclesiastical settlement of Downpatrick Head (Ordnance Survey map 7) seems to have succeeded a cliff fort, of which traces remain on the projecting headland, and on the great rock-pillar of Dunbrista. The headland of Port, in Conaghra, near Glenlossera (O. S. 6), was probably another fort. There is a strong fortification of earthworks, with a mortar-built wall, at the huge rock-castle of Dunvinalla (Dunbhinneala) at Portacloy (O. S. 1). Doonmara (O. S. 4) in Porturlin is probably the site of a shore-fort on a rock. Along the shore of Broadhaven (O. S. 3 and 4) we first find Dunanierin and Dunkeeghan, or Dookeeghan<sup>2</sup> (Dun, or Dumha Caochain,<sup>3</sup> in 1417), an entrenched headland, with the remains of a castle of the Barretts. Farther up the haven is Duncarton (O.S. 4), or Dunkirtaan (Dun Cartain); the headland is fenced all round, with the foundations of several buildings inside, and a castle and earthworks on the neck (O. S. 4).

Crossing into the Mullet, there may have been a fortified spur between two gullies on the eastern shore; but the traces of the fosse are very slight, and the dry-stone wall is nearly removed. Along the western coast, however, is a remarkable succession of fortified headlands. Spinkadoon (O. S. 2) had a stone wall, and, I think, an outer fence, now almost levelled. The neighbouring Dun Fiachra or Dun Fiachrach was strongly fortified, as we shall see. Dunnamo (O. S. 9), the chief fort of the Mullet, had an abattis, two fosses, and mounds, the inner capped with a dry-stone wall, and, on a rising ground inside it, a nearly levelled ring-fort. Dunaneanir, not far to the south, has a remarkable walled rock, only accessible by a reef at low water. Across a narrow chasm to the south, we find an unusually small

<sup>&</sup>lt;sup>1</sup> Archaeologia Cambrensis, vol. x., Ser. vi., p. 79, and reprint by Mr. Willoughby Gardner, p. 34, for comparison with the forts at Kerry Head.

<sup>&</sup>lt;sup>2</sup> The use of 'Dun' and 'Dumha' for the same structure is frequent in Irish literature. Sir John Rhys pointed out certain Gaulish divine epithets, ''Mercurius Dumiatus,'' and '' Segomo Dunates,'' which he suggested referred to the words 'Dumha' and 'Dun' (Hibbert Lectures, 1886, pp. 12, 34), perhaps referring to the hill-fort in which the god was reverenced. One of the '' Maqi Mucoi Netta Segamonas '' inscriptions lies in a ring-'' fort '' at Island, Co. Waterford. The Journal Roy. Soc. Antiqq. Ir., vol. xxxvi., p. 251.

<sup>&</sup>lt;sup>3</sup> The Ui Mac Caochain tribe, as marked by O'Donovan on the map of Ui Fiachrach, runs half way from Cuan inbhir mhoir, or Broadhaven, eastward.

entrenched headland, and the grave of Eanir (Ean Fhir, 'the lone man'). Near the glebe-house we have Dunadearg, a walled rock-tower, probably accessible only by a plank, or a natural arch, now fallen; and across the bay to the south, at the lowest point of the shore, is a long massive rampart (hereafter described with the curious group of huts and souterrains inside its defence. The rest of the Mullet, with low or sandy shores, did not lend itself to such fortifications; and it is noteworthy that far inland from the shore we have described the ring-fort is almost unknown. Dun Domhnaill and about six other ring-forts lie from Blacksod Bay to Glencastle; but only, at the most, two ring-forts' are recorded in the whole of the Mullet.

We meet no further sites till we come to Achill.<sup>2</sup> Its ring-forts are notable for the unusual thickness of their walls compared to the size of their enclosure, only four are recorded, and they are all greatly defaced; two are nearly levelled. An island called Dunmore and a headland Dunagappul remain near Doogort (O. S. 42); about half a mile eastward lie the Doonty sea-rocks. On the southern shore at Dooega Head, is a headland called also Doonty, over a cove named Gubadoon, "the mouth of the fort " (O. S. 54). Farther eastward, in the Blind Sound, or Bealach-glas (O. S. 65), is an isolated fort, once on a promontory, named Dunnaglas. On Achillbeg are two cliff forts, Dunacurrogh<sup>1</sup> (O. S. 65), and the great and complex Dun of Kilmore (O.S. 75).

The forts south from Achillbeg, on Clare Island, Caher Island, Inishbofin and Inishark. are reserved for the survey of that group of islands.

The allusions to the promontory forts in early writers down to 1200 are very few and vague, save the Cuchullin-Curoi legends in the Dindsenchas, and other works. The names *Cothair* and *Dun* are used for such forts in them as at present. For example, Balor's Prison, on Tory Island, is Cathair Conaind, as well as Tor Conaind, in the Book of Leinster; Dunseverick, Downmacpatrick on the Old Head of Kinsale and Caherconree are Dun Sobairche, Dun Cernmna and Cathairchonrui in the "Triads." Dun Crimthann on Howth was probably not the Bailey Fort, but on the Dun Hill or where the St. Laurences built their first castle at the harbour. Baginbun Fort seems to have been known as Dun Domhnaill at the time of the Norman invasion. Names like Dunnabrattin, Britons' (i.e. Welsh) fort, and D onegall, foreignets' C Norse fort, show that some of these structures were believed to have been made or garrisoned by invaders.<sup>4</sup>

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<sup>&</sup>lt;sup>1</sup> The supposed trace on a knoll near Elly, presumed by O'Donovan to be the fort Oileach, named as 'beyond the waves' of the Inver Blacks d Bay, in 1417, and one in Emlagh.

<sup>&</sup>quot;Unless the "Doon," a low shore rock on Iniskea North, be a fort. I could not learn its character.

<sup>&</sup>lt;sup>2</sup> Locally "Dunacurroge."

<sup>&</sup>quot; Irish Triads" ed. Kuno Meyer, Todd Lecture Series. vol. xiii., p. 5. Also "Codex

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The types which I suggested, in 1906,<sup>1</sup> as a basis of a survey of the promontory forts, nearly all occur. They are: (a) the simple promontory fort with a single wall or mound and fosse—e.g. Spinkadoon, Dunaneanir, and Porth; (b) the complex fort of several earthworks, with or without a stone wall, e.g. Dunnamo, Dun Fiachrach, Dunacurrogh, and Dunnaglass; (c) the "entrenchment and citadel,"<sup>2</sup> of which no example occurs in the district under examination; (d) the multiple fort, with a fenced promontory and lesser fortified headlands connected with it, such as Dun Kilmore. The predominance of the prefix "Dun," so marked all round Ireland, is especially marked in county Mayo.

Of the features of the Mayo Forts from Broadhaven to Achill, we find, as usual, no perfect gateways; but enough remains to show the structure of the entrances at Dun Fiachra, Dunnamo, Porth, and Kilmore. Dunnaglass has a banquette or terrace—a very rare feature in such forts; it, Dun Kilmore, Dunnamoe, and Porth have the remains of huts. Steps—as is also true of Irish cliff forts in general—do not occur. Another rare feature, the earthwork with a banquette, which I noted in two cliff forts in Corcaguiny, Kerry, occurs in Dunnagappul on Clare Island, but is not in the scope of this paper. Fresh water, as a rule, is found close to, but not in any of, these forts.

#### DUN FIACHRA (O.S. 2).

Dun Fiachra, or more correctly Dún Fiachrach (pronounced Doonfiera), in Aghadoon.<sup>3</sup> Local tradition only remembers Fiachra as the owner of a famous "water-horse," mounted on which he used to leap across the narrow gullies into the Dun.<sup>4</sup> As we suggested, he may be perhaps identified with Fiachra Foltsnathach, ancestor of the Tireragh and Tirawley chiefs, living in the latter half of the fourth century, a generation before the introduction of Christianity into northern Connaught. It is interesting that his descendant, king Eogan Bel, was buried in a fort named Rathobhfiachrach and Rathuifiachrach, upright, holding his spear, and with his face turned northward against Ulster.<sup>6</sup>

Palatino-Vaticanus" (ed. Rev. Dr. MacCarthy). Same series, vol. iii., pp. 147, 148). See also Dindsenchas (ed. W. Stokes), *Revue Celtique*, xv., p. 448 (ed. E. Gwynn), Todd Lecture Series vol. vii., p. 57.

<sup>&</sup>lt;sup>1</sup> Journal Roy. Soc. Antiqq. Ir., vol. xxxv., p. 240.

<sup>&</sup>lt;sup>2</sup> Like Islandikane and other forts in county Waterford.

<sup>&</sup>lt;sup>3</sup> Aghdoon in Petty's maps, "Down Survey" 1652, and "Hibernia Delineata," 1683, No. 33.

<sup>&</sup>lt;sup>4</sup> There is also a legend that the dun was a resting-place of the hapless swan maidens, the daughters of Lir.

<sup>&</sup>lt;sup>5</sup> "Tribes and Customs of Hy Fiachrach or O'Dowds' Country" (ed. J. O'Donovan, 1854), p. 472. Rathuifiachrach was probably on the opposite (north-eastern) border of Connaught.

The place was not unworthy of so great a chief; it lies in the townland of Aghadoon in the Mullet, in the barony of Erris, at the north-west corner of county Mayo. A stream flows into the southern creek, which, like the opposite gully, ends in a beach of shingle on which quantities of wrecktimber are often washed up. Though only level with the opposite sides of these bays, it rises considerably higher than the land at the end of the neck. The cliffs of dark rock are brightened by thick veins of snow-white quartz, running up through the strata and with thinner side branches. A waterfall descends the cliff to the south, nearly opposite to the defences of the dún.



FIG. 1.-Dun Fiachrach, the Mullet, Co. Mayo.

Low down the narrow neck are the nearly effaced remains of a wall, about 6 feet in thickness; it has no fosse. Going westward by the narrow path, along the summit of the neck, at 58 yards from the first wall, we find a second, 8 feet thick, which, though levelled to the foundations, shows that it had two faces of large blocks, the interior being filled with earth and stones. At 18 feet from this, westward, is a short but well-marked fosse, 7 feet deep. It is 12 feet wide at the bottom, and 21 feet at the ground-level. A gangway, 8 feet wide, crosses it about 25 feet from the northern, and 10 feet from the southern cliff. Inside this is a sloping glacis 18 feet wide, and nearly 40 feet from cliff to cliff. At the summit of its slope is a strong wall, very slightly curved (convex to the land); its faces were of regular
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blocks, with which the entrance passage is also lined; the filling was also of stones and earth. The bottom layer of the face is laid as stretchers; the upper part as headers. The wall is from 9 feet at the passage to 10 feet thick; the entrance is 3 feet 9 inches to 4 feet wide, and looks towards the E.S.E., directly towards the old road-way which leads in that direction from the end of the neck up the slope of the shallow valley to the plateau. Inside the gangway on the glacis, just below the gateway, lies a slab of stone, very probably the lintel of the gateway; it is 5 feet 2 inches long, sufficient to span the opening, which is only 3 feet 9 inches wide - a mere "creep entrance." Inside we see that the garth was fenced with a thinner wall, from 4 to 5 feet thick, of earth and stone. The space within the gateway is 29 feet 6 inches wide, the gateway being 6 feet from the southern, and 21 feet from the northern, of these fences. The narrow space widens into a broad garth on the summit of the head, falling in a fairly steep slope to the gate. The garth was tilled, and so no traces of huts or inner divisions remain. At about 136 yards from the gate the sward ends and only a bare rock-surface-the earth washed away by storms-and heaps of rocks remain beyond.

### DUNNAMO (O. S. 9).

Dun na mbo, "the fort of the cows," as Owen Heenaghan, of Emlybeg, wrote in 1821,<sup>1</sup> for, according to tradition, the people of the Mullet secured their cattle in its ambit during the terrible battle of Cross—a conflict unrecorded in history, but which set its mark deeply on the traditions at Termoncarra.<sup>2</sup>

The first to notice the fort, but not by name, was Dr. Pococke<sup>3</sup> (soon afterwards ordained Bishop of Ossory), in 1752. In that year he went from Achill to the Mullet. He called on Mr. Anthony O'Donnell, at Termon Carra, and rode along the sea-shore to the "N.E." (N.W.) of that place. He "observed a small detached rock which had some fortification on it (Dunaneanir), and, going further, saw a little head which was defended by a modern fortification made across the neck of it in Queen Elizabeth's time, as they say, in order to deposit goods that were shipwrecked, that they might not be plundered. I went on further, and returned, seeing a little to the westward (southwestward) a passage underground from the sea where the tyde goes in about 50 yards, and is seen from a large hole<sup>4</sup> over it." The main interest in this

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<sup>&</sup>lt;sup>1</sup> Letter fastened into a copy of P. Knight's "Erris in the Irish Highlands," R. I. Acad. Library. O'Donovan (O.S. Letters, Mayo, vol. i., p. 251) says :—" The name is locally pronounced Dun na mbo, as if signifying Dun of the Cows," but suggests that the correct form is Dun modha, from the chief of the Clan Huamor.

<sup>&</sup>lt;sup>2</sup> See "Erris and Tyrawley" (Rev. Caesar Otway), p. 89.

<sup>&</sup>lt;sup>3</sup> Dr. Pococke's Tour in Ireland, 1752 (ed. Rev. Dr. G. Stokes), pp. 90, 91.

<sup>\*</sup> Poulnashantinna, between Dunnamo and Dunaneanir.

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is who "they" were whose statement, that so indubitably archaic a structure was Elizabethan, Dr. Pococke and his editor so readily received.

The fort was first described by John Bernard Trotter,<sup>1</sup> who visited it October 4th, 1817. He mentions the rocks thrown up by the sea in storms, and continues :—" Doonamoe point presents to the curious the spectacle of a very old and massive wall drawn across it with an entrance left, and a kind of large guard-house within on one side. In front stone stakes, of great height and size, had been driven in after the manner of the chevaux de frise. The nature or cause of this antique fortification is unknown to all the people of Erris." He recognized its likeness to Baginbun, but considered it far more ancient, and possibly Danish. He does not mention the ring-fort, which had probably been levelled even before the time of his visit.

P. Knight, C.E., in 1836, barely mentions "Doon a moa" in a list of forts in Erris. He took no interest in such remains save "as showing the former importance of the country." In an appendix he gives from his sister's notes a very artificial and evidently "touched-up" legend, but possibly based on a real tradition. The owner of Dun Domhnaill, Donald Doolwee, reserves for himself "the peninsula on the west coast where the beautiful Doon a moa still stands."<sup>2</sup>

John O'Donovan<sup>s</sup> gives us a most valuable study of its remains in 1838. Less aptly than Trotter, whose account he quotes, he compares it to the Norman fortifications at Rindown, on Lough Ree; but he had evidently at that time seen no other actual promontory fort. He continues :—" The wall extends across the neck of the  $Rinn.^4$ ... The military wall of Dunamoe is in the secondary cyclopean style—that is, built of rude stones, without cement, but not of the massy character which distinguishes the age of the giants. It is 8 feet high, and seems to have been originally 15 feet high. It had a door or gateway in the middle, which is now entirely disfigured and destroyed; and, on the outside, there is a trench of considerable depth sunk in the earth immediately under it and parallel with it. Inside this wall there are three small enclosures of oblong form (built of stone and lime-andsand-mortar), and one larger than either outside it; but they are not ancient or coeval with the large wall (p. 254).

"Near the south-eastern extremity of the *Rinn* are some slight traces of what I conceive to have been a round stone fort; but its stones are so displaced by the Atlantic storms, which have thrown up among them a vast

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<sup>&</sup>lt;sup>1</sup> "Walks through Ireland " (1812-1817; published in 1819), pp. 503, 504.

<sup>&</sup>lt;sup>2</sup> "Erris in the Irish Highlands." 1836, p. 108; appendix, p. 167. The story is retold by Otway.

<sup>&</sup>lt;sup>3</sup> Ordnance Survey Letters, Co. Mayo (MSS. R.I.A., 14. E. 18), vol. i., pp. 251-256.

<sup>&#</sup>x27;His usage of the term "Rinn" shows how Rindown had impressed him.

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quantity of rocks and flags torn from the cliffs beneath that it is impossible now to form the slightest idea of its extent,  $\ldots$  or even to decide with certainty whether it was square or round.<sup>1</sup>

"The stone stakes . . . are now nearly worn down to the stumps by the intruding Atlantic, which dashes upon them not only water, but sometimes pebbles and stones of some weight. The Atlantic here is as great a destroyer of antiquities as the utilitarian ! . . The angular buildings are decidedly modern; but the stone stakes, the cyclopean wall, and the trench may be of considerable age."

The Rev. Caesar Otway<sup>2</sup> in 1845 gives a valuable sketch-plan and careful description so inaccessible to most readers that I must abstract it at some length :-- " Dunamoa, ... a wall about 10 feet high ..., from cliff to cliff. protected outside by a fosse cut in the rock, and, in the centre, there was a gateway, protected by outworks containing caserns and covered ways of a singular and elaborate construction. This wall and the ruin bore marks of remote antiquity, their stones large and cyclopean.... The promontory ... bore traces of being fenced all round.... Near the seaward front, ... inclining to the south, there are the foundations of a square building of some size; ... its exact form I could not trace,... In front of the wall and besetting the whole plain ... a great number of sharp, flaggy rocks are fixed on end. Mr. Michael Anthony O'Donnell, of Termoncarra, said that he remembered stones here not only much larger but more thickly set.... They were .... brought down to build the adjoining village." Otway cites O'Donovan's extract from Trotter for their former size, and says they were taken for quoins and sills in the adjoining village. Mr. O'Donnell also said that the tradition ran that Dunamoa "was erected by the Burkes, and was besieged and taken by the Danes." Otway's plan differs altogether from those of the Ordnance Survey and Mr. Wakeman's paper; but it is more accurate and makes one regret that a man capable of such solid work has left us so little. as he passed by most remains without description, while eagerly giving their legends. I reproduce his plan for comparison with my own.<sup>3</sup> His reason given for the destruction of the abattis is far more probable than that of O'Donovan, although stones of considerable size have been washed up and blown about in storms on headlands little lower than that of Dunnamo. Small pillar-stones over 5 feet long, suitable for an abattis, are not uncommon on the moor about a mile east from the fort.

The three last writers to notice Dunnamo entered into little detail.

<sup>&</sup>lt;sup>1</sup> It is unmistakably oval. <sup>2</sup> "Erris and Tyrawley, pp. 67-71.

<sup>&</sup>lt;sup>3</sup> I was careful not to refresh my memory of his plan until my own was made and checked on the site.

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Mr. W. Wakeman, who had visited the fort with O'Donovan in 1838, was resting at Belmullet, in 1886, after completing work in Sligo.<sup>1</sup> Hearing of "lines of upright stones and an immense dry-stone wall," he recalled his former visit, and went after forty-eight years again to Dunnamo. Unfortunately his paper is almost confined to notes on the plan, which is very inaccurate. He notes the lines of stones more to the west (south-west), and shows a curved-walled fosse (really straight). The passage was 3 feet 8 inches wide; there were three bee-hive huts behind the wall, 9 feet long by 4 feet 6 inches wide. The rampart was 210 feet long,<sup>2</sup> 8 feet thick, and in places 18 feet high (really 8 feet), with no sign of mortar. The fosse was 6 inches (really 8 to 9 feet) deep and about 14 feet wide. The abattis stones were in four rows. The circular fort was 109 feet in diameter.



FIG. 2.—Dunnamo Fort. The Mullet, Co. Mayo. A. rampart: E. fosse: c. shallow fosse: n. gateway: E. hut at gate; F. G. H. guardrooms; I. J. huts inside fort: K. enclosure.

Dr. Charles Brown<sup>3</sup> (1894) notes that only the part of the wall "overhanging the sea on the south side" was perfect, the facing neatly fitted and without mortar. Colonel Wood-Martin, in 1894, gives a brief account, based on Wakeman, and with his plan and view; he says the fosse is "a foot deep."

<sup>&</sup>lt;sup>1</sup> For Col. Wood-Martin's "Rude Stone Monuments."

<sup>2</sup> Reete about 120 feet : the figures got reversed.

<sup>&</sup>lt;sup>2</sup> Proc. R.I.A. vol. iii., Ser. iii., p. 640 . Ethnography of the Mullet," &c.

<sup>\* &</sup>quot; Pagan Ireland," p. 190.

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The fort is beautifully situated on a headland (240 feet high at the ringfort) and commanding a noble view of the lighthouse on Eagle Rock, and southward to the huge mountains at Mulranny and Achill and to Iniskea Island along a series of foaming bays and dark headlands and reefs.

The builders, as in the vast majority of such forts, took advantage of a fault in the cliff; that at Dunnamo is a deep-marked cleft ending in coves and conspicuous far away. Down the southern half of the fault a natural gully, with a small stream, saved half their work, and a broken, ragged slope outside it gave them a suggestion for the abattis. The illustration<sup>1</sup> shows how well they raised the wall on the mainly natural scarp. The fine layers of pink, grey, and dark brown gritstone, were more easily quarried, as a deep fosse was dug to the north side of the intended entrance.

Describing the features in order, we first reach a patch of velvet-like sward, mainly sea-pink, in which some forty low stones, rarely exceeding a foot high, more usually barely rising over the surface, mark where the tall spikes rose a century ago. They begin at 30 feet from the outer entrance, and run in a patch, 18 feet wide and 15 feet out from the mound, for about 66 feet. The lines at the northern end radiate from a point in the rampart where now no mark or feature is visible ; they all (as Wakeman noted) are in four rows. Unlike the abattis at Dun Aengusa, Dubh Cathair, and Ballykinvarga, in Aran and Clare,<sup>2</sup> there seems to have been a space between these spikes and the defences. This, if true, is a case of want of foresight, as giving free ground for an enemy to reform and move freely in an attack. We rather incline to think that the depression outside the mound, now nearly filled up, was a fosse, with an outer mound levelled when it was filled, and that the stones were set up to the latter earthwork.

The next defence, and also confined to the north of the entrance,<sup>3</sup> is a well-marked mound of earth, in front of it a clearly marked, but shallow, depression, 6 feet wide and about 6 inches deep, which some previous writers have confused with the effective fosse. It begins at 10 feet from the end of the entrance wall, running, like the other works, approximately towards the E.N.E.; then it can be seen for over 80 feet as far as to the gully at the "northern" end of the great fosse. It runs for 15 feet past the end of the

<sup>&</sup>lt;sup>1</sup> Plate vi., fig. 1.

<sup>&</sup>lt;sup>2</sup> See Proceedings R.I. Acad., vol. xxviii. (c), p. 21, and p. 180, and vol. vi., Ser. 3, p. 429; also Trans., vol. xxxi., Plates liii, lvii.

<sup>&</sup>lt;sup>3</sup> It is interesting to find that certain French promontory forts, of considerable complexity, are absolutely lop-sided, the entrance being along the edge of a crag, and the walls running across only part of the ridge or neck (Bulletin, Préhist. Soc. de France, 1908, p. 73; Couzon, 1909, p. 302; Clédar, Alpes Maritimes: Essai d'inventaire des Enceintes Préhistoriques (Castelars), du Var. Dr. A. Guébhard, 1906, from Compte rendu du premier Congrès Préhist. de France, p. 44, Le Barban.

chasm, and then curves regularly round to meet it. This is evident proof that it curved round the mound, which, for at least 15 feet, has disappeared with the falling cliff since the earthworks were dug. A shallow fosse outside a stone wall, though rare, is not unknown. It occurs at Caherconree, a mountain cliff-fort, and is even mentioned as at the fort in the legend of Cuchullin, in "Bricriu's feast"-" out over the stone wall (cathair) till he fell into the mire of the fosse at the palace-gate."1 We also find it at Doonaunroe, in Clare, and at certain Cork and Kerry ring forts, like Staigue, Cahernanackree, and Cahermoygilliar. The mound is of the usual type, about 3 feet high and 9 feet thick on top. It is of light, rather loose soil, with a layer of stones under its surface, and above the present level of the field. The fosse is cut into the rock to the "north-east" of the entrance. It is straight, 6 to 7 feet under the field-level, and is 6 feet wide at the bottom, and 22 feet at the field-level. It commences at 28 feet from the entrance wall, and runs for about 54 feet to the break of the gully; as we saw, it probably ran for about 15 feet farther when entire. The inner mound is 21 feet thick, and is nearly covered by the dry-stone rampart and the talus of fallen stones to either side.

It seems that the original works consisted of the natural stream-bed, and scarps to the left (south-west) of the entrance and the fosse (or fosses), with the earth-mounds to the right. The rampart was probably rebuilt several times. The outer entrance seems different from any recorded in the primitive forts, not only in Ireland, but elsewhere in the British Isles, and on the continent of Europe; although external defences of the gateway, sometimes of considerable complexity, are not unknown.

As shown by Otway (and the remains tally generally with his plan) the enclosure was shield-shape, running to a point, with the entrance in the right flank. It is about 46 feet long, the wall 5 to 6 feet thick. To the right, about 25 feet out from the wall, is a nearly levelled circular hut, 13 feet across, between the entrance and the head of the great fosse. This and another hut (of which I saw no trace, and which Otway does not mark) to the left are shown, flanking the entrance, in the Ordnance Survey Map of 1840. Wakeman gives the gateway as 3 feet 8 inches wide, which closely agrees with that of Dun Fiachra (3 feet 9 inches), but no trace of this is visible through the debris, and a new wall built across the gap.

The rampart is straight, resting for the "southern" part on the upturned ends of the strata along the fault; a low ledge about 9 feet high, apparently a natural scarp, turns back at the south-west end. The "northern" part rests on the mound inside the fosse. The whole is 118 feet long, 65 feet

<sup>&</sup>lt;sup>1</sup> Fled Bricrend (ed. G. Henderson, Irish Texts Soc.), p. 105.

# WESTROPP-Larger Cliff Forts of West Coast of Co. Mayo. 25

3 inches to the south of the plan-line, the wall extending 52 feet 6 inches to the "north," the mound for 15 feet more, stopping 15 feet from the cliff. It may have been 150 feet long in all before the northern gully fell in. It is 9 feet high, where most complete near the "southern" end, or 17 feet if we include the low crag on which it stands. It is about 20 feet thick in the middle, and 14 feet at the "north" end. The facing is good and regular, of thin slabs of no great size; but very little now remains, as, unlike the limestone cathair walls elsewhere, there are no long headers to bond it, and the filling is small and loosely thrown in, not, as is usual, carefully packed behind the facing, as the latter was laid layer by layer.

Taking the plan-line through the gateway as a conventional base, there is a space (7 feet long to the wall of the "northern" guard-room), which Otway shows as a second cell. The existing cell had an opening into it, and is irregular in plan, the north-east corner being cut off. It is 9 feet by 5 feet; the door at the north-west corner opens into a rectangular "yard," nearly levelled, at the south-west corner of which, adjoining the gateway, are the foundations of a circular hut, 7 feet 6 inches in diameter inside. The walls seem about 3 feet thick in every case; there is abundance of blown sand and broken shells; but so far as I could find, on two examinations, there is no trace of mortar. To the "south" of the entrance is another guardroom, shown by Otway; it is now so entirely overlaid with debris that only its outer wall, 17 feet 6 inches long and 3 feet thick, at 8 feet 9 inches from the line of plan, is discernible. At 10 feet from its "south" end lies a circular hut 12 feet over all, with a somewhat square annexe, 12 feet each way (over all) to the south-west side. At 15 feet from this the rampart ends at the natural scarp, whence a steep, rough slope ends in a formidable precipice.

There are no other hut-sites or ancient fences in the garth. On its highest point are the traces of the ring-fort. Only the eastern and western segments are traceable, and heaps of storm-blown stones from the rocky slope seaward conceal the outline. So nearly as I could measure it is 75 feet over all, east and west, and 63 feet north and south, by 51 feet east and west inside. The walls are about 12 feet thick; and it lies about 243 feet back from the rampart.

## PORTNAFRANKAGH OR "PORTH" (O.S. 9).

Passing the fortified rock and unusually small promontory fort (barely 27 feet each way) at Dunaneanir, we go down the coast, past the end of Portanalbanach, or "Scotch Port," and the glebe, till beside the larger bay of Portnafrankagh, or "French Port," we reach a large headland known locally as "Porth" and "Port Point," which was defended by a great

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rampart on the landward side. As for the word 'Port,' if not derived from the bay, it is a not uncommon word for a fort.<sup>1</sup> The Dindsenchas of Almu uses it as synonymous with *lis* (les) and *dún*; the "Book of Rights" reserves it for chief forts, like those reserved to the King of Cashel. Like most native words for forts, it is not confined to any one type of defence. This, though very simple when compared with Dunnamo, or even Dun Fiachra, is so strong and unusual in its surroundings as to require careful consideration. Like nearly all the Mullet Forts (Spinkadoon, Dun Fiachra, Dunadearg, and the small cliff fort at Dunaneanir), it is unmarked, even on the new maps. Otway, in 1845, passed over its remains without noticing their character; and when Mr. O'Donnell pointed it out to him, it "required some accurate inspection to prove it to have been a fortification." He found it to be a stone rampart reduced to 3 feet in height, with "indistinct traces of a gate and some side lodges." There were extensive "caves, or rather burrows," not regularly built souterrains.2



FIG. 3.-Porth Fort, and group of huts, The Mullet, Co. Mayo.

The low headland, in fact, is fortified carefully against landward attack; it was very accessible from the sea at many points; but the ancient occupants never even fortified a knoll inside it with a ring-wall. They built a great rampart on the lowest part of the neck, through even, marshy ground; they had not dug a fosse through the soft, wet field outside the wall, or carried back the end of their fortification along the low bank on the shore to the north for

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<sup>&</sup>lt;sup>1</sup> Dindsenchas (ed. E. Gwynn, Todd Lecture Series, vol. vii., p. 15; Leabhar na gCeart (Book of Rights, ed. O'Donovan), p. 93. The Danish fort of Linn Duachail is called "Longport" in the Annals of Ulster. <sup>2</sup> " Erris and Tyrawley," p. 64.

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more than 25 feet. Another remarkable fact is that, save in the cathairs of Moghane and Turlough Hill in Clare, and the Cahercarberys on Kerry Head,<sup>1</sup> I have never seen such evidence of systematic overthrow save where the fort was used as a quarry. Here at Porth this was not the case; the great lintels lie close to the defaced gates, and the marsh is strewn with the large slabs of the wall. If it was a great work arrested almost as soon as it was commenced, this could hardly be so; and I incline to believe that the remains are the only record of some remote great tribal tragedy where a colony, possibly of searovers, was exterminated and their fortress carefully overthrown lest it should be used for other enemies.

Destructions of forts are, of course, very common in early Irish literature. and down to comparatively recent times, as in the "Cath Finntraga," where we read of the crowding into three forts near Fahan of the inhabitants and their domestic animals and their destruction by fire. In the "Cathreim Conghail Clairinghnigh,"<sup>2</sup> however, we have a striking case of the extermination of an invading band and the demolition of their fortress, the Cathair of Muirn. Conghal bids his men "destroy this cathair, that it may never be inhabited after us, and that the world may not be harried from it any more." It lay on the seashore, and Conghal sails away with the booty. Earlier in the same story, which may date from the time of the Norse wars, we read how Niall comes in his chariot to Dundabeann<sup>3</sup> (Sandle Mount), and sees its grianan and palace burning, the great cathair destroyed, and blood-stained bodies on its chief posts. The occupants of Muirn's cathair, too, were all slain and enslaved, and the jewels distributed. So also in actual history we have such episodes as that in A.D. 869, when "Dun Main, in the west of Ireland, was demolished, and an extraordinary and indescribable slaughter was effected there."<sup>4</sup> The Norse plundered the promontory fort of Dun Sobhairche in 933.<sup>5</sup>

The Niala Saga,<sup>6</sup> in telling of the song of the Weird Sisters before the Battle of Clontarf in 1014, makes them prophesy of Ireland :—

"Now new-coming nations that island shall rule Who on *outlying headlands* abode ere the fight."

The site was in many ways desirable for invaders, having suitable creeks

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<sup>&</sup>lt;sup>1</sup> Journal Roy. Soc. Antiqq., Ir., vol. xxv., p. 224, and vol. xl., p. 123; also Proc. supra, vol. xxvii. (c), p. 218.

<sup>&</sup>lt;sup>2</sup> Irish Texts Society (ed. Mac Sweeney), pp. 57, 145.

<sup>&</sup>lt;sup>3</sup> This fort is also described in the "Mesca Ulad."

<sup>4 &</sup>quot;Wars of the Gaedhil with the Gaill" (ed. Todd Rolls Series), p. 33.

<sup>&</sup>lt;sup>5</sup> Chronicon Scotorum (ed. Hennessy).

<sup>6 &</sup>quot;Burnt Nial," Sir G. Dasent's translation (ed. 1900), p. 328.

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for their ships, rich grass inside and before the wall, rabbits in the sandhills, fish, shell-fish, and birds round the shore. The other promontory forts, on the other hand, were on high, steep cliffs, with unsheltered, inaccessible creeks unfit for seafarers, but very suitable for places of refuge of the landward population during a raid.

The simplicity of the fort favours a belief in its great age. The wall is 10 feet thick in one section, without steps, terraces, or elaborate gateways. The northern end is returned along the low cliff for 24 feet; thence it runs southward (by compass), being of large stonework without filling, usually 4 or 5 feet high outside.

At 290 feet from the northern bend it turns abruptly to the S.S.W., each reach being in a straight line. This southern portion is inferior and perhaps later, being of stone-faced earthwork, 8 to 10 feet thick. It is fairly preserved for 78 feet, then nearly levelled, but still traceable for 45 feet to the end of the low drift-bank, 10 to 12 feet high, on the shore of Portnafrankagh Bay. The blocks of the northern part are often 3 feet to 4 feet 6 inches, and 2 feet to 2 feet 6 inches, and a foot to 15 inches thick. They are well laid but with open joints. At 156 feet from the north is a gateway, the piers between 3 and 4 feet high. There are apparent remains of a second entrance, and, still farther south, of a third gap without piers. The lintels lying near the first two measure 4 feet 6 inches and 5 feet 2 inches long. The first ope, like those of the cliff-forts, was under 4 feet wide. The whole wall is 436 feet long.

I saw no "guardrooms," but there were some slight walls at right angles to the rampart. At 117 feet westward from the gap we find on a low rocky knoll an early settlement. At the south end is a sunken cell 6 feet inside, whence a passage curves to the north and east. There is an ambry in the first, such as we find in beehive huts in Kerry, and in a souterrain in one of the cathairs of Ballyganner, County Clare. The passage is 21 feet long, Near the end is a hut-ring 18 feet across, and to the north-east of the last a few feet away another hut, with two cells 6 feet and 3 feet wide inside, and 24 feet over all. Further north 12 feet away is another curved souterrain 36 feet long, bending to the north-east round the outside of the last hut. A low oval mound, 12 feet by 9 feet across, lies 18 feet from another house-site, 15 feet by 12 feet, which is 9 feet from the two-celled hut. Northward, also 9 feet away, is an irregular enclosure, its wall, 6 feet thick to the west and south, and 3 feet elsewhere, divided by a crescent wall into two rooms; the southern is 12 feet each way, the northern 15 feet long. A nearly levelled hut, 21 feet over all, adjoins the last on the south-west. All is levelled to about a foot high, and the subterranean parts are uncovered, probably by Mr. Dawson before 1841.

### DUN KILMORE (O.S. 75).

The most complex of the Irish promontory forts, save Doon-Eask Fort near Dingle,<sup>1</sup> is "Dun Kiluole," or Dun Kilmore, on Achillbeg Island. It is most remarkable that such a work escaped the notice of the Surveyors; neither it nor the name appears on the Ordnance Maps. It shows how unfavourably the determination to dispense with antiquarian aid has affected the Survey from a national point of view, when such forts as Dunroe, Porth, Dun Fiachra, Doon Castle, and Doonaunmore promontory forts are absent from "authoritative maps," and others like Dunabrattin, Ferriter's Castle, Meenacarroge, Brumore, Dundahlin, and Doonegall have only recently been marked; but the surveyors are hardly blamable.



The fort, or series of fortifications, stands on three low headlands westward from the Scalp or low valley through the Islet.

At the landward end we first find a fosse 10 feet wide and rarely over

<sup>1</sup>Journal Roy. Soc. Antiqq. Ir., vol. xl., p. 281.

 $[5^*]$ 

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4 feet deep, with a stone-faced earthwork inside, convex to the land. The mound is about 20 feet thick and 9 feet high; much of it only retains the facing for about 4 feet up from the fosse; but near the northern bend<sup>1</sup> is a reach 8 to 10 feet high, well built of carefully laid slabs, with a regular batter of 1 in 4 to 1 in 5 —a rather unusual slope. This rampart is 138 feet long, and has fallen with the cliff at the southern side, but runs along the northern cliff (a steep, grassy slope), and meets the ring-fort. The gateway faces the east, and is 6 feet wide, lined with set slabs like those in the evidently very early forts of Moghane and Turlough Hill.

Entering the forecourt we find, at 36 feet from the inner piers of the gate, a kerb-like row of blocks running N.N.W. and S.S.E.; its object is not apparent.

At 65 feet from the outer gate we reach a fine ring-fort.<sup>2</sup> There is no trace of an outer mound; and the fosse is nearly filled to the east. A gateway faces the outer gate, which it exactly resembles in design and width. The mound is earthen, and was once stone-faced all round, though little of the masonry remains. It is 20 feet thick and rises 4 feet to 6 feet over the garth; and to the west it is 18 feet thick and 9 feet high above the ditch. It measures 259 feet over all, east and west, and 220 feet inside, the northern part having fallen with the cliff; the garth is only 150 feet across, north and south. The western fosse is 6 feet wide below, 10 feet at the field-level, and 3 to 5 feet deep. It still holds water in wet weather, as we had every opportunity of observing in the late August, so destructive, by its endless storms and rain, in County Mayo. There is a gangway 3 feet wide, 45 feet from the northern cliff, opening westward; thence there is for 18 feet a deep cutting into the ring, with set slabs, and long since grassed over. The ditch is 4 feet 6 inches deep for 96 feet, and more shallow for 114 feet to the edge of the south cliff, which is uninjured, and forms a steep, grassy slope.

In the garth is an early burial-ground called Kilmore; no trace of a church remains, but there are numerous graves lying east and west in a low rectangular mound, hardly a foot high, measuring 43 feet east and west, and 25 feet north and south. There are also some small cist-like enclosures of slabs, and a round, low slab pier or altar, 3 feet high and 6 feet across at 16 feet from the east gateway. A similar "altar" lies outside the mound at 54 feet to the west of the last, and 100 feet from the north cliff. Each is

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<sup>&</sup>lt;sup>1</sup> Plate VI., figure 2.

<sup>&</sup>lt;sup>2</sup> The occurrence of a ring inside a promontory fort is not unprecedented. Besides Dunnamoe in Ireland, the two promontory forts at Appenay sur Belléme (Orne), France, have each a low ringfort or mote, 6 feet high, the earthworks rising nearly 11 feet over the fosse; they yielded worked flints and fragments of vases. The fosse is nearly 56 feet deep. (Bulletin Soc. Préhist. de France, 1910, p. 325.)

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heaped with rounded stones from the shore, nearly all of pure white quartz, which frequently are laid *ex voto* on undoubted altars and on holy wells elsewhere. On my asking one of the bystanders if such was the case, there was some hesitation in the reply; and at last we were told that it was children put them there, and that the place was not a Christian burialground. A basin, or "bullaun," 16 inches across in a block of brown gritstone, lies near the north-west corner of the mound, as is common in old graveyards. There are hut-enclosures against the rampart to the north-west.

At 167 feet from the ring-fort we reach a creek between the two outer headlands. The neck of each is fortified. The southern, called the Dún, has two fosses, with three mounds running straight across it, at 30 feet from the head of the creek. The outer mound is barely traceable and 8 feet wide; the outer fosse is 9 feet to 10 feet wide and 4 feet to 5 feet deep. The central mound is 16 feet wide, and appears to have had a strong fence to its landward face, leaving a banquette behind. This feature occurs in better preservation at Ferriter's Castle in Kerry, and the inner west mound of Cahermurphy Castle in Clare. Traces also occur in Doonagappul on Clare Island, which bears considerable likeness to the inner Dun of Kilmore. Inside is another fosse, 16 feet wide above, and in parts 7 feet deep. It has a levelled inner mound, 7 feet to 12 feet thick.

The middle of the fosse is filled up from 42 to 71 feet from the northern cliff by a hut nearly levelled, and measuring 27 feet north and south by 32 east and west over all, with walls, 6 to 10 feet thick. The whole workare 123 feet long, and the ends seem uninjured by the sea. There are no hutsites on the headland, off the end of which is a detached rock of equal height with the Dun.

The northern headland is called "Dangan." We were told that last year (1909) the side-wall of a mortar-built structure of that name, with several "loop-holes" in it, slipped down the north cliff. There is faint trace of a wall across the neck; then, at 138 feet from the end of the creek, is a fosse, 28 feet wide at the ground-level, 9 feet deep, and 36 feet long, to the south of the gangway, which follows the line of the ridge of the neck. All to the south has perished in the landslip which, with masses of stones of the overthrown building, hung about 12 feet down, needing but little to start it again on its journey into the sea below.

Inside the fosse is the wall, below of dry stone (or, rather, perhaps a stone-faced mound), on which rests the base of a mortar-built wall, 10 feet thick, and barely 4 feet high. It was probably a mediæval guardhouse, built across the older works, utilizing the northern half of the fosse for a basement story.

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While I was told by a young man, of his own accord, a story of two giant brothers, residents in the Dun and the Dangan, one of whom by mistake killed the other, "with a shot," and then slew himself, I found some unexplained hesitation in giving any information about the graveyard. The altars (so the older men said) were over the giants; but they denied that Kilmore was a Christian burial-place, or that pebbles on the altars were ex voto. The natives, during our two visits, treated us with the utmost kindness and courtesy, nor, save in that matter, showed any unwillingness to tell all that they knew of the places or themselves. As to burial in promontory forts, such cases occur as the ogham pillar in Dunmore on the Blasket Sound in Kerry and the "giant's grave" in Doon Eask in the same county. There is a very curious case, dating about 990, given in the Eyrbiggia Saga. A certain Thorulf died, and his body acted as a vampire, slaying men and cattle. The neighbours, as the Ulstermen did in the case of Eoghan Bel in this very province, exhumed the corpse and removed it with some difficulty to a little headland, where they re-interred it. His son Arnkel then raised a wall right across the promontory, to the landward of the "howe" (mound), sufficiently lofty "that none might come thereover," and imprisoned the vampire. The remains of the wall about 18 feet high, remained on "Haltfoot's Head" in Iceland when the saga was written.<sup>1</sup>

It would be unpardonable to dogmatize as to the age of these singular defences. Whether the inner headlands were first entrenched and then the outwork or the ring-fort was made nearer the land, or whether the outwork was the afterthought, I dare not try to decide. I incline to believe that it was later than the ring-fort—first, because such an annexe to ring-forts (whether of earth or stone) is always later than the principal fort and also because the cutting away of the northern part of the ring while the northern bend of the annexe remains, suggests that the original full width of the cliff was occupied by the fort. There is no reason to assume that the latter was a crescent, or it is more likely to have been closed to the north for shelter, as there was an equally safe cliff on the south side, on which it could have been made to abut.

It is, however, very evident that an early Christian church (or churches), perhaps of wood and clay, was built inside the ring-fort. Churches—for "Kilmore" may imply a "Kilbeg," timber—because in a place so little disturbed traces of stone oblong buildings might be expected to remain.<sup>2</sup>

<sup>&</sup>lt;sup>1</sup> "The Story of the Eredwellers-Eyrbiggia Saga" (W. Morris and E. Magnusson), pp. 91, 92, and Notes, pp. 281, 282. It was written about 1220; but the hero is alleged to belong to the end of the tenth century.

<sup>&</sup>lt;sup>2</sup> As we have more than once pointed out, the present nearly treeless condition of the district

## WESTROPP-Larger Cliff Forts of West Coast of Co. Mayo. 33

The name "Kildanat" is shown at this place in Petty's map of Mayo, 1653; in 1683, in "Hibernia Delineata," and Kildanai on Watson's map, 1786; There is another Kildawnet near the castle, not far up the Sound from Achillbeg. The defacement of the defences of the Dun, by an evidently early hut, shows that the inner fort was regarded as of no importance by the later occupants of the headland.

The number of legends of giants attached to the cliff-forts of Mayo is noteworthy, and evidently implies that, to the natives, the structures lay in an unremembered past. Dunbrista was the abode of the giant "Geodruisge," Duncartan of "Kirtaan," Dundownall of "Donnell Doolwee." Fiachra, "Eanir," and "Darrig" seem to have been of superhuman size—Fiachra's horse having been able to leap into Dun Fiachra; "Eanir's" grave being 12 feet long; and "Darrig" having been perhaps able to leap over the chasm into his fort. Otway, however, was told that "Darrig" was a recent outlaw. The *red* rocks of the *fort* of Doonadearg and the ring entrenchment at the point near the *single* grave show that both persons were made from the names, simple though these were. All these gave their names to fortified headlands, whence Dun Fiachra, Dunaneanir, and Dunadearg. The allocation of a residence to each giant brother at the Dun and the Dangan at Kilmore, and the accounting for the ringwork as the burial-place, are more interesting as a piece of folklore.

Dunnamo and Dunanierin, on the other hand, were the work of mere men in local tradition in Mayo. On the Clare and Kerry coasts, and those of Aran, Waterford, Wexford, and Dublin, I never found any supernatural being regarded as a fort-builder on the headlands, nor any supernatural occupants but the "Grey man" of Dunlecky and the "Maelchu" (or earless dog) of Browne's castle.<sup>1</sup>

In selecting these typical forts I was tempted to include others like Dunnaglas; but I think the cases described above are sufficient to clear the ground and form a preface to the account of the antiquities of the more southern islands, whenever, and by whomsoever, laid before the Academy.

proves nothing, as there is abundant evidence in names and documents that many regions were thickly forested even in the early seventeenth century.

<sup>&</sup>lt;sup>1</sup> Specially confected out of the personal name Maelchu, to account for the place-name Clashmelchon. Journal Roy. Soc. Antiqq. Ir., vol. xl., p. 108.

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# III.

# GLASS-MAKING IN IRELAND. By M. S. D. WESTROPP.

#### PLATES VII.-IX.

#### [Read FEBRUARY 27. Published APRIL 1, 1911.]

NOTHING appears to be known at present about any manufacture of glass in Ireland previous to the close of the sixteenth century, and even for a considerable time after that the records are very scanty.

In the year 1589 one George Longe, in a petition to Lord Burleigh (Lansdowne MSS.) asking for a patent for making glass, proposed to reduce the number of glass works in England, and to set up eleven new glass houses in Ireland.

Longe stated in his petition that he had found the materials and had brought to perfection the making of glass in Ireland, having employed at least twenty-four persons for two years, and spent upwards of  $\pounds 500$  on the undertaking. He also stated that he bought the patent for glass-making in Ireland from Captain Thomas Woodhouse, who, together with a Ralph Pylling, assisted him in setting up two glass houses. Woodhouse had obtained a patent in 1588 for eight years for making glass in Ireland.

Nothing further, however, seems to be known concerning any glass made in Ireland by Longe, or even where his glass houses were situated.

In 1608 an Adam Whitty of Arklow obtained a licence to manufacture glass in Leinster for ten years.

The next record we have relates to a glass house near Birr early in the seventeenth century. In "Ireland's Naturall History," by Gerard Boate, published in 1652, it is stated that, early in the century, several glass houses were set up in Ireland by the English, among the principal of which was that near Birr, which was said to have supplied Dublin with drinking-glasses and window glass. Boate also states that at this period no glass houses were erected in Dublin or other towns, but all in the country; and that the sand for glass-making came from England; the alkali was obtained locally from the ash-tree, and that the clay for the pots came from the north.

Cooke's "History of Birr" states that in 1623 Sir Lawrence Parsons granted a lease of part of the lands of Clonoghill, near Birr, to Abraham Bigo, with a proviso that the tenant was not to set up any glass house or glasswork on any other land, or to buy any wood of any other for his glass-work, but only of said Parsons. This glass house appears to have been carried on until Easter, 1627, when the lease was surrendered.

Remains of an old glass house, which may have been that erected by Bigo, were discovered about forty years ago at Clonbrone, near Birr.

The Bigo family appear to have been refugee glass-makers from France, who came to England and finally settled in Ireland early in the seventeenth century. Besides the Birr glass-works carried on by Abraham Bigo, Philip Bigo, in the reign of Charles II, obtained grants of land in the neighbourhood, and is said to have established glass-works, but no traces of them have yet been found.

Most of the glass houses erected in Ireland after about the middle of the seventeenth century being in towns, those in the several towns will be noted separately under the town in which each was situated.

#### DUBLIN.

The earliest record of a glass house in Dublin occurs in the second half of the seventeenth century, though exactly when it was set up is not at present known—probably about 1670.

In D'Alton's "History of the County of Dublin" mention is made of a glass house having been erected by a Captain Philip Roche, presumably late in the seventeenth century.

This glass house was probably in Mary's Lane, Dublin, as it is stated that it was afterwards carried on by a Mr. Fitzsimons; and a Christopher Fitzsimons was proprietor of a glass factory in this locality early in the eighteenth century.

In the Parish Registers of St. Michan's Church, Dublin, several entries occur, from the year 1677, relating to glass-makers, and in March, 1696 (o.s.), there are entries of the burial of the following seven persons who were killed by the fall of the glass house, viz. :—William Loecraft, Daniel Smith, Charles Wheaton, Bartholomew Rivers, John Robinson, William Leasy, and Laurence Hughes. The glass house was probably soon rebuilt and the manufacture of glass continued.

Philip Roche, who lived at Finglas, died in December, 1713; and in his will, amongst other bequests, left  $\pounds 20$  to the son of the widow Fitzsimons,  $\pounds 5$  each to John Lynch and Philip Hudson at the glass house, and to Mrs. Fitzsimons, for the use of her children, the first  $\pounds 100$  coming to him out of the glass house.

Fitzsimons probably carried on the manufacture after Roche's death, his name being the only one afterwards mentioned in connexion with the factory.

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In 1755 Christopher Fitzsimons petitioned Parliament for aid to carry on the manufacture of flint glass in Dublin.

It is said that the factory was afterwards carried on by Fitzsimons' son, who, at length, discontinued the business, and became simply an importer of English glass. The name of Christopher Fitzsimons appears in Dublin directories from about 1760 to 1779 as a glass merchant at No. 1 George's Hill. The glass house appears to have been situated on the piece of ground bordering on Mary's Lane, between George's Hill and Bradogue Lane (now Halston Street). It is marked in maps of 1773 and 1787, but no mention of it occurs in directories of these dates; and the latest reference to it in the newspapers appears in 1759. Probably it ceased work about 1760.

From 1729 to 1752 several advertisements relating to this glass house occur in *The Dublin Journal* which are worth recording, as they give lists of the various articles made :

Nov. 1st, 1729.—At the Round Glass House in Mary's Lane, Dublin, are made and sold all sorts of fine drinking-glasses, salvers, baskets with handles and feet for desserts, fine salts ground and polished, all sorts of decanters, salts, &c.

Jan. 18th, 1746.—At the Round Glass House, in Mary's Lane, the fire being now out after working a considerable time, are sold all sorts of the newest patterns of drinking-glasses, decanters, &c., fine large globe lamps for halls, for one to four candles, bells and shades, mounted in the newest patterns with brass; all kinds of specia glasses for apothecaries, jars for confectioners; with salvers, baskets, sweetmeat, and jelly-glasses. It is the only art or work of its kind in the Kingdom carried on. All double flint wineglasses, decanters, water-glasses, and saucers at 7*d*. per lb., the single flint at 2x. 4*d*. per doz., 14 to the dozen. Dram and whiskey-glasses at 1*s*. 6*d*. per dozen, 14 to the dozen. In exchange will be allowed for double flint broken glass  $2\frac{1}{2}d$ . per lb., and for single  $1\frac{1}{2}d$ , per lb.

Dec. 9th, 1746.—At the Round Glass House, in Mary's Lane, are making all sorts of the newest fashion drinking-glasses, water-bottles, decanters, jugs, water-glasses, with saucers plain and moulded; all sorts of jelly-glasses, sillybub-glasses, sweetmeat do., for desserts; salvers, orange-glasses, covers for torts, bells and shades; hall-lanthorns for one to four candles, barrellanthorns, globe lamps, &c., all mounted with brass after the newest fashions from London. All sorts of apothecaries' bottles, specia glasses of all sizes, rounds, urinals, breast and sucking-bottles, cupping-glasses, funnels, &c. All sorts of tubes, globes, &c., for electrical experiments, weather-glasses, receivers for air-pumps, and all other sorts of philosophical instruments. The undertakers of said work are making the necessary dispositions for carrying on likewise the making of black bottles, melon-glasses, gardevins, &c.

#### WESTROPP-Glass-Making in Ireland.

Jan. 4th, 1752 .- At the Round Glass House on George's Hill near Mary's Lane are made and making all sorts of the newest-fashioned drinking-glasses, water-bottles, claret and Burgundy ditto, decanters, jugs, water-glasses with and without feet, and saucers; plain, ribbed, and diamond-moulded jellyglasses of all sorts and sizes, sillybub glasses, comfit and sweetmeat ditto for desserts, salvers, glass plates for china dishes, Toort covers, pine and orange glasses, bells and shades, hall lanthorns, globe lamps, chamber ditto, glass branches, cut and plain barrel lanthorns, etc., all in the newest-fashioned and most elegant mounting now used in London. All sorts of apothecaries' bottles, together with tubes, etc., for electrical and philosophical experiments. All sorts of cut and flowered glasses may be had of any kind to any pattern, viz.: wine-glasses with a vine border, toasts, or any other flourish whatsoever; beer ditto, with the same; salts with or without feet, sweetmeat glasses and stands, cruets for silver or other frames, all in squares and diamond-cut; gardevins, tea-canisters, mustard-pots, crests and coats of arms, sweetmeat bowls and covers, jars and Bakers for mock china, etc. As this is the only manufacture of glass in the kingdom, no expense has been spared by the proprietor to procure the best workmen, and newest patterns from London, and he promises the greatest satisfaction in regard to colour and workmanship.

As seen in the above advertisements, the proprietor states that he is the only manufacturer of glass in Ireland; but as will be seen two other glass houses were erected in Dublin about 1730 and 1734, which, however, appear to have ceased work before 1752.

About 1730 a glass house for making bottles and window glass was erected on the Bachelors' Quay, and was carried on by some of the original partners until about 1741. In that year it was advertised for sale; and application was to be made either to William Maple, Esq., Dublin, Edward Shanley, Dublin, or to the Rev. Richard Stewart, Belfast.

Probably the manufacture was carried on for some years, as in November, 1747, John Bradshaw, Edward Ford, and Edward Shanley petitioned Parliament for aid, and stated that they had lately erected a bottle-glass house. Parliament decided that they deserved encouragement.

In 1752, however, the piece of ground extending from the Bachelors' Quay to Abbey Street, on which the glass house was built, was advertised to be let; and it was stated that the glass house was as large and as well suited for bottle-making as any in England; application was to be made to Alderman Hans Bailie or to Mr. Hugh Darley.

In 1754 William Deane & Co. purchased the glass house from Bailie for  $\pounds 1200$ , and carried on the bottle-making industry. This glass house was known as the Square Glass House.

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About 1754 a company, consisting of Hugh White, Annesley Stewart, Thomas Hawkshaw, and George Boyd, was formed for the purpose of making glass bottles; and a glass house, known as the Round Glass House was erected in Abbey Street. In 1757 Deane & Co. joined with Hawkshaw & Co., and carried on the manufacture of bottles, and afterwards that of window-glass, the latter of which they said was unknown in Ireland before.

In 1758, besides bottles and window glass, they advertise large glass bells for gardens, glass vessels suitable for picklings, sweetmeats, etc., particular kinds of bottles for preserving orange and lemon juice, gardevins, rounds for apothecaries, and any green or bottle glass-ware desired.

In 1756 Hawkshaw & Co. received £1500 and Deane & Co. £2000 from Parliament for carrying on the glass manufacture, and in 1767 Deane & Hawkshaw obtained £150 from the Dublin Society for window glass valued at £2,600, and in 1769 £200 for window glass and bottles valued at £10,000.

Some of Deane's expenses when he started in 1754 are interesting :-  $\pounds$ 800 for Stourbridge clay,  $\pounds$ 30 for Irish clay,  $\pounds$ 15 for colouring,  $\pounds$ 10 for sand, and  $\pounds$ 410 to fifty-four persons from abroad to settle and carry on the manufacture.

Deane & Hawkshaw appear to have carried on the bottle and windowglass manufacture until about 1794, when their names disappear from the directories.

In 1734 a glass house was erected in Fleet Street, nearly opposite Price's Lane, for the manufacture of flint glass. Among the objects made were fine drinking-glasses, salvers, decanters, branches, globes for lamps, phials, glasses for confectioners, green glass vials for chemists and apothecaries, and bells for gardeners.

In 1741 the proprietors appear to have had some trouble with the fire, as they advertise London glass, which they will sell at their former prices until they can light the fire.

In 1752 they appear to be still importing English glass, and there is no mention of their actually making any glass; while in 1756 a Hugh Henry is stated to have purchased the whole stock-in-trade of the glass warehouse.

No glass house is marked in Fleet Street in Rocque's map of Dublin dated 1756.

In 1747 a bottle-glass house was erected on the North Wall, a little below the present Custom House, the site being known as The Foot Lots, Nos. 1, 2, and 3. The glass house was burnt in 1748, but was rebuilt the same year.

In 1754 and 1760 the site was advertised for sale; but whether the glass house had then ceased working is not known. By the year 1768, however, the works were closed, as in that year a Henry Roche, stone-cutter, took the premises where the glass bottle factory formerly was on the North Wall. A glass house is marked on this site in maps of Dublin of 1773 and 1787, but no mention of it occurs in directories of these dates.

In 1748 a glass house on the North Strand is mentioned, as in *The Dublin Journal* of November 29th, 1748, it is stated that "a gentleman left some clay with Mr. Minty at the Glass House on the North Strand to make tryal of."

In 1750 a new glass house was erected at the lower end of Lazer's Hill. The advertisement in *The Dublin Journal* of June 9th, 1750, states that the following articles were made, viz. :--Wide-mouthed quart and pint gooseberry bottles suitable for pickles, etc., gardevins of any size; pint, quart, pottle and gallon rounds for druggists and distillers, round and square canister bottles for snuff or flower of mustard, small garden bell-glasses; tavern and public-house quart, pint, and half-pint decanters for wine, cider, and ale. All the above goods of bright green glass. This factory does not seem to have lasted very long. No other notice of it occurs; and it is not marked on Rocque's map of 1756.

In July, 1754, a William Gordon brought over from England a number of workmen for a new glass house which was erected in Abbey Street opposite the Ship Buildings : and in August of the same year it is said they were making bottles as good as any imported. In 1761 it is stated in an advertisement in *The Dublin Journal* that the proprietors of this glass house had brought the manufacture to such a degree of perfection that for several months past not a single bottle had been imported from Bristol, Liverpool, or any other part of England, and that they could afford to sell the bottles for 18s. per gross, being 6s. cheaper than those formerly imported from England. This factory appears to have lasted for some years, being marked on a map of 1773.

In 1759 an English company, with Thomas Smith Jewdwin, John Landon, and Henry Lunn, as proprietors, started a glass house in Abbey Street, for the purpose of making crown glass, and in the following year erected another for making all sorts of flint and green glass.

In a petition to Parliament in 1768, the proprietors stated that they were natives of London, and had brought over skilled artists from abroad for making flint glass and bottles, that they had spent money in searching for and providing necessaries of the produce of Ireland for the manufacture, and that they trained and instructed Irish apprentices; but that the foreign artists refused to work with the Irish, which stopped the manufacture of window glass. They also stated that, in 1764, Hugh Boyd, of Ballycastle, asked them to take a lease of the Ballycastle bottle-glass house, at the rent of £1000 per annum. This they did; but on Boyd's death in 1765, his executor, Jackson Wray, behaved very badly, and threatened to imprison them for alleged debt. Owing to Wray's persecution, Lunn said he would have to give up the manufacture of flint glass.

Lunn, however, appears to have carried on the manufacture of glass in Abbey Street until 1793, when the glass house was taken over by Charles Mulvany & Co. Mulvany & Co., in 1801, commenced making window glass, while their output of flint glass was said to have been the most extensive in Ireland. This company carried on the manufacture in Abbey Street, and later also at Ringsend, until about 1837.

About 1763 James Donnelly & Co., with English workmen, started a glass house in Marlborough Green, where all kinds of cut, plain, and flowered flint and green glass were made. In 1764 the glass house was enlarged and the furnaces rebuilt.

This factory was probably taken over by the Williams family (Richard, William, and Isaac); for in 1764 Williams & Co., of Marlborough Green, obtained a premium for their glass from the Royal Dublin Society.

In 1785 William and Richard Williams petitioned Parliament against the proposal to pull down the glass houses in the city of Dublin, and to erect them outside; and stated that they had carried on the manufacture in the one place for nearly thirty years, and were employing about seventy persons.

About 1772 Richard Williams opened a warehouse for the sale of his glass at 15 Lower Ormond Quay; and among the objects mentioned were lustres, girandoles, chandeliers, candlesticks, and candlemolds, pyramids, salvers, bowls, decanters, water-glasses, drinking-glasses, smelling-bottles, epergnes, hall and staircase bells, and many other articles of cut, plain, and engraved flint glass, and also plate glass.

One of the Williams family erected a new glass house in Marlborough Street in 1777; but when the scaffolding was removed, it fell to the ground, killing four men. William Williams, who died in 1788, is said to have made flint, bottle, plate, and window glass; and in 1773 advertised garden glasses of all sizes, window glass in cribs, or cut in squares; pickling-jars of all sizes; gardevins to fit any case, and any article and of any colour that is made of glass. The Williams family appear to have carried on the glass manufacture in Potter's Alley until about 1831, when the concerns were taken over by Edward S. Irwin and Charles Irwin, who continued the manufacture until 1855.

In 1785 iron works were erected by a Mr. Carrothers, near Ballybough Bridge; but during the next year they were removed to Thomas Street; and the concerns at Ballybough Bridge were taken over by Thomas Chebsey & Co., for the purpose of carrying on the manufacture of flint glass and plate glass for coaches. In 1788 they opened a warehouse in Jervis Street, which they

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#### WESTROPP-Glass-Making in Ireland.

called the "Venice Glass House," as probably they made some glass in the Venetian style. In 1798 Thomas Chebsey died, and the partnership was dissolved. John Chebsey and the other partners advertised for sale the warehouse in Jervis Street, the two glass houses at Ballybough Bridge, and the stock-in-trade, comprising large quantities of every article in the flint-glass trade, and also a large number of green and flint phials, rounds and tincture-bottles for apothecaries. The concerns at Ballybough Bridge were said to cover about two acres, with two fronts—one on to Annesley Bridge, and the other on to the North Wall. John Chebsey appears to have been connected about 1800 with the glass house in Newry, formerly belonging to Samuel Hanna. Chebsey & Co. apparently kept on the warehouse in Jervis Street for a couple of years; but after 1800 their name disappears from the directories.

This glass company made a considerable quantity of fine flint-glass. In 1788 they exported a large consignment to Cadiz; and in the same year the glass houses were visited by the Lord Lieutenant and the Marchioness of Rockingham, accompanied by a number of the nobility, for the purpose of ordering a set of magnificent lustres for St. Patrick's Hall and the new rooms at the Castle; and in 1790 a large quantity of plain and cut flint glass from the Venice Glass House, Dublin, was advertised for sale in Kilkenny. From 1787 to 1794, the annual value of the flint glass produced by Chebsey & Co. varied from £4000 to £7000. The site on which Chebsey's glass-works stood is now occupied by Vitriol Works.

In 1787 it is stated that the demand for crown glass for the French market was so great that a wealthy English firm erected a glass house for this branch of the manufacture, at the foot of Ringsend Bridge; but no further allusion to this factory occurs.

John D. Ayckbown, a London cut-glass manufacturer, whose name appears in Dublin directories from the year 1783, as a glass-seller, at 15 Grafton Street, advertises in 1800 as the proprietor of the "New Venice Glass and Chrystal Manufactory," on the Blackrock Road, near the Canal. After this his name still appears as a glass-seller, but nothing further appears to be known about his glass house.

James Donovan, whose name occurs as a glass and china merchant on George's Quay, and in Poolbeg Street, from about 1770, appears in the directories from 1819 to 1824, as a glass-manufacturer in Richard Street, Ringsend.

In 1838 the Rev. Dr. Prior was proprietor of glass-works on Fitzwilliam Quay, Ringsend. This glass house was afterwards known as the Ringsend Bottle Company, and in 1883 exhibited black and white glass bottles at the Cork Exhibition.

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Three other glass bottle companies also exhibited, viz. :--The Irish Glass Bottle Co., Charlotte Quay; The Dublin Glass Bottle Co., North Lotts; and Alexander Brown & Son, 175 Church Street; but no mention of white flint or cut-glass appears.

In 1855 the brothers John and Thomas Pugh, from Cork, had a glass house in Liffey Street. They had formerly been in the employment of Charles and E. S. Irwin, and appeared to have carried on the business when the Irwins retired.

In 1856 the proprietors were the two Pughs, George Collins, and Joseph Marsh; from 1864 to 1869, Pugh, Munkettrick, & Co.; and from 1870 to 1896, Thomas and Richard Pugh. From 1864 to 1896, when the manufacture ceased, the glass house was in Potter's Alley.

The Pughs, who turned out large quantities of cut and engraved glass, flint glass, and also coloured glass, were the last of a long line of flint-glassmanufacturers in Dublin.

#### WATERFORD.

The earliest record of a glass house connected with Waterford occurs in 1729. About this time one was erected within two or three miles of the town, on the banks of the Suir, at a place called Gurteens; but although practically belonging to Waterford, the glass house was really in Co. Kilkenny.

Advertisements occur in the *Dublin Journal* in 1729 and 1731, stating that all sorts of double and single flint glass, garden glasses, vials, and other green ware were made, together with bottles with and without marks. The proprietor, John Head, also stated that crown and other glass for windows was soon to be made. The manufacture was carried on until about 1741, when the glass house and twenty-one acres of land, with a good quay and slips, warehouses, sheds, and a malt-house, were advertised to be let for a term of years; application was to be made to Michael Head or to George Backas in Waterford. Materials belonging to the glass house were also to be disposed of, including pots, iron tools, kelp, and a large parcel of ingredients for making crown glass. Probably shortly after 1741, the manufacture ceased, as about 1760 the whole of the lands were offered for sale, but no mention was made of the glass house.

The next glass house we have a record of was erected on the quay at Waterford in 1783 by George and William Penrose, who in that year petitioned Parliament for aid to establish the manufacture of flint glass in Waterford, and in the following year stated that they had established a complete flintglass-manufactory on a very extensive plan, and were enabled to make all kinds of useful and ornamental flint glass of as fine a quality as any in Europe, having a large number of the best manufacturers, cutters, and engravers.

The Penroses carried on the flint-glass manufacture until 1797, when they sold their interest in the glass house, and it was purchased by a company, the proprietors being Ramsey, Gatchell, & Barcroft. This firm carried on the flint-glass manufacture on the quay until about 1802, when they erected a new glass house on the piece of ground known as the "Old Tan-yard" in Ann Street. The old premises on the quay were to be let for a term of seventy years or upwards, but a warehouse on the quay for the sale of the glass appears to have been retained.

In 1820 Ramsey and Barcroft appear to have left the business, which in 1824 was carried on by Gatchell & Walpole.

Jonathan Gatchell having died shortly after this, his place was taken by his son George, who, later on, took a George Saunders into partnership.

In 1842 George Gatchell & Co. opened a warehouse at 103 George Street, Limerick, for the sale of their glass, which included cut and plain glass of every description, and every article made of glass for use, luxury, or ornament, also chandeliers, lustres, lamps, hall-bells, and candelabra in bronze, ormolu, and glass. Medical establishments were also supplied with glass.

In 1848 the partnership with Saunders was dissolved, and George Gatchell alone carried on the business.

An advertisement in *The Waterford Mirror* of 1820 states that the Waterford glass house had for thirty-six years given employment to nearly two hundred persons.

In 1849, owing to alterations in the glass works, a quantity of cut glass was sold by auction, including decanters, claret-jugs, water-jugs, liqueurbottles, carafes, pickle-urns, salad, celery, and sugar-bowls, butter-coolers, cream-ewers, custard- and jelly-glasses, and about 300 dozen tumblers, goblets, and wine-glasses. The factory was carried on for a couple of years; but probably owing to the English competition, it was closed in 1851.

In October of that year the entire stock of glass was sold, including gas chandeliers, one crystal chandelier for six lights, dinner and table lamps, together with beautiful specimens of Bohemian and Venetian glass; and in February, 1852, the-steam engine, materials, tools, fixtures, office furniture, and a variety of glass were sold.

This mention of the sale of Bohemian and Venetian glass at the warehouse of the Waterford factory proves that because a piece of glass was purchased at the warehouse, it need not necessarily have been made at the factory. Owners of pieces of glass at the present day will tell you that

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such-and-such a piece was purchased at the Waterford glass house, thinking therefore that this is conclusive evidence that it was made there.

In the London Exhibition of 1851, George Gatchell exhibited a centrestand for a table consisting of forty pieces of cut glass; quart and pint decanters, cut in hollow prisms; a centre-bowl on detachable tripod stand, and vases with covers.

The Waterford factory did not produce as much glass as some of the other Irish glass houses, although, at the present day, almost every piece of cut glass to be found in Ireland is said to be "Waterford."

From 1786 to 1794 the value of the glass amounted to about £1000 annually, except in the year 1787, when it reached £3500, while in the Cork, Dublin, and Belfast factories the value varied from about £3000 to £10,000.

#### DUNGANNON AND BELFAST.

About the year 1771 a Bristol glass-maker named Benjamin Edwards came over to Ireland, and erected a glass house at Drumrea, a few miles north of Dungannon. He did this probably at the instance of the proprietors of the Tyrone collieries, who foresaw that advantage might be gained from the glass manufacture.

In 1772 the glass house was at full work, and in an advertisement in *The Dublin Journal*, and also in *The Belfast News Letter* of December of that year, the proprietor stated that he was making all sorts of the newest-fashioned wine, beer, and cider glasses; enamelled, cut, flowered, and plain decanters; water-glasses, plates, epergnes, and epergne saucers, candlesticks, cans, jugs; cut, flowered, and plain salvers, jelly and sweetmeat glasses, hall-bells, globes and shades; confectioners' jars, with all kinds of glass fit for chemists and mathematicians; salts and salt linings, mustard-castors, white phials, and all kinds of bottles for perfumers, retorts, and receivers, green phials, green and white mustard-bottles, and every other article in the glass way.

In the following year the glass house was advertised to be let, the proprietors stating that clay fit for making the pots, sand, and coal were to be had on the spot, and that there was no reason why as good flint glass as any imported could not be made. They also stated that no person need apply unless one who was determined to carry on the business in the best manner. Whether the manufacture was continued or not is uncertain—perhaps it was for a few years; but in 1776 Benjamin Edwards went to Belfast, where he erected a glass house at the east end of the Long Bridge.

In 1781 Edwards advertised his glass house, and stated that he had made and

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was making all kinds of enamelled, cut and plain wine-glasses, cut and plain decanters with flint stoppers; carafes, common, dram-, and punch-glasses; flint and green phials, flint and green gardevins, retorts, and receivers, and all kinds of chemical wares, cruets, salts, goblets, &c. He also said that he had brought a glass cutter from England, who was constantly employed.

In 1783 Edwards erected an iron foundry adjacent to the glass house, and took as partner a man named Shaw, who retired in 1789.

In 1811 Edwards let the foundry, which was carried on by Chaine & Young.

In 1788 Edwards opened a warehouse for the sale of his glass and iron goods, on Hanover Quay, Belfast, where, he stated, he had a complete assortment of cut, plain, and figured glass.

In the years 1787 and 1788 the value of the glass produced by Benjamin Edwards was  $\pounds 1,306$  and  $\pounds 1,780$  respectively.

John Edwards, son of Benjamin, erected, in 1789, a tobacco-pipe manufactory, adjoining the glass house, and appears to have carried it on for some years.

In 1800 Benjamin Edwards took his sons John, Hugh, and Benjamin junior, and his son-in-law, William Ankatell, into partnership, and opened a warehouse at Newry, on the Canal Quay, opposite the Sugar House, for the sale of cast metal, and cut, flowered, enamelled, and plain flint glass.

In the following year they erected an iron foundry on the Merchants' Quay, Newry.

In 1803 the partnership between Benjamin Edwards and his sons was dissolved, and John Edwards started a new glass house on his own account at 79 Peter's Hill, Belfast, of which more later.

In 1804 and 1805 Benjamin Edwards advertised the manufacture of all sorts of flint decanters, wine-glasses, goblets, tumblers, salad-bowls, etc., cut and engraved to the newest patterns; but no mention is made of enamelled glass. He also advertised a variety of liqueur, cruet, and other stands in silver and plated ware, Grecian and other lamps, lustres and girandoles. Whether he obtained the liqueur and cruet stands complete with bottles, or made the latter himself, is uncertain.

Benjamin Edwards senior retired from the firm in 1807, and the business was carried on by Benjamin junior and Hugh Edwards. Benjamin senior re-entered the business in 1811, but did not remain long, as he died the following year, on September 29th; and in December the lease of the glass house was advertised for sale. However, Benjamin junior in 1813 stated that he intended carrying on the glass manufacture in the same extensive manner as heretofore. About 1815 he appears to have got into difficulties, as

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there was a meeting of the creditors of Benjamin Edwards, deceased, Hugh and Benjamin Edwards junior; and in 1816 the foundries at Ballymacarrett, Belfast, and at Newry, were advertised for sale.

Benjamin Edwards, however, appears to have got over his financial troubles, as in 1824 he enlarged his glass house concerns, by taking the adjoining establishment, formerly occupied by John Smylie & Co., glass-makers. He does not appear, however, to have been very successful, for in 1826 the whole of the concerns were advertised for sale, and in the following year were purchased by T. J. Wright & Co. (Thomas Joseph Wright, Robert McCrory, and A. J. McCrory) for the purpose of carrying on the flint-glass manufacture. In 1829 the partnership was dissolved and the stock of cut and plain glass, together with glass pots, sand, and utensils, were sold.

Probably the manufacture ceased then, though in 1836 A. J. McCrory advertised the glass house to be let, and stated that the chimney was forty feet in diameter and capable of being enlarged.

One glass-house chimney is still standing on the ground which was formerly adjacent to the end of the Long Bridge, but now some distance from the end of the present bridge, owing to the land having been reclaimed. Whether this is the chimney of Edwards' or Smylie's glass house is uncertain.

In 1784 another glass house was erected in Belfast at the east end of the Long Bridge, for the manufacture of bottles and window-glass. It was finished in August, 1785, and commenced making bottles in April, 1786. The height was 120 feet and the diameter 60 feet.

In Benn's History of Belfast it is stated that thirteen persons subscribed  $\pm 100$  each for starting the glass-bottle manufacture, and among these were Cunningham Greg, James T. Kennedy, Charles Brett, Robert Hyndman, Hugh Hyndman, and John Smylie, the firm being known under the name of John Smylie & Co.

In 1786 Smylie & Co. advertised bottles at 20s, and 22s, per gross, vitriolbottles, bell-glasses, gooseberry bottles, bottles for gardevins, and every other article in the glass way. They stated that gentlemen might have their initials stamped on the bottles for an additional 4s. 4d, per gross, besides paying for the stamp, or the name at a reasonable rate, in proportion to its length.

In 1787 Smylie & Co. commenced making window-glass, and in 1789 stated that the crown glass made at their glass house was fourteen per cent. cheaper than that imported, and was then, though not at first, superior to any Bristol glass.

In 1792 Smylie & Co. erected a new glass house for making bottles, the old one being retained for window-glass.

From 1788 to 1794 the value of Smylie's window glass varied annually from about  $\pounds 4,000$  to  $\pounds 9,500$ .

Bottle and window-glass continued to be made by Smylie & Co. for some years; but in 1809 the surviving partners offered for sale the entire concern, with the two glass houses, either as a whole or in parts to suit purchasers.

Probably the manufacture ceased shortly after 1800, and the concerns were left idle; but in 1823 the whole of the ground, and one glass house thereon, which was 180 feet in circumference and 150 feet high, were to be let, and, as previously mentioned, were taken over in 1824 by Benjamin Edwards, junior.

As previously stated, John Edwards erected a flint-glass house at 79 Peter's Hill in 1803. Edwards became bankrupt in 1804; and the glass house was purchased by Joseph Wright, and handed over to a company, "without a farthing profit." Three of the other partners were John Martin, John McConnell and George Thompson.

In June, 1809, this company, known as the Belfast Glass Works, advertised plain, cut, and engraved glass, lustres, girandoles, chandeliers, etc., and stated that from recent improvements and discoveries they could supply goods equal, if not superior, to any manufactured in any part of Ireland.

An advertisement in July, 1809, from Hugh and Benjamin Edwards junior in answer to this is rather amusing. Hugh and Benjamin Edwards beg to inform the public that they continue to manufacture flint glass of every denomination of a most superior quality; their thorough knowledge of the business, acquired during a practice of upwards of twenty years, and under the guidance of their father, a professional glass-maker, enables them to assure their friends and the public that they have a great variety of cut, plain, and engraved glass that cannot be surpassed by the recent discoveries of persons totally unacquainted with the nature of any kind of glass.

About 1813 the glass house on Peter's Hill stopped working owing to repairs being necessary; but in the following year recommenced work, the proprietors stating that they were making every description of cut and engraved flint glass, equal to any made in Great Britain or Ireland.

In 1833 the proprietors stated that they intended to relinquish the business, and would let or sell the interest in the concern, which was in complete repair and in full work. The glass house, however, was not let or sold, as in 1836 they stated that they were making every article of flint glass.

In 1838, owing to the death of one of the partners, the Belfast Glass Works were offered for sale; and the proprietors stated that there was a six-pot furnace recently erected, and capable of manufacturing 4,000 lb. of glass weekly, and that the premises were held on lease for thirty-three years at an annual rent of £69 18s. 6d., and had been established over thirty years.

The purchasers could have the entire stock of cut and plain glass, utensils, coal, sand, pots, moulds, etc.

The Belfast Glass Works appear to have been purchased by John Kane, about 1840.

In 1823 John Wheeler, who was formerly in the employment of Benjamin Edwards, erected a glass house for making flint glass at the east end of the Long Bridge near the other glass-works. In the next year he appears in partnership with J. Stanfield and John Kane, a wine merchant and brewer. The warehouse of this glass house, known as the New Glass House Company, was burnt in 1825; and the remaining stock of plain, cut, and engraved flint glass was to be sold.

About this time Stanfield and Wheeler appear to have retired, and the business was carried on by John Kane alone.

In 1827 he stated that he had enlarged his glass house, and had for sale a large amount of cut and plain flint glass.

In 1829 the concern was called the Shamrock Glass Works, Ballymacarrett; and in 1833 Kane opened a warehouse for the sale of his glass at 40 North Street, and stated that he was making rich cut glass, patent deck lights; heavy, light, and lunette watch-glasses; figure shades, oval and round, etc.

About 1840 Kane appears to have purchased the Peter's Hill Glass Works, and to have carried on both concerns until about 1850.

About this period the glass works in Ballymacarrett were taken over by Christopher O'Connor and William Ross, and appear to have been carried on by Ross until about 1868.

In 1813 Wallace Tennant stated that he had erected glass works in Queen Street, Belfast, and from general and particular knowledge of the business was going to make every description of flint glass.

In a directory of 1819 his name appears as a glass-cutter; probably the works did not pay; and he became simply a cutter of other people's glass.

In *The Cork Mercantile Chronicle* of April 17th, 1805, Wallace Tennant advertised that he was about to open a warehouse for fancy and useful glass, and solicited patronage for Cork manufacture, as he had no doubt but that he would produce articles of equal merit to those imported. In this case, as afterwards in Belfast, he probably was simply a glass-cutter.

About 1870 John Edwards, a descendant of Benjamin Edwards, was making glass bottles in Belfast, but only on a very small scale, and the manufacture did not last long.

By about 1870 the manufacture of flint glass had quite died out in Belfast, having lasted for nearly a hundred years.

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#### CORK.

Although premiums were offered by the Royal Dublin Society, as early as 1753, for erecting a glass house in Cork, no one appears to have taken advantage of the offer; and it was not until 1782 that a glass factory was set up in the city.

On November 6th, 1783, Atwell Hayes, Thomas Burnett, and Francis Richard Rowe presented a petition to Parliament asking for aid to carry on the glass manufacture in Cork, and stated that, in the month of May, 1782, at great expense and under a variety of difficulties, they had embarked on the undertaking by sending a proper person to England to take plans of the most complete and extensive works of that kind carried on there, and also to employ experienced hands and procure the best materials, the accomplishment of which had been attended with heavy expense and great inconvenience.

They also stated that they had surmounted all difficulties, and had procured the most ample set of materials and implements and a set of the most able artificers that England could afford, and that they had now erected two houses, one for bottles and window glass and the other for plate and flint glass of all denominations, which were allowed to equal if not to excel any in Europe. The establishment, they said, had already been attended with an expenditure of upwards of  $\pounds 6000$ .

The following advertisement in *The Hibernian Chronicle* for May, 1784, is interesting :---

"Thomas Burnett & Co. inform the public that they have now ready at their glass manufactory in Hanover Street, Cork, a great variety of plain and cut flint glass, with black bottles of every denomination, which for excellence of quality is equal to any made in England. They now flatter themselves that after upwards of two years' perseverance through a variety of difficulties, they have established this useful branch of business on a sure footing. John Bellesaigne next door to the glass house retails the glass of said manufactory only."

In 1787 Bellesaigne opened a shop in Patrick Street, Cork, where he had a great variety of cut and engraved glass, which, he stated, he himself saw made at Waterford.

In 1785 Burnett & Co. advertised bottles and squares as good as any imported, or made in Ireland.

Thomas Burnett and Francis Rowe appear to have retired from the business about 1787; and it was then carried on by Atwell Hayes and Philip Allen.

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In that year they obtained a premium for their glass from the Royal Dublin Society, and in 1792 stated that they were at full work making flint glass; and, later in the same year, that as the flint-glass manufacture was well established, they intended to start the bottle and window-glass house, for which purpose they would take in one or two partners.

In 1793 the partners were Allen, Hickman, and Hayes, who carried on the business until about 1805, though after 1800 only black bottles are advertised.

Atwell, Hayes, & Co. received premiums from the Royal Dublin Society for their glass, the value of which amounted to £1600 in 1787, £2304 in 1792, and £500 in 1793.

The manufacture appears to have ceased for a few years after about 1805; but about 1810 Smith, White, & Co. appear as proprietors of the Cork Glass House. White retired in 1812, and from that year until about 1818 the business was carried on under the name of William Smith & Co.

In 1818 the old Hanover Street glass house was offered for sale, "with the consent of all concerned."

The proprietors stated that the premises extended from Hanover Street to Lamley's Lane, and had a quay on the south side of the river, that the glass house contained every accommodation for making flint glass and black bottles, and that the glass-cutting machinery was modern and had as a moving power a steam-engine lately erected.

The sale was objected to by John Graham and Edward Brown, who stated that they had an interest in the Hanover Street glass house. However, in 1818, the stock of glass of the Hanover Street factory was sold by auction, including cut lustres, Grecian lamps, one four-light Grecian lamp, richly cut, with patent drops; hall-globes, side bells, candlesticks, dessert sets, butter-coolers, pickle-glasses, sugar-bowls, cream-ewers, jelly glasses, salts, jugs, decanters, rummers, wine, and finger-glasses, etc.

Graham and Brown, previously mentioned, had a glass-cutting shop at Glanmire, close to Cork; and in 1820 they stated that, owing to the introduction of English glassware, they would open a shop on the Grand Parade for the sale by auction of their own glass. This glass was probably made some time previously in Hanover Street and cut by them at Glanmire.

The Cork Glass House Company in Hanover Street had probably ceased work by about 1818.

In 1810 the name of Daniel Foley appears in Cork directories as the proprietor of a glass wareroom in Hanover Street; and in 1815 he started a glass factory in the same street, under the name of the Waterloo Glass House Company, for making flint and bottle glass.

In the next year the following notice occurs in *The Overseer*, a Cork weekly paper :---

"By the forming of the Waterloo Glass House Company, which is now at full work, Mr. Daniel Foley is giving employment to more than one hundred persons. His workmen are well selected, from whose superior skill the most beautiful glass will shortly make its appearance, to dazzle the eyes of the public, and to outshine that of any competitors. They have a new band of music, with glass instruments, bessons, serpents, horns, trumpets, &c.; and they have even a glass pleasure-boat, a cot and a glass net, which when seen will astonish the world."

Daniel Foley & Co. had their warerooms in Hanover Street, where they sold lustres and all kinds of fancy glass; and in 1821 they advertised the sale of china as well, having been appointed agents in Cork for Mason's ironstone china and Grainger & Lee's Worcester china.

In 1824 Foley & Co. opened a warehouse at 48 Lower Sackville Street, Dublin, for the sale of their glass; and stated that, owing to the amount of labour and machinery at the Waterloo Works, they could execute orders quicker than any other firm.

In the following year Foley took as partner Geoffrey O'Connell; and in 1829 they stated that they had reduced the price of glass 20 per cent., and by a recent improvement in the process of annealing they were enabled to warrant their glass hot-water-proof.

The firm of Foley & O'Connell carried on the business until 1830, when the partnership was dissolved, and the manufacture ceased.

The stock-in-trade was sold at reduced prices; and in January, 1831, the premises were sold by auction, together with the remaining stock, including decanters, claret-jugs, salad-bowls, dessert services complete, water-jugs, crofts, tumblers, rummers, butter-coolers, pickle-urns, chimney lustres, chandeliers, ceiling lustres, &c.

The premises appear to have been purchased by the Midleton Brewery for warehouses; and at the present day the site is occupied by Beamish & Crawford's Brewery, on whose premises still stands the old Glass House chimney.

In 1818 another glass house was erected in Cork by Edward and Richard Ronayne, at the western end of the South Terrace, and known as the Terrace Glass Works. This glass house appears to have made white flint-glass only; and the proprietors stated that they made cut and plain glass lustres, Grecian lamps of the most perfect and brilliant metal, superior to any heretofore exhibited in Cork, and equal to any in the United Kingdom.

About 1830 warerooms were opened at 121 Patrick Street, Cork, for the sale of the glass.

In 1838 the partnership between Edward and Richard Ronayne was dissolved, and the business carried on by Edward Ronayne alone, who continued it for a few years.

In 1841 the works were closed, and the whole concerns offered for sale, including a steam-engine, tools and apparatus for turning for forty glass-cutters, an excellent claymill, and a large quantity of potclay, firebrick, from fifty to sixty glass-house iron pans, and all other necessary materials for the immediate working of the concern. With the closing of this factory the glass-manufacture ceased in Cork, having lasted nearly sixty years.

In John Francis Maguire's account of the Cork Exhibition of 1852, it is stated that in 1825 the export orders of Cork would have kept a glass house with eight pots in constant employment; and also that the Waterloo and Terrace Glassworks each employed twenty-four glass-blowers, thirty cutters, and sixteen apprentices, besides clerks, labourers, &c.

#### NEWRY.

The manufacture of flint glass was introduced into Newry probably between 1780 and 1790; but the earliest notice of glass having been made there occurs in 1792, when Emanuel Quin & Co. were proprietors of a glass house in William Street.

In 1795 the proprietors were Michael Dunbar & Co., who stated that they had an extensive variety of flint glass of their own manufacture, equal in quality to any manufactured in the kingdom. Their glass warehouse was on the Merchants' Quay, where they also had a pottery manufactory for some years before they took over the glass house.

In the following year Samuel Hanna & Co. appear as proprietors, and at the same time advertised for some one to take over the management of the glass house. Apparently John Chebsey, one of the partners in the Ballybough Glass House, Dublin, took over the management, as in 1801 the whole of Samuel Hanna's concerns were advertised to be let, and it was mentioned that the glass house was lately in the possession of John Chebsey.

It is uncertain if this factory was working after this period, as no mention of it occurs again until 1845, when the extensive premises known as the "Old Foundry and Glass House" were advertised for sale.

In 1824 a new fint-glass house was erected by John R. Watt & Co. at 16 Edward Street. *The Newry Telegraph* of 1826 calls attention to the beauty of the glass made by Watt & Co., and as a proof of its excellence states that a set of claret glasses were ordered by His Excellency the Marquis of Wellesley.

In 1828 John Kirkwood became partner with Watt; and in the same year

Watt retired, and Isaac M'Cune became partner, the firm being then known as Kirkwood & M'Cune. This firm carried on the business until 1837, when M'Cune went to Belfast, and John Kirkwood carried it on alone.

In 1838 the works were offered for sale, as Kirkwood stated he wished to remove to his extensive flint-glass manufactory at Ramhill, near Liverpool. The sale appears not to have taken place, as Kirkwood continued as proprietor until 1847, when the works were closed and the stock-in-trade sold.

The closing of this factory terminated the manufacture of glass in Newry.

### BALLYCASTLE.

In 1755 a glass house was erected at Ballycastle, Co. Antrim, for the purpose of making bottles, the sand for which was obtained locally.

Hugh Boyd appears to have been the chief proprietor, and with him were associated Jackson Wray, Laurence Cruise, James Urch, and John Magawly. In the same year the proprietors stated that the public could be supplied with any number of bottles, and that the glass house was 60 feet in diameter, and was capable of carrying on the glass-bottle-manufacture in all its branches.

They also stated that they intended to make window and plate glass; but no mention occurs of any window glass ever having been made. Apparently, in 1756, Laurence Cruise died, and a third share in the glass house was offered for sale. Boyd and the other proprietors carried on the business until 1764, when, at the instance of Boyd, Henry Lunn and Thomas Smith Jewdwin, English glass-makers in Dublin, took a lease of the Ballycastle glass house, at the rent of £1000 per annum.

Hugh Boyd died in 1765, and Lunn, Jewdwin, and Magawly appear to have continued the manufacture of bottles, having received premiums from the Royal Dublin Society in 1765 and 1766, for bottles valued at  $\pm 1930$ .

The Ballycastle glass house continued working until about 1785 or 1790.

In 1782 among the ships arriving in Belfast was one from Ballycastle laden with glass; and in 1795 the Ballycastle colliery was advertised to be let, but no mention was made of the glass house.

The chimney remained standing until towards the close of the last century, when it was pulled down; and the site of the factory is now occupied by tennis grounds.

#### LONDONDERRY.

The only record of glass-making in Londonderry occurs in 1820. In the Ordnance Survey of the County of Londonderry it is said that in that year Joseph Moore converted the sugar establishment in Londonderry into a glass house, and, with his son, carried on the manufacture on a small scale until 1825, when they abandoned it owing to the imposition of duty on glass.

Probably only black bottles were made here.

#### IRISH GLASS IN GENERAL.

An Act of Parliament of 1746 placed a duty of 9s. 4d. on every hundredweight of materials for flint glass made in Great Britain. The Act restricted the importation of glass into Ireland, English glass only being allowed to be imported, and also prohibited the export of any glass from Ireland.

In 1777 the duty on glass in Great Britain was increased; but no duty was placed on Irish glass until 1797, when every quart bottle became liable to a duty of one farthing, and smaller sizes in proportion. Dealers in glass had also to take out a licence of twenty shillings.

In 1811 flint glass made in Ireland and exported became liable to duty; and in 1825 the final blow came, when a duty of £12 10s. was placed on every 1000 lb. of metal made in Great Britain and Ireland.

From this time the manufacture of glass in Ireland began to decline. In 1829 the tax on flint glass produced  $\pounds 23,612$ ; while in 1834 it had fallen to  $\pounds 14,678$ . The excise duty on glass was removed in 1845; but by that time the glass industry in Ireland was almost dead.

In 1825 there were eleven flint-glass houses in Ireland; in 1833, seven (two in Dublin, two in Cork, one in Belfast, one in Waterford, and one in Newry); and in 1852, only two—one in Dublin, and one in Belfast.

The restriction on the exportation of glass from Ireland, imposed by the Act of 1746, was removed in 1780; and shortly after that new glass houses were erected in Cork, Waterford, Newry, and Belfast.

Immense quantities of glass were imported into Ireland from England, and some also from the Rhine district, during the eighteenth century, notwithstanding the large amount made in the country.

From about 1719 to 1727, the average imports of drinking-glasses amounted to about 133,000, and of bottles to nearly 55,000 dozens annually, besides other glass-ware to the value of about  $\pounds$ 4000.

About 1737 the average number of glass bottles imported annually amounted to nearly 79,000 dozen, at 1s. 4d. per dozen; drinking-glasses to nearly 102,000, at 2s. per dozen, and other glass-ware to the value of over  $\pounds4000$ .

About 1747 the average value of imported glass was nearly  $\pounds 9000$  annually, and about 1773 the imports of bottles amounted to about 40,000 dozen, drinkingglasses to nearly 210,000, and other glass-ware, to the value of over  $\pounds 3000$ .
Ten years later the imports had altered very little, except that the number of drinking-glasses had fallen to about 22,000.

Numerous advertisements appear in the old newspapers announcing the importation of English glass, chiefly from London, Newcastle, and Bristol. From about 1730 to 1800 the imports include :---double and single flint drinking-glasses; flowered and plain wine and beer-glasses; water-glasses and saucers, diamond-cut salts, diamond-cut and scalloped bowls and dishes; gilt, cut, flowered, and plain decanters; diamond-cut beer, cider and wine-glasses; cut and plain salad-bowls; water plates, candlesticks, curious cut salts, etc.

In 1754 a Belfast glass merchant imported cruets mounted with Stourbridge glass.

After 1780 a good deal of glass was exported from Ireland, chiefly to America, Spain, and Portugal. In 1784 the exports to America amounted to 532 dozen bottles, and 20,736 drinking-glasses; while in 1785 it is said that one of the Dublin glass houses had received orders from America which would keep it fully employed for two years.

In 1788 a record exportation of flint glass was made to Cadiz by Chebsey's factory at Ballybough Bridge, and in the same year a large quantity of window glass was also exported.

In Wallace's "Essay on the Manufactures of Ireland," published in 1798, it is stated that much of the glass consumed in Ireland was imported, while that made in the country was largely exported to America; so that very probably a large proportion of the glass now found in Ireland is really of English origin.

At the present day it is often very difficult to say whether a particular piece of glass is Irish or English; and it is still more difficult to differentiate between the products of the various Irish glass houses, unless pieces bear marks indicating the place of manufacture. It may be mentioned that the glass-fittings of Sheffield plated epergnes, cruets, &c., are almost always of English glass, Birmingham, Dudley, and Whittington, near Sheffield, having been the chief sources of supply.

Pieces which became broken may, however, have been replaced by those of Irish manufacture. In 1772 Benjamin Edwards of Belfast advertised epergnes and epergne saucers.

A good deal of the old cut glass now found in Ireland has a decided blue tint, which is commonly said to indicate that it was made in Waterford, though on what authority no one seems to know. The blue tint is simply caused by a little too much oxide of lead in the composition; and as this might occur in any pot of metal, glass with this tint may have been made in any of the Irish, or even English, factories.

The few undoubted pieces of Irish glass which have been found stamped with the name of a particular glass house are of a clear metal, without any trace of the blue tint, though not so white as modern glass. An analysis of a piece of glass having this blue tint gives the following composition :—

Lead ox	ide	 	 36.26
Potash		 	 8.48
Soda		 ••	 3.08
Silica, in	 51.88		
			100.00

There is no trace of cobalt, to which some attribute the blue colour.

The metal of Irish and English flint glass was made from practically the same materials, the sand being obtained chiefly from the Isle of Wight, though the glass house at Drumrea, near Dungannon, used local sand.

Sand for bottle glass was obtained in Ireland—that for the Dublin glass houses from the North Bull; for Cork, probably from Youghal and Tramore; and that for Ballycastle, from the immediate neighbourhood.

It is said that ships trading between the South of Ireland and France often brought back sand as ballast; but whether this sand was used in the manufacture of glass either in Cork or Waterford is uncertain.

Again, the patterns on Irish and English cut glass are very similar, which may be accounted for by many of the proprietors of Irish glass houses being Englishmen, and also from the fact that glass was cut in Ireland by English workmen.

Benjamin Edwards, who managed the glass houses at Drumrea and Belfast, came from Bristol, and probably carried on the manufacture in the same manner as in the latter town. The only records of enamelled glass in Ireland which appear as late as 1801 occur in connexion with these two factories, and this special kind of glass was largely made in Bristol.

Diamond-cut glass is mentioned as having been imported into Ireland from England in 1747; but it was probably not until somewhat later that much cutting was employed on Irish flint glass.

Cut and flowered glasses, and diamond-cut cruets are mentioned in 1752 as having been made in the Mary's Lane glass house, and also glasses engraved with vine borders, toasts, &c.

The various patterns cut on Irish glass were probably largely copied from those employed in England; and, as far as can be ascertained, the earlier pieces had less cutting than those of later date. Pieces with shallow-cut wreaths, and broad, low nail-head cutting, are supposed to be the earlier forms of decoration; still no definite rule can be laid down, as pieces of the second quarter of the nineteenth century still have the broad, low nail-heads, while pieces with deep, sharp diamond-cutting are usually late—about 1820 to 1840, or even later.

Some of the Irish glass may have been gilt, as in 1786 a John Grahl and a Richard Grant obtained a premium from the Royal Dublin Society for gilding on glass.

As it is almost impossible to obtain authentic pieces from individual Irish glass houses, it is very difficult to say if a particular style of cutting was peculiar to any one factory. It is said, however, that the sharp diamondcutting was extensively employed at Ronayne's factory in Cork; and it is certain that the very fine diamond-cutting, strawberry-cutting, and the large upright fluting were used at Waterford.

Another fact which makes it difficult to determine anything from the cutting is that the glass made in one town was often cut in another: for example, large quantities of Waterford glass were cut in Cork and Belfast, while Limerick possessed glass-cutters and engravers who probably decorated glass made in Cork and Waterford.

Both the Cork and Waterford factories had warerooms in Dublin, and during the time the glass houses were working a considerable amount of Cork and Waterford glass, besides English and Scottish, was sold in Belfast, while Dublin glass was largely sold in Cork.

In decanters, as being the commonest examples of the old glass to be found at the present day, the forms vary a good deal, some being barrel-shaped, others squat, and others again tall, with slender necks, and gradually swelling bodies. They almost always have raised rings round the neck, except in the late examples, usually three, either quite plain, a kind of triple ring, feathered, triangular or cut. Cork and Waterford certainly used the triple ring, almost always three being on each decanter, while Belfast used the triangular ring, and generally only two.

Some of the later decanters, about 1830 or 1840, had no rings, but the neck was cut in prisms, &c., and the sides perpendicular. A peculiarity of Irish glass, especially in salad-bowls, salt-cellars, and pickle-urns, is the plain, roughly moulded base so often found attached to pieces otherwise finely cut. These moulded bases, although occasionally polished round the edge, appear rather incongruous.

Besides cut glass, a large amount of engraved glass was also made in Ireland, chiefly decorated with fine lines, stars, &c., and also with vine-leaves and bunches of grapes. This engraved and flowered-glass, as it was called, appears to have been made in all the factories.

Many of the decanters, water-jugs, finger-glasses, &c., bear fine, upright R.I.A. PROC., VOL. XXIX., SECT. C. [9] mould-marks, which were formed probably by first placing the gathering of glass on the blowing iron into a ridged mould, and then taking it out and blowing it. Some pieces appear to have been blown into a mould having a diamond pattern, flutings, &c.

The old tall-stemmed drinking-glasses were made in large numbers in Ireland during the seventeenth and eighteenth centuries; but it is very difficult to distinguish these from English specimens.

Drinking-glasses, however, with tall stems, often enclosing air or white twists, and having unusually small bowls, appear to be peculiar to Ireland.

It is said that coloured glass was made in Ireland in small quantities during the eighteenth and nineteenth centuries, and probably that used as framing to mirrors may have been made in the Dublin and South of Ireland glass houses. No coloured glass, however, is mentioned in any of the advertisements of the different factories, with the exception that in 1773 William Williams, at his bottle and window-glass manufactory in Dublin, stated "that he made any article of any colour that is made of glass."

Large quantities of cut glass are made at the present day in England America, and on the Continent, many pieces being exact copies in form and cutting of the old glass. The colour of the modern metal is, however, seldom like that of the old, being far too white and brilliant, and the pieces themselves generally much lighter in weight. As many pieces of this modern glass are passed off as old, this short account of Irish glass cannot be better brought to a close than with the words—*Caveat emptor*.

The illustrations are from pieces in the writer's possession, and from drawings of patterns used in the Waterford glass factory about 1820-30.



Cut and Engraved Decanters, stamped underneath ' Cork Glass Co '' h 8-in.



" Flowered " Decanter, probably Waterford h.  $7\frac{1}{8}$ -in.

Cut Decanter, stamped underneath " Penrose, Waterford, "  $h_{1,75}^{1}$  in



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PLATE VIII.



Moulded Decanter, stamped underneath "B. Edwards, Belfast." h.  $7\frac{5}{8}$ -in.

Cut Decanter, stamped underneath "Francis Collins, Dublin." h. 8<sup>3</sup>/<sub>4</sub>-in.



Drawings of Patterns used in the Waterford Glass Factory about 1820-30

WESTROPP-GLASS-MAKING IN IRELAND.



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PLATE IX.





Drawings of Patterns used in the Waterford Glass Factory about 1820-30.

WESTROPP.-GLASS-MAKING IN IRELAND.

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## IV.

# EARLY IRISH POPULATION-GROUPS: THEIR NOMENCLATURE, CLASSIFICATION, AND CHRONOLOGY.

#### By JOHN MAC NEILL.

Read JANUARY 23, 1911. Published April 28, 1911.

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#### I. PLURAL NAMES.

1. AMONG the continental Celts, each distinct population-group bore a plural name, e.g. Haedui. The singular form denoted an individual member of the community, e.g. Haeduus. This system of nomenclature, very general in ancient Europe, might be expected to exist in the oldest Irish traditions. In Ptolemy's description of Ireland, the sixteen peoples named all bear names of this order.

2. Most of the names given by Ptolemy lack identification in the native Irish tradition. The absence of these from Irish writings may be accounted for in more than one way. Some of the names may have been inaccurately recorded by Ptolemy. Some may have been corrupted beyond recognition by his copyists. Some may have designated peoples whose identity became forgotten through conquest and dispersion, for there is ample evidence that the period between Ptolemy's time (c. A.D. 150) and the beginning of contemporary records in Ireland was marked by great commotion, involving widespread changes in distribution and relative status of the older elements of the population.

3. The Ogham inscriptions, as I have shown in an article on the word *Moccu* (Ogham *mucci*) in Ériu, vol. iii., part i., sometimes record names not only

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of persons but of peoples. The people-names, however, chiefly belong not to the class discussed above, but to a subordinate class, as will be seen. It is therefore unnecessary here to consider the question of the earliest date of the extant Oghams. Between Ptolemy and the oldest probable manuscript records in Ireland there is a gap of at least three centuries. The names Scotti and Atecotti, known through Latin writings of the fourth century, are probably of a general application, not designative of special groups. Orosius gives one people-name not mentioned by Ptolemy, the Luceni, whom he places on the southern coast over against Spain; they have not been identified in Irish tradition. (Is Luceni a copyist's error for Iuerni?)

4. In Christian Ireland, from the fourth century onward, the plural formula for people-names exists only as a survival. The Ulidian tales, which are held to embody very ancient traditions, assign indeed a prominent part to peoples with plural names, the Ulaid, the Lagin, the Galeoin, the Érainn, but not a more prominent part than to the Connachta, whose name belongs to quite a different order. As the phrase *teora Connachta* shows, this name, though plural, is the plural not of a word denoting an individual, but of a collective noun. Already in the pre-Christian period such collective nouns have for the most part displaced the older formula, tending to obliterate it largely from traditional memory, since among the hundreds of collective names on record only a small proportion are known to originate from an earlier group bearing a plural name.

5. The obsolescence of the earlier order of names is further exemplified in the complete absence, so far as my observation goes, of any instance of the use of the singular to denote an individual. The only approach to such usage in my knowledge is the occurrence of a few names like Cormac Gaileng, Ailill Érann, Mugdorn Dub, etc., for persons who in the genealogical lore stand as eponymous ancestors to the Gailing, the Érainn, the Mugdoirn, etc.

6. In the Christian period, the surviving plural names (except in genealogical writings) tend more and more to become dissociated from populationgroups, and to attach themselves in ordinary usage to geographical areas, e.g. Laigin, usually meaning the country Leinster, or the people of Leinster, of whom the original Laigin were only one section.

7. The following names from Irish MS. sources appear to belong to what may be called the first order, i.e. to the Haedui-type<sup>1</sup>:—

8. \*Arai, dp. Araib. Mid. Ir. Ara Thíre, Ara Chliach.

<sup>&</sup>lt;sup>1</sup> The lists of people-names assembled in this paper are of course drawn mainly from Hogan's Onomasticon Goedelicum, which may be consulted with regard to the territorial location and extent

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9. \*Coraind, \*Corrind, dp. Corannaib, Correndaib, Windisch, Táin Bo Cuailngi, index. In the Boyne valley, corresponding to Ptolemy's Coriondi. Cp. Corcu Cuirnd, Cuirenrige.

10. Cruithni, gp. -ne, ap. -niu, but in composition Cruithen-tuath, Cruithenchlár. MacFirBisigh, Book of Genealogies, R.I.A. copy, p. 54, quotes a poem on the aithechtuatha, with the couplet (eight and seven syllables):

> Clann Chathraighe a ccriochaibh Cruithent or chin Cairbre Cinn Cait cruaidh.

The correct reading is probably Cruithen, t from the familiar Cruithentuath being added by MacF. or some earlier scribe. The early stem should have been \*Qretino-, \*Qreteno-, and perhaps the Greek form Prettano- may have been influenced by Brittani. Cruithni, Cruithne, may represent an early secondary formation in -io-, or may be merely a late development like Érnai, Mugdornai. Such a development could arise from ap. Cruithniu, dp. Cruithnib, which would be common to both forms, and even a np. \*Cruithin could easily become Cruithni in transcription.

11. Éli, gp. Éle.

12. Érainn, gp. Érann (not gs. as in Onom. Goed.), ap. Érna (= Érnu), dp. Érnaib, = Iērni, Iverni, "Hiberni." Probably a secondary formation from an older \*Ivēri, whence \*Ivēriu, Ériu, Iwerddon. In the Ulidian tales, the Érainn are frequently called Clanda Dedad, and in the genealogies they have, besides Ailill Erann, an eponymous ancestor Iar macc Dedad. The group of tales centring in Conaire Mór are the heroic legend of this race, and Conaire's father is called Eterscél (also Eterscéle) moccu Iair. Macc Iair is a personal name, not an ordinary patronymic: hence the sept-name Ui Maicc Iair and the Ogham Maqi Iari. Windisch (T.B.C. index) cites Iarna as a duplicate form of Érna. We may suppose the double base ér, *iar*, to have arisen from a coexisting pair ĭēr-, ĭvēr-. Cp. Ierne, Ptolemy's Iernos potamos, Iernis polis, contemporary with Iuverna, Iuerna, Hibernia.

13. Féni, gp. Féne, as Meyer has shown (Fianaigecht, p. viii), may be an ancient people-name, not the name of a class as has been supposed.

- 14. \*Fothairt, gp. Fothart.
- 15. \*Galing, gp. Galeng.
- 16. Galiúin, Galeoin, gp. Galian, Galion.
- 17. Lagin, gp. Lagen.

of the peoples and the inflexional and variant forms of the names. A small proportion of names are taken from material not found in Dr. Hogan's lexicon. While my lists cannot claim to be complete, it is hoped that they may form a basis for a more exhaustive collection and for the classification and study of the nomenclature.

18. Manaig or Monaig, dp. Manachaib, but derivative Manchaig. Cp. Manapii.

19. Maugdoirn, Mugdoirn, gp. -dorn, ap. -dornu. Cp. Ptolemy's Darini.

20. Sogain, gp. Sogan. Cp. Sograige (?), Corcu Sogain, Corcu Suigin (Sogain here being gs. of the eponym, as in moccu Sogin, Ogham mucoi Sogini).

21. Ulaid, gp. Uloth, ap. Ultu. The earlier np. must have been Uluti or Oluti, and one may surmise that Ptolemy's Ouolountioi, whose location well corresponds to that of the Ulaid around Emain, is a scribal corruption of Oulouti = Uluti, perhaps through the influence of the Latin *voluntas*.

22. Vellabori (Ptolemy), Velabri (Orosius) seems to have left a trace in the place-name Luachair Fellubair (LL 23 a 17). This name occurs in a poem which aims at accounting for the distribution of the peoples said to be descendants of Fergus Mac Roig. Wherever Rudraige, the Ulidian king of Ireland, won a battle, his grandson Fergus planted a colony of his own race.

> Cech rói reraig corruadchathaib cen chridenas cotgab iar fír roslín Fergus dia fhinichas.

Of these colonies were Ciarraige Luachra (in North Kerry) and Ciarraige Cuirche (Kerrycurrihy barony, co. Cork), and the victories of Rudraige which led to them are thus recited :

Fich cath Curchu cath Luachra laechdu Fellubair secht catha i Cliu intochtmad friu i nGlendamain.

Ptolemy clearly indicates the Vellabori as inhabiting the south-western corner of Ireland, and Orosius speaks of the Velabri as looking towards Spain. In the verse cited, we should expect gp. Fellabor = \*Vellabron, but the word may be used eponymically in gs. like Dedad in Luachair Dedad, another name for the same district.

23. In the absence of examples of the singular, it seems likely that Aidni, Luaigni, Luigni, Uaithni belong to this order rather than to the collectives in -ne.

24. Dési is to be classed apart, being the plural of a common noun déis "ensemble de vassaux." Aire désa, lord of a vassal tenantry. See D'Arbois de Jubainville, Cours de Littérature Celtique, vol. viii, p. 204. In the story of the migration of the Dési (ed. Meyer, Ériu, iii., p. 141), the narrator is at pains to explain (ll. 215-219) that the derogatory term dési is not applicable properly to Dál Fiachach, the dominant people of Dési Muman:

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25. Coica toirgi laisna Déisi. A cuic fichet dib tarthatar raind, a cuic fichet aile nach tarthatar ocus is dona toirgib [sin] is ainm Déisi. Ar itt e fil fo deisis ocus dligud ocus bodagas dona flathaib .i. do Dail Fiachach Suigde ocus ni hainm doib-side Déisi. "The Dési had fifty migrations' (i.e. consisted of fifty migratory peoples). Twenty-five got a share (of the conquered land), another twenty-five got no share, and to these migratory peoples the name Dési belongs. For it is they who are under (*deisis*) vassal-tribute<sup>2</sup> and law and *bodagas* to the rulers, i.e. to Dál Fiachach Suigdi, and Dési is not a name for the latter."

26. The story professes to give a list of the migratory peoples who assisted Dál Fiachach in the campaign. The list names forty-seven peoples, not fifty. The first three are mentioned twice in immediate succession, and so may have been counted as six by the compiler of the list, who doubtless aimed at collecting fifty names and ceased to extend his list when it seemed to reach that number. These migratory bodies are described by a term (*loinges*, l. 103), indicating that they were already landless. The account of the *aithechtuatha*, BB 255a, has two lists, of which the first, ending on the line 18, contains 46 names. Most of these correspond to the names in the Dési story, and the list was doubtless extracted from a version of the story. These premisses fully sustain the interpretation of *déis* given by D'Arbois de Jubainville.

27. \*Airgéill is given by Hogan on the authority of the index to Stokes's Tripartite Life. The gp. is Airgiall, but the np. in Mid. Ir. texts, as noted by me, is only Airgialla. The name seems to be of comparatively late formation, and cannot be classed with the old order of plural people-names.

27a. Mac Fir Bhisigh (Geneal., p. 54) quotes a poem on the *aithechtuatha*, which include "Absdanaigh for iarthar Erenn, for Luachair Chairbrighe." Further it is stated that the Absdanaigh iarthair Erenn are of the Fir Bolg. See also Onom. Goed. Since Cairbrige is said to be an older name for Ciarraige Luachra (perhaps for the territory, from a people supposed to have anciently possessed it), the locality indicated is Luachair in western Munster.

28. As in Airgialla, so in several other plural names with O-stem, Middle Irish usage substitutes a strengthened nominative : Araid for \*Arai, gp. Arad, ap. Arada; Érna, Érnai for Erain; Fotharta, Gailenga, Mugdorna, Mugdornai. The added syllable is occasionally maintained in gp., e.g. septem genera Gailinga. Cp. what has been said above on Cruithni, \*Cruithin.

<sup>&</sup>lt;sup>1</sup> torche, toirge. For the meaning cp. "Isead cheados fochand toirchi Chiarraidi . . . co Mumain," Lecan 253 b; "Cuis toirche Chorco hOichi o Loch nEchach," ib. 271 a.

<sup>&</sup>lt;sup>2</sup> For deisis Rawl. B 502 has chis = rent.

#### II. COLLECTIVE NAMES.

29. Already, before the earliest documentary period, a new formula has come into general use, that of collective singular names. Of such names there are five varieties :--

- (1) Dál followed by genitive eponym, e.g. Dál Cais.
- (2) Corcu followed by genitive eponym, e.g. Corcu Duibne.
- (3) Eponym compounded with -rige, e.g. Boonrige.
- (4) Eponym compounded with -ne, e.g. Cuircne.
- (5) Eponym compounded with -acht, e.g. Cianacht.

Lóigis (Mid. I. Laigis, modern I. Laoighis, English Leix), gs. Lóigse, may be a sixth variety.

30. Until the eighth century, this class of people-names, which I would call the second order, though long established, had not become stereotyped as in later usage. They were to some extent interchangeable. Korku Reti (Adamnan) = Dál Riatai. Corcu Sai (L. Arm.) = Sairige. Dál Musca = Muscraige. Dál nEogain, Dál Céin = Eoganacht, Cianacht. This interchangeable character shows that the different forms were felt to belong to one order or system of nomenclature, which is also proved by the applicability to all of the personal name-formula in moccu (Ogham mucoi, maqi mucoi), which becomes obsolete in the eighth century.

31. The eponym is occasionally feminine. From this and other indications, I have formed the opinion that the eponymous ancestor may be a divine or mythological personage. Many of the stories in which the genealogists relate the origin of these early groups bear a strong mythological character.

32. Dál is explained by Ven. Bede, in reference to the Dalreudini (i.e. Dál Réti, Dal Riata), as meaning *pars*, and this among various senses of the word seems best suited to its usage in people-names: Dál Réti, Réte's division or section of the Érainn. The eponym may be often, if not always, the name of a divine ancestor.

33. Corcu (later Corco, Corca) appears as an indeclinable noun.<sup>1</sup> A possible connexion with coirce is suggested to me by Professor Marstrander : cp. the use of Síl in later group-names, e.g. Síl Muiredaig.

The genealogists, ignoring the obvious fact that Corcu is a common generic term equivalent to Dál, supply an eponymous ancestor Corc for several of the peoples named in this form.

<sup>&</sup>lt;sup>1</sup> But a late dp. coreaib occurs in Book of Rights.

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. 34. Dál is found before the following eponyms :---

Aengusa Mus	sca	Connaig	Maic Cuirp	Mude
Airde		Conrach	Maic Néth	Mudine Indae
nAisci (Naisc	ei ?)	Corb	Maigin	Mugaide
Araidi	,	Cormaic	Maigne	Mugaidithi
Auluim		Cualni	Maignen	Mugith
Oluim		Cuinn	Maignenn	Muigid
Uluim		Cuirb	Maithe	Muine
Baiscinn		Cuirc	Maitti	Muindi
Bardeni		Cula	Mathar	Muisge
Bairdine		Dairine	Math <sup>3</sup> Lego	Muith
Beccon		Dallain <sup>2</sup>	Math <sup>3</sup> Lobha	Musca
Birnd		Damail	Mathra	Na Cethre nArad
Buachalla		Didil	Mathrach	Nat Corp
Buain		Ditil	Matrach	Niad Corb
Buinne		Druithne	Metrach	Niath Lega
Bundruini		Duach	Maugnae	[Niath Lobha]
Cabail		Duibne	Mechon	Nimde
Cabula		Duluim	Mochon	Nuidne
Cauala		Echach	Menda	Nuidine
Cairbri		Eogain	Meandach	Nuisce
Coirpri		Fiachach	Mendad	Nuiscidi
Cais		Fiatach	Mendato	nOich
Calathbuig		Foichidh	Mendet	Riatai
Cathula		Gabla	Mennaid	Riata
Cealtru		Gailline	Medruad	Riada
Ceata		Gella	Mendraide	Ruitne
Céin		Idnu	Messe Corb	Runtair
Céte		Imdae	Mas Corb	Runtir
Ceide		nIochair	Mes Corb	Sailni
Cethirnn		Luigne	Messin Corb	Seille
Codaid		Luigni	Mos Corp	Tidil
Conchubuir		Luiscni	$\operatorname{Mocoirp}$	Tidilli
Condad <sup>1</sup>		Luisein	Mo Dala	Tri Conall
Condaid		Macon	Mo Dola	nUlad
Condaith		Meacon	Mo Dula	nUlaim
Confinn		$\mathbf{Mecon}$	Moga	Uoig
Congaile		Maic Con	$\mathbf{M}$ oga $\mathbf{R}$ uith	Urcon
Conluain		Mie Con	Muaigh	

<sup>1</sup> Connad = Ogham CUNANETAS. <sup>2</sup> Dál nDallain (recte Dál Dálann = Corcu D.), Onom. Goed. s.v. Dál Condaith. <sup>3</sup> Probably a scribal error for *Niath*.

Achland	Ce <sup>5</sup>	Druithne	Inmend
Achlann	Cede	$\operatorname{Duib}^{\mathrm{s}}$	Inomain
Athchlann	Chéin	Duibe	Itha
Achrach	Cluain	Duibne	Laege
Acrach	Choemne <sup>6</sup>	Duibindi	Láige
Adain	Coilgenn	Duibne	Loegde
Adaim	Comne	Duichne	Laegde
Aengusa	Condlaigen	$\operatorname{Duin}^9$	Laigde
hAibligh <sup>1</sup>	Condluain	Duithne	Luigde
Ainge	Chroissine	Dula	Luachra
Airtbe	Croisin	Echlann	Luigdech
Airtbind	Cuilend	Echrach	Luigne
Airtgein	Cuirn	Ela	Ma
$Aland^2$	Chuirnd	Ele <sup>9#</sup>	Maigh
Andsae	Culla	Ethrach	Maighe
Aola	$\operatorname{Dain}^7$	Echach	Maige Locha
Arad	Dálann	Ethach	Maigen
Athrach	Dallan	Eoluim	Maigne
Ethrach	De	Faimnia	Maradh
Auloim	Deala	Fásaigh	Mogha
Aunichesa	Dega	Ferai	Moda
Bairdni	Dene	Fiachach	Moncho
Baiscinn	Díne	Fiachrach	Mu Druad
Bibuir	Dimoena	Fir Tri <sup>9</sup>	'Mdruad
Bili	Doine	Irtri	'Mruad
Birn	Dome	Foche = Oche	Muichet
Bruidhi <sup>3</sup>	Din	$\mathbf{Foduib}^{10}$	Muichi
Caela <sup>4</sup>	Ditha	Fuindche	Muinche
Chaelraigi	Dithechtai	Gaola	Muinchi
Caullain	Condithechtai	Iche	Nechtae

35. Corcu is found before the following eponyms :---

<sup>1</sup> See h*Uiblig.* <sup>2</sup> = Ddlann <sup>5</sup>. <sup>3</sup> Perhaps Corbraige (Cor. read as Corcu). <sup>4</sup> Perhaps Corea Ela read as Cor. Caela. <sup>5</sup> Perhaps Coreo Oche. <sup>6</sup> Perhaps Coreo Emme cp. Eminrige. <sup>7</sup> Perhaps C. Adain. <sup>5</sup> Coreu Duib = Dubrige, Onom. Goed. <sup>9</sup> Aduin <sup>9</sup> <sup>9</sup> Also written Corcorthri, Corcothri, etc. <sup>10</sup> Cp. VODDUV in Macalister, no. 40, ACURCITi aVI VODDUV ANGAC (=\*Vodubi Angaci, and with the last word cp. Ui Angain, BB 156 b 28, a sept of Ciarraige, U Aingeda, maic Aingeda, 156 a 27, 28). The initial A may perhaps not properly belong to the inscription.

<sup>2a</sup> Auniche, Fuindche, Muichi, Muinche, Muinchi all seem to be scribal variants of (Corco) hUiniche 'do Gallaib. Ériu 111, p. 139.

<sup>9</sup><sup>a</sup> Not in Onom. Goed. "Ate and so na tuatha tuctha i n-eraic Fergusa Scandail .i. Cores Ele 7 Cores Thenead 7 Coreamruad Alta," Lecan 450. For the allusion, cp. Book of Rights, p. 88 note, which shows that the three tuatha must have been in eastern Munster.

Rinn	Sechlaind <sup>3</sup>	Thened
Rinne	Selcind	Tethba
Roeda	Sochlend	Timine
Roide	Sogain	Tine
Raeda	Suigin	Toilgenn
Raeidhe	Sodhain	Uais
Raide	Soilcind	hUiblig
Raighe	Thede = Dál Céte	hUiniche
Roeada	Themne	Ulad
Ruaid	Temrach	Ulum <sup>4</sup>
Ruisen	Tened	
	Rinn Rinne Roeda Roide Raeda Raeidhe Raide Raighe Roeada Ruaid Ruaid	RinnSechlaind³RinneSelcindRoedaSochlendRoideSogainRaedaSuiginRaeidheSodhainRaideSoilcindRaigheThede = Dál CéteRoeadaThemneRuaidTemrachRuisenTened

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36. -rige has dative singular rigiu. Though I have no instance establishing the gender as neuter, still the ending is to be identified with the neuter noun rige 'kingship.' Hence it would appear that groups of this order originally formed petty states each under its king. Historically, some of these groups are large enough to form several petty kingdoms, while others must have been mere village communities.

37. In these compounds rigion = rige becomes<sup>5</sup> -rige. If the eponym retains a second syllable ending in a vowel, -rige suffers syncope, e.g. Nechtarge (epon. in moccu Nechtae), Osscirge, later by metathesis or analogy, Nechtraige Osraige. The close correspondence between the territory of Osraige (diocese of Ossory, but anciently also extending much farther westward) and the place assigned by Ptolemy to the Ousdiai makes it likely that the names also are closely associated (Ossc -rge = \*Osdia-rigion? Should we not expect Uisserge?). When the eponymic element ends in r preceded by a consonant, only one r appears in writing: Gabraige = \*Gabrorigion (eponym Fer Dá Gabar), Bibraige = Corcu Bibuir, Odraige also Odorrige. This arises from a usage in spelling, cp. gobann, Goibniu.

38. In Middle Irish, there is an increasing tendency to substitute *-raige* for *rige*, and the later MSS. show a strong preference for *-raide*. In the following list add *-rige*, *-raige*, where the hyphen appears:

Ai-?	Airb-6	Allt-	Arb-
Aib-	Alt-	Aman-7	Art-

<sup>1</sup> Olchind, Selcind, Sochlend, Soilcind, Toilgenn appear to be variants of one name.
 <sup>2</sup> Perhaps
 = Róede.
 <sup>3</sup> Cp. Echlann, Achland.
 <sup>4</sup> = Auloim, Ecluim.

<sup>5</sup> Holder, Altcelt. Sps., gives *Icorigium*, vicani Segorigicness, both from the Prussian Rhine Province, and *Carbantorig*[i]on from southern Scotland. With the last cp. *Corbetrige*.

<sup>6</sup> "Ar slicht Nothar meic meic Fir Airbeir do Ernaib ita Aibride," Lecan 453. Read Airbrige? <sup>7</sup> Amanrige, Emenrige, will be found in Onom. Goed. under tuath, and the topographical references show that these are identical with Amanchaire, Emenchairi. In the latter we have probably one more form of collective people-name, formed with the word corio-, cuire. Cp. banchuire, Coriondi, Gaulish Coriosolites, Petrucorii.

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[11]

Au-	Caen-	Coth-	Grac-
Baen-	Cae-	Crec-	Grag-
Belt-	Cai-	Creg-	Graic-
Bend-	Cailt-	Crech-	Gran-
Benn-	Cairb-	Crobert-	Grec-
Bent-	Cair-	Crot-	Greg-
Bendt-	Calb-	Cuart-	Gregi-
Bennt-	Cal-	Cuilen-	Gruth-
Bib-	Call-	Cuin-	Gub-
Biurraidh ?	Carb-	Cuir-	Gubt-
Bidb-	Cas-	Cuiren-	Inninn-
Bid-	Cath-	Culindt-	Ladh-
Blad-	Cat-	Cup-	Lagh-
Blath-	Catt-	Cu-	Lam-
Blae-	Cecht-	Cur-	Lath-
Blai-	Cel-	Curand-	Lat-
Blod-	Cell-	Cuth-	Latt-
Blodh-	Cerd-	Dart-	Luad
Boend-	Cer-	Dub-	Lubart-
Boand-	Ciar-	E-?	Lubu[t]
Boind-	Clom-	Eigin-	Luch-
Bocc-	$\operatorname{Cloth}$	Em-	Lud-
Bodb-	Cnam-	Emen-	Luid-
Bolg-	Co-1	Eoch-	Luff-
Bonand-	Coc-	Erc-	Lug-
Bond-	Coil-	Herc-	Luig-
Bonn-	Coen-	Fed-	Lus-
Bon-	Coin-	Forb-	Man-
Boon-	Coirp-	Frad- <sup>2</sup>	Mann-
Borb-	Coith-	Gab-3	Mas-
Brecc-	Cond-	Gael-	Mase-
Bresc-	Con-	Gail-	Maugin-
Brocenn-	Corb-	Gaman-	Mughan-
Brod-	Corbet-	Garb-	Med-
Brug-	Corc-	Geg-	Meg-
Bru-	Corp-	Glas-	Men-
Brui-	Cort-	Glunn-	Mend-
Cael-	Cosc-	Grafimin-	Menn-

<sup>1</sup> "Aimirgen Gluingeal a quo Coraidi (= Corco Raidi?) 7 Orbruidi 7 Corco Athrach Ele, Lecan 456.

2 Read Trad-?

· Aengus Fear da Gabar mac Conairi Moir meic Etersceoil a quo Garbraidi, Lecan 450. Oengus Fer Gabra mac Conairi maic Meissi Buachalla diatat Gabrige, Eriu iii., p. 139.

## MACNEILL- Early Irish Population-Groups.

Molt-	Odor-	Sai-	Sort-
Musc-	Od-	Saith-	Sorth-
Naind-	Orb-	Sciath-	Suob-
Necht-	Osse-	Scorb-	Tac-1
Nechta-	Ossa-	Scot-	Taec-
Nos-	Os-	Sed-	${\operatorname{Tec}}$ -
Nois-	Pap-	Sem-	Teoc-
Noth-	Pab-	Semon-	Teoch-
Nud-	Part-	Snob-	Tore-
Nudh-	Rath-	Sob-	Trat-
Nuidh-	$\operatorname{Rech}$ -	Sub-	Trad-
Nut-	Ros-	Sogh-	Tread-
Nuth-	Roth-	Sord-	Treg-
	Roith-		U-

39. The suffix -ne, ds. -niu, points to a collective ending -inion. In Middle Irish, when the preceding consonant resists palatalisation, -ne becomes -na. In the following list, doubtless, many names are included which do not denote population-groups, since the suffix has a much wider application.

The instances which are known to be people-names are indicated by the mark  $\uparrow$ .

Mag Aibne	Brefne	Ath Coirthine	Cuairne
Aidne	Brebne	Coirtene	Cuerne
Ailbine	Brestine	Dún Coistinne	Mag Cualgerne
Loch Aillinne	Loch Bricerne	†Conaille	Áth Cuillne
Loch Aindinne	Bruachairne	Aes Conchinne	†Cuircne
Cluain Airdne	†Buaigni	Mag Conchinne	Ros Cuissine
Airene	Buichne	†Conchuburne	Tráig Culcinne
Cúl Aisne	Cabcenne	Coningne	Daimine
Mag Argarni	Cluain Caichne	+Conmaicne	Dáimne
Belach mBarnini	Cascene	Creidne	†Dáirine
Bechlarna	Cúl Caissine	+Cremthanna	Damhairne
Beltine	Mag Cargamni	Cremthinne	Es Danainne
†Blaitine	Cattene	Ard Crimne	†Delbna
Blaittine	Cerne	Crinna	Delmne
Blárna	Dún Cermna	Ard Cróinne	Delna
Bogaine	Mag Cétni	†Tuath Cruadhlui	nde Deoninne

<sup>&</sup>lt;sup>1</sup> Tacraige, etc., a subdivision of the Arai. The variants suggest an original Toeccrige, Tóicc-, cp. MUCOI TOICACI. The people was one of the four sub-divisions of the Arai, and the eponym appears as Toeca in the following (Lecan 450) :— Ceithri meic Laider in arad .i. Dula 7 Tocca 7 Nena 7 Arta.

Dergne	†Gailine	Tír Marcceini	Scédni
Dún Detchine	Gailinne	Metine	Sceinni
Detnae	Gebtine	Muscraige Mitaine	Segene
Cúl Dreimne	Gobnine	Midbine	†Semaine
Drebne	Goistine	Cluain Moescnae	Semoni
Drebine	Gratine	†Tuath Mochtaine	Semuine
Dún Dreimne	Greftine	", Mochthuinn	e Semne
Mag Drithne	Gruitini	Dún Muairne	Cúl Siblinne
Duichni	Domnach Iarlainne	Ailech Muirinne	Cúl Sibrinne
Sliab Eblinne	Áth Inroine	Nemeni	Dún Sraibtine
$\mathbf{E}$ dne	Inber Labrainne	Glenn Nemthinne	" Sraiftine
Eilne	Loch Labrainne	Ochaine	" Sraiptine
Eilbine	†Lathairne	Oichene	Taelcoine
Cúl Emni	Latharna	†Ochmaine	Taiblene
Loch Érne	†Ligmuine	Oicne	Mag Taideni
Ernine	Locharna	Caill Oichni	Talcainne
Etarbainne	†Luaigni	Oinmine	Talindi
Fertene	†Luguirne <sup>1</sup>	Ollbine	Cluain Tibrinne
Findine	+Luigni	†Plaitine	†Tretherne
Benn Foibne	Mag Luidni	Raigne	Tuath Uindsinde
Ros Foichne	+Mairtine	Raimhne	Mag Uaidni
Foidne	$\operatorname{\acute{A}th}\operatorname{Cliath}\operatorname{Mairgene}$	Saidni	†Uaithni
Fuaithniu	Áth Liac Margini	Saimni	
Ard Gabreni	Cuan Manainne	†Saithni	
40. Interch	ange of formulae :		
	Dál Aengusa Musca = Da	ál Musca – Muscraig	çe
	Dál Auluim = Corcu Aul	oim	
	Dál Bardeni = Corcu Bai	irdni	
	Dál Baiseinn = Corcu Ba	liscinn	
	Dál Birnd <sup>2</sup> = Corcu Birn	= Osraige	
	Dál Buain = Boonrige		
	Dál Céin = Corcu Chéin	= Cianacht	
	Dál Céte, cp. Corcu Cede	1	
	Dál Conchubuir = Conch	ubuirne³	
	Dál Conluain = Corcu Co	ndluain	
	Dál Cormaic = Corcu Cor	rmaic Lagen	
	Dál Cuinn = Connachta		
	Dál Cuirb, cp. Corbraige		
	Dál Cuirc, cp. Cuircne		
	Linguinno II 124 h lost ling	not in Ononi Good	

<sup>1</sup> Luguirne, I.L 134 b, last line, not in Onom. Goed.
 <sup>2</sup> "Genelach Dail Birn .i. Osairge," Rawl. B 502, 128 b 25.
 <sup>3</sup> See note on *moccu Conchubuir* below.

Dál Druithne = Corcu Druithne Dál Duibne, cp. Corcu Duibne Dál Echach, cp. Corcu Echach Dál Eogain = Eoganacht Dál Fiachach = Corcu Fiachach Dál Luigne = Corcu Luigne Dál Maigen, cp. Corcu Maigen Dál Maigne, cp. Corcu Maigne Dál Maugnae, cp. Mauginrige Dál Me Druad = Corcu Mu Druad, Corcumruad Dâl Mo Dula, cp. Corcu Dula Dál Moga, cp. Corcu Moga Dál Riatai = Korku Reti, Corcu Riada Dál Ulad, cp. Corcu Ulad Corcu Bibuir, cp. Bibraige Corcu Cuirn, cp. Cuirenrige Corcu Dálann = Dál Dálann Corcu Duib = DubrigeCorcu Loegde, also named Dáirine Corcu Och(a)e, cp. Ochaine Corcu Luachra = Orbraige Droma Imnocht Corcu Nechtae, cp. Nechtarge, Nechtraige Corcu Ruisen = Tuath Ruisen Corcu Sai = Sairige Corcu Themne = Temenrige Saithrige, cp. Saithne Semraige, Semonrige = Semaine, Semoni, Tuath Semon

41. Of collective names in -acht, I have only three certain instances, all very prominent in history, Cianacht, Connachta, Eoganacht. The plurals Cianachta, Eoganachta are also frequent, especially when more than one subdivision of these groups is in question. Of the singular Connacht I have no example; but the phrase teora Connachta shows that here, too, we have a collective noun. These instances may be added to Bibracte cited by Thurneysen (Altir. Gram. § 262) in support of his view that the abstract nouns in -acht were originally collectives. Other possible examples are Ailech Esrachtae, Ard Cánachta, Cluain Cuallachta, Crích Cugennachte.

42. In my paper on the Moccu-formula (Ériu, vol. III), I brought together a number of instances to show that this formula, which was used as a kind of surname until the eighth century, had relation to the people-name, the eponym in the latter being extracted, so to speak, and its genitive preceded by *moccu* being used to form the surname or gens-name of the individual. I also showed that moccu in Old Irish was represented by mucoi or maqi mucoi in the Ogham inscriptions, and that the corresponding people-name, where it could be identified, belonged to the class of collective names which I have ventured in this paper to designate as the second order. With a view to testing these deductions more fully, I have brought together all the examples of mucoi and moccu which since then I have been able to collect. The result has been to confirm the deductions of my paper in Ériu. I have found no conflicting instance. In many cases, the corresponding people-name has not yet been discovered; but since it appears fairly certain that the formula always testifies to the existence of an ancient population-group whose name must have embodied the eponym found after mucoi or moccu, I give here the whole list of examples.

43. If I am correct in referring moccu Elich to Éli, and moccu Echach (Echdach) to Dál Echach = Fothairt, these instances, together with moccu Baird, appear to indicate that the formula was also applicable in the case of peoplenames of the first order. The rarity of the instances is a matter of course, considering that but few names of the first order were preserved, and that of these few a number, like Érainn, Lagin, comprised subdivisions of the second order. It is even probable, as Corcu Sogin beside Sogin suggests, that the collective formula could be applied to the older names treated as eponyms.

44. Eponyms following MUCOI and its variants in Ogham inscriptions :-

	1.	ANAdo
	69.	ALLATO cp. Altraige <sup>2</sup>
	76.	BIDANI
1902 p	. 5.	BRECI cp. Breccraige
1	162.	CALLITTI cp. Cailtrige
1	183.	CORIBIRI cp. Dál Coirpri <sup>3</sup>
]	126.	CUNAVA[LI] cp. Conaille <sup>4</sup>
ź	229.	CUNIA
2	246.	DON <sub>m</sub> I
	13.	DOVVINIAS Corcu Duibne <sup>5</sup>

<sup>1</sup> The numbers are those of Macalister's collection ; the years and pages refer to the Journal of the Royal Society of Antiquaries of Ireland.

<sup>2</sup> This identification is hardly doubtful. The inscription belongs to the barony of Trughanacmy, Co. Kerry. The Altraige were a subdivision of the Ciarraige, their eponymous ancestors being (gs.) Alta, a descendant of Ciara, also named Mug Taeth, eponymous ancestor of the Ciarraige, according to the genealogists. The Altraige inhabited part of the lands of Ciarraige Luachra and Corcu Duibne.

<sup>3</sup> Dál Coirpri, one of the four primary divisions (*cethri primsloinnte*) of the Lagin. They seem to have been situated in East Munster, of which a large part had once, it was believed, belonged to Leinster. Of Dál Coirpri were the families of Ua Riain (Ryan) and Ua Duibidir (Dwyer), noted East Munster surnames. The inscription, however, belongs to East Muskerry barony, Co. Cork.

<sup>t</sup> Conaille (cp. *Conalneos fines*, L. Arm.) = Cunovalinion. The Conaille of Muirthemne may be regarded as neighbours of the Isle of Man, where the inscription is found.

<sup>5</sup> This and the three following inscriptions are from the barony of Corcaguiny = Corcu Duibne.

- 20. DOV.....
- 31. DOVINIA
- 32. DOVINIA

189. GLUNLEGGET

- 211. IVODACCA
- 214. LITOS
- 212. LUGA
- 247. LUGUNI cp. Dál Luigni<sup>1</sup>
- 1899 p. 427. LUGUNI Luigne<sup>2</sup>
- 1895 p. 359. MACORA
  - 213. MACORBO cp. Dal Mocoirp.<sup>3</sup>
  - 223. MaCoRBo
    - 196. MAQI EURI<sup>4</sup>
      - 3. MAQI MEQ fo ...
    - 220. MEDALO cp. Dál Mo Dala.
- 1898 p. 397. M<sub>EU</sub>TINI
  - 208. NETA SEGAMONAS<sup>5</sup>
  - 225. NETA SEGAMONAS
  - 231. NETA [SEGAM]ONAS
  - 237. ODARREA cp. Odrige, Odorrige.<sup>6</sup>

<sup>1</sup> The inscription is from Co. Waterford. Dál Luigni were among the Dési allies (Ériu iii., p. 149).
<sup>2</sup> Inscription from neighbourhood of Kells. The Luigne of Meath inhabited this neighbourhood, not the barony of Lune, which takes its name from the Luagni.

<sup>3</sup> "Dál Niacorp" (a daerthuath of Cashel, therefore distinct from Dál Niath Corb, of which was the Leinster dynasty) Onom. Goed. is probably for Dál Macorp = Maic Corbb.

4 For Iari?

<sup>5</sup> The three inscriptions bearing this eponym are found within a small area, the district of Dungarvan and Ardmore on the south coast. The eponym may be translated "Segomo's champion." Apart from this name, so far as I am aware, no trace of Segomo has been discovered in Irish tradition. He was known, on the other hand, to the Gauls as a war-god, "Mars Segomo." We should look for a tuath bearing some such name as \*Dál Niath Segamon in the district mentioned, but no instance of such a name has been found. The name Segomo, however, and the locality are strongly suggestive of a late settlement of Gauls on the southern coast. The story of the Dési settlement (Ériu iii., p. 139) names among the Dési allies Corco h Uiniche do Gallaib, and Dal Maignenn, descendants of Maigniu Gall. We can only identify the descendants of Segomo's Champion with the Eoganachta, who claimed Nia Segamon as their ancestor. In Corcu Loegde, = Dáirine, we find another instance of a tuath owning two distinct eponyms. The occupation of Cashel by the Eoganachta cannot well be disconnected from the Dési settlement. (1) The whole territory east of the Suir and within the later Munster belonged traditionally to the Osseirge (Osraige), who were akin to the Lagin. (2) Airmuma, "East Munster," is specifically the name of a territory west of the Suir, now the barony of Upper Ormond. Oenach Airmuman = Nenagh. (3) The baronies of Kilnemanagh Upper and Lower were held by Dal Coirpri, one of the cethri primsloinnte Lagen, "the four chief denominations of the Lagin." (4) Cashel, according to the legend (Keating, Forus Feasa, book i, sec. 3), was first "found" in the time of Corc son of Luguid, and had not previously been a residence of the kings of Munster. Oengus, grandson of Core, was king of Munster in St. Patrick's time, and Core was said to have reigned in the time of Niall Noigiallach. The traditional occupation of Cashel then by the Eoganachta may be placed about A.D. 400. (5) As the seat of the Eoganacht dynasty, the place bore a name of Latin origin, *caissel = castellum*. For the tradition of its older names see Keating, 1. c.

<sup>6</sup> Cp. Coica do maccaib Odra di hUllaib diata Odrige (Ériu iii., p. 138). These take part in the Dési invasion, and the inscription is from the Dési district.

79. QERAI Cerrige, later Ciarraige.<sup>1</sup>

160. QRITTI cp. Crothraige.

218. ROTTAIS cp. Rothraige, Roithrige.<sup>2</sup>

- 198. SOGINI cp. Sogain, Corcu Sogain, Corcu Suigin.
  - 88. TOICAXI
  - 89. TOICACI
  - 91. TOICAC
- 149. TORIANI

1903 p. 76. TREnAluGGo

1896 p. 129. TRENAQITI

- 109. TUCACAC<sup>3</sup>
- 107. UDDAMI
- 242. VALUVI
- 139. VIRAGNI
- 243. VIRI QORB

45. As applied to contemporaries, the quasi-surnames in *moccu* become obsolete in the eighth century. The latest instance I have found is that of Luccreth moccu Ciara, the author of a poem commencing *Cú-cen-máthair maith in chland*, which is found with the Eoganacht genealogy in the Books of Ballymote and Lecan and in Rawlinson B 502. From internal evidence this poem appears to have been composed early in the eighth century. In the Book of Leinster and later documents *moccu* is misunderstood as an equivalent of *macc hui*, *filius nepotis*, and commonly represented by *mc. h., m. h., macc ua*, etc. Abbreviations in the following list : MD (with date in calendar) = Martyrology of Donegal; LL, BB (with page of facsimile) = Book of Leinster, Book of Ballymote ; Ad = Adamnan's Vita Columbae, Reeves, index ; Onom = Hogan's Onomasticon Goedelicum ; Arm = Hogan's Glossary to Book of Armagh ; AU (with year of annal) = Annals of Ulster ; SL = Stokes's Lives of the Saints from Book of Lismore, index.

46. Eponyms following *Moccu*:—

$\mathbf{L}\mathbf{L}$	368	Ultan m. h. Aignich	see Eignich below
,,	5 7	Mo Boe m. h. Aldae <sup>4</sup>	
BB	<b>212</b>	Mo Bhi qui dicitur mc. h. Alla	
,,	225	Brenaind mc. h. Alta <sup>5</sup>	Altraige

<sup>1</sup> The inscription is from Magunihy barony, adjoining Ciarraige Luachra.

<sup>2</sup> From a Dési inscription. The Roithrige take part in the Dési invasion.

<sup>3</sup> Macalister's suggested reading of the inscription, which is defaced. Perhaps it was originally TOICAC as in no. 91.

<sup>4</sup> See pedigree of Mo Baedan from Fiachra Allae, BB 218 g.

<sup>5</sup> See note on ALLATO above. Alti postulates a different stem. The pedigree of St. Brendan has "macc Findloga maice Olchon maice Altai vel aliter macc Findloga m. Olchon m. Gossa m. Gabli m. Ecni m. Altae...do Chiarraige Luachra do Altraige Cind Bera ocus do Choreu Duibni," LL 349 a; "macc Findloga m. Elchon m. Aeltai do Chiarraigi Luachra do Alltraige Chaille," LL 371 a.

## MACNEILL-Early Irish Population-Groups.

Ad.	,	Brendenus mocu Alti	Altraige
$\mathbf{L}\mathbf{L}$	367	Colman mace Cuansi	cp. Corcu Andsae
	368	Odran mc. h. Araide	Dál Araidi
BB	228	Odran mc. h. Araide	93
Ađ		Comgellus mocu Aridi <sup>1</sup>	29
MD	Jun. 7	Mo Cholmoce mac ua Arta	Artraige
BB	225	Colum mc. h. Arte	9 7
$\mathbf{L}\mathbf{L}$	359	Nechtan m. h. in Baird <sup>2</sup>	Longo-Bardi
MD .	Apl. 22	Neachtain mac ua Baird	33
, .	Aug. 30	Usaille mac ua Baird <sup>2</sup>	,,
Ériu	iv. p. 75	Sechnall macc ui Baird <sup>2</sup>	29
BB	226	Colman mc. h. Bairdine <sup>3</sup>	Dál Bardeni
$\mathbf{LL}$	367	Colman m. h. Bairddeni	23
22 1	356	Mo Cholmoc m. h. Beona	
,,	373	Nem m. h. Birn	Dál (or Corcu) Birn <sup>4</sup>
MD J	un. 14	Nem mac ua Birn	3.9
Onom, p. 197		Cell macu Birn	,,
$\mathbf{L}\mathbf{L}$	368	Setna Dromma m. h. Blai	Blairige
Onon	1	Druim mic ua Blae	33
Ad		Lugbeus mocu Blai	<b>9</b> 9
$\operatorname{Arm}$		Miliuce maccu Booin	Boonrige, Dál Buain
BB	226	Caindech mc. h. Buachalla	Dál Buachalla
$\mathbf{LL}$	367	Cainnech m. h. Buachalla	2 7
,,	368	Oidrine m. h. Buachalla	**
Onom	n, p. 197	Cell maccu Buadáin	
MD Oct. 4		Fionocc maccu Cha	cp. Cairige, Caraige
$\mathbf{L}\mathbf{L}$	356	Ecca m. h. Chae	33
BB	227	Mo Laisi mc. h. Caidi	cp. Catrige
$\mathbf{LL}$	368	Mo Lasse m. h. Cáte	<b>3 9</b>
,,	"	Mo Beoc m. h. Cati	3 7
BB	227	Mo Beoc mc. h. Chaiti	,,
,,	"	Mo Laisi mc. h. Carraigi	
$\operatorname{LL}$	368	Mo Lasse m. h. Caisrige	

<sup>1</sup> Pedigree from Fiachra Araide, epon. anc. of Dál A. LL 348 d.

<sup>2</sup> Nechtan or Nechtain, Ausaille = Auxilius, and Sechnall = Secundinus were three of the seven sons of "Lupait sister of Patrick" by Restitutus of the Longobardi, LL 355 a, 372 a. We have here in *moccu Baird* a curious extension of the formula to a foreign people. In LL 372 a, Lupais is called "mathair mace hú Baird." See Anscombe, The Longobardic Origin of St. Sechnall, Ériu iv., p. 74.

<sup>3</sup> " Colman maccu Barrdini, do Dal Barrdainne a chenél," Onom. Goed. p. 331.

<sup>4</sup> Dál Birn was a synonym for Osseirge, Osraige, who are called Síl mBirn, LL 339 a 1, from an ancestor Loegaire Birn Buadach.

<sup>5</sup> Colum Epscop of Tir Da Glas has a pedigree from Dál Cais, BB 221 f.

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BB	<b>2</b> 26	Colman mc. h. Chais	Dál Ca <b>i</b> s	
Ad		Mater virorum mocu Ceiin	Cianachta	
* 7		Chonrii mocu Cein	"	
37		avia To Cummi mocu Cein	51	
$\mathbf{L}\mathbf{L}$	368	Mo Chummae m. h. Chein	25	
$\mathbb{B}\mathbb{B}$	227	Mo Chuma mc. h. Chen	3.5	
,,	226	Comgall mc. h. Cein	2 9	
$\mathbf{L}\mathbf{L}$	327	Comgall m. h. Chéin	• •	
,,	,,	Findlug m. h. Chéin	7.9	
BB	227	Fintan mc. h. Chen <sup>1</sup>	, ,	
,,	228	Mo Gobboc m. h. Chein	• •	
$\mathbf{L}\mathbf{L}$	368	Mo Gobboc m. h. Chein	,,	
Ad		To Channu mocu Fir Cetea	Dál Céte	
BB	173	Lucreth macu Ciara	Ciarraige	
$\mathbf{L}\mathbf{L}$	357	Lucill m. h. Chiara	"	
$MD J_{i}$	an. 31	Caindeach mac ui Chil	Celrige	
$\mathbf{BB}$	227	Fintan me. h. Cind——		
$\mathbf{L}\mathbf{L}$	290	Díl mc. hú Chrecga	Creccraige	
,,	367	Colman mc. h. Coirtged <sup>2</sup>		
BB	226	Colman mc. h. Coirtged <sup>2</sup>		
$\mathbf{LL}$	355	Cilline m. h. Colla	cp. Corcu Culla	
	362	Ultan m. h. Conchobuir <sup>3</sup>	Dál Conchobuir	
AU	656	Obitus Ultain moccu Choncobair	,,	
	662	Ultan moccu Chonchobair quievit	,,	
BB	228	Ultan mc. h. Conchubair	,,	
LL	368	Mo Lasse m. h. Chonna	cp. Dál Condad	
$\operatorname{Arm}$		Ad insolas Maccu Chor	cp. Cuirrige	
$\mathbf{LL}$	367	Mo Chua mc. h. Choraig		
BB	227	Mo Chua mc. h. Choraig		
MDM	[ar. 16	Abban mac ua Corbmaic <sup>4</sup>	Dál Cormaic	
BB	123	Aban maccua Cormaic	,,	
$\mathbf{LL}$	357	Abbain m. h. Chormaic	,,	
,,	364	Abban m. h. Chormaic	• •	
MD I	)ec. 27	Fiacha mac ua Chorbmaic	,,	
AU	663	Baetan moccu Cormaicc	,,	
AU	690	Cronan moccu Chualne	Dál Cualni	

<sup>1</sup> S. Fintan Find of Druimm Ing, Cianacht pedigree, BB 221 a, 232 b 48.

<sup>2</sup> See Forgtech, Fortgech, and cp. Corcu Oirethe, C. Oirethen.

<sup>3</sup> "Ar ba do D. C. doson," Onom. Goed., p. 332. In the Book of Armagh he is called *episcopus* Conchuburnensium, *episcopo Conchuburnensi*, indicating the alternative form Conchuburne = Dal Conchubur.

<sup>4</sup> Pedigree from Cormac, son of Cú Corb, and epon. anc. of Dúl Cormaic, one of the *cethri prim*sloinnte Lagen. "Is dib Aban maccua Cormaic," BB 123 b 26. His pedigree, BB 222 e, f.

MACNEILL- <i>Early</i> Irish Population-0	Groups.
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MD Feb. 7Mellan mac ui CuinnDál Cuinn1Sep. 10Seighin mac ui Chuinn,,Oct. 9Aedhan mac ui Chuind,,LL362Aedan m. h. Cuind,,BB226Colman m. h. Cuind,,LL367Colman m. h. Cuind,,BB227Mo Chua mc. h. Chuind,,LL367Findlug m. h. Chuind,,FMUltan mac hui Cunga,,AU664Ultan mac CaungaOnommoccu Daiménecp. DaimineAdCainnechus mocu Dalon2Corcu DalannBB226Caindech mc. h. Dalann,,,,227Mo Laisi mc. h. Dartada,,MD May 21Inis mac ua Dartadha,,AU653Colman m. h. Dulduil3LL367Colman m. h. Dulduil3LL367Colman m. h. Dulduil3LL368Mo Lasse m. h. DartadaMD May 21Inis mac ua DartadhaJL367Colman m. h. Dulduil3LL368No componecu Delduib3LL367Colman m. h. Dulduil3LL368Noombén mac ua Duibh
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AdErcus4 mocu DruidiLL362Neman m. h. DuibDubrige, Corcu Duib.MD Sen 13Naombán mac ua Duibh
LL 362 Neman m. h. Duib Dubrige, Corcu Duib. MD Sep 13 Naomhán mac ua Duibh
MD Sep 13 Naomhán mac na Duibh
in separation in a second seco
, Apl. 8 Aedhan mac ua Dhuibhne Corcu Duibne
LL 358 Aedan m. h. Duibni ,,
MD Feb. 20 Colgu mac ua Duineachda
AU 602 Quies Finntain filii nepotis Echdach <sup>5</sup> cp. Dál Echach
Onom 539 Fintan maceu Echtach ,,
,, ,, (Fintan) moccu Edagur
BB 228 Ultan mc. h. Eignich cp. Eiginrige
MD Apl. 9 Aedhac mac ua Elich cp. Éli
LL 358 Aedach m. h. Elich "
., 362 Finnio m. h. Fiatach <sup>6</sup> Dál Fiatach
AU 578 Quies Vinniani episcopi mc. nepotis
Fiatach

<sup>1</sup> The numerous pedigrees of the saints of Dál Cuinn (= Uí Néill, Ui Briúin, Airgialla, etc.) include Espoc Aed, Aed Coel, Aedan, Aeidgen, Maedog, and at least four Colmáns. "Seigine m. Fiachna m. Feradaig m. Nindeada m. Fergusa m. Conaill m. Neill," Lecan 93.

<sup>2</sup> " Dal nDallain a quo Caindeach," Onom. Goed. s.v. Dál Condaith.

<sup>3</sup> See Telduib below. <sup>4</sup> Apparently a native of the Hebrides.

<sup>5</sup> S. Fintan of Cluain Eidnech was of the Fothairt, whose epon. anc. in the genealogies is Eochu Find Fuath nAirt, so that Dál Echach may be a synonym of Fothairt.

Fintan Cluana Eidneach uill • mae Garbain mc. Corcrain cuirr

mc. Eachach mc. Breasail ain · mc. Den mc. Condlai comlain

me. Airt Cirp me. Cairpri Niad • me. Cormaic mair co mormiad

(1.45) mc. Aengusa moir miad ngart · mc. Eachach Finn Fuath le hArt. BB 231 a.

<sup>6</sup> Pedigree from "Fiatu Find a quo Dál Fiatach," LL 349 c.

 $[12^*]$ 

	BB	226	Findbarr mc. h. Fiatach	Dal Fiatach
	$\mathbf{L}\mathbf{L}$	867	Findbarr mc. h. Fiatach	2.2
	MD Ja	n.11	Suibne maccu Ir Tri	Corcu Fir Tri
	BB	226	Colman m. h. Forgtech <sup>1</sup>	
	$\mathbf{L}\mathbf{L}$	367	Colman m. h. Fortgech <sup>1</sup>	
	$\mathbf{L}\mathbf{L}$	364	Mo Cholmoc m. h. Gualae no	
			h. Gáili <sup>2</sup>	Gailine
	",	367	Mo Lua mc. h. Gaili	5.5
	BB	227	Mo Lua mc. h. Gaili	* 9
	"	,,	Mo Chuma mc. h. Gaili	5.5
	$\mathbf{L}\mathbf{L}$	368	Mo Chummae m. h. Gaili	2.2
	27	"	Mo Shenóc m. h. Gairb	Garbraige <sup>4</sup>
	MD Oc	t. 21	Siollán mac ua Ghairbh	35
	LL	364	Mc. h. Gairb abbaid Maigi Bili.	
			Sillan Magistir	5 7
	Onom,	p. 197	Cell maccu Geridáin	
	$\mathbf{L}\mathbf{L}$	356	Mc. h. Greccae	Greccraige
	2 3	367	Colman m. h. Guaili <sup>3</sup>	
	BB	226	Colman mc. h. Guaili <sup>3</sup>	
	Lecan	455	Eterscel Mor macu Iair <sup>5</sup>	Érainn
	BB	227	Mo Laisi mc. h. 1mdae	Dál Imde
	$\mathbf{L}\mathbf{L}$	368	Mo Lasse m. h. Imda	9.9
	AU	638	Do Laissi maccu Imde	<b>9</b> 9
	BB	227	Mo Chua mc. h. Lapae	
	LL	367	Mo Chua m. h. Loppae	
	,,	368	Mo Gobboc mc. h. Laime	cp. Lámraige
	BB	227	Mo Gobboc m. h. Laime	3.9
	AU	637	Cronan moccu Loegdae	Corcu Loegde
	$\mathbf{LL}$	367	Mo Chua m. h. Laigde	9.7
	ΒB	227	Mo Chua mc. h. Laidgi	2.2
	2.7	228	Mo Rioc me. h. Laigdi	2.5
	LL	368	Mo-Rióc m. h. Laigde	2.3
?	Ad		Columbanus mocu Loigse <sup>6</sup>	Lóigis
	MD Ma	у 16	Colman mac ua Laoighse	2.2
	LL	360	Colman m. h. Laigsi	2.7
	9.7	356	Oenu m. h. Laigsi <sup>6</sup>	23
	5 7	367	Oenu m. h. Laigsi	3.5

· Coirtgeon above.

2 " Di Gailinni di Ultaib do," LL 364, last column. This Mo Cholmóc may be identified with Colmán moccu Guaili. Perhaps the scribal variants Gual-, Guail-, Gail-, Gail- may be traced to an earlier spelling Góil- (di diphthong.).

<sup>2</sup> See foregoing note. <sup>4</sup> Cp. Domnach maccu Garba, Onom. Goed. <sup>5</sup> See § 12

<sup>6</sup> Pedigrees of Oenu and Colmán from Lugaid Laigsech. epon. anc. of Lóigis, BB 219 c.

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$\mathbf{SL}$	275	Enna maccu Laigsi	Lóigis
$\Gamma\Gamma$	368	Mo Shinu mc. h. Lugair	Luguirne
BB	228	Mo Shinu mc. h. Lugair	3.2
,,	<b>224</b>	Mo Caemo mc. h. Lugair	""
Arm	t	Dubthoch mc. h. Lugir	"
AU	<b>789</b>	Comotatio reliquiarum Mo Chuae	
		moccu Lugedon	
Eriu	iii, 138	Moccu Luigdech	cp. Corcu Luigdech
$\operatorname{Arm}$	L	Muirchu maccu Machtheni	cp. Tuath Mochtaine <sup>1</sup>
MD	Jun. 8	Murchu mac ua Maichtene	""
,,	,,	Meadhran mac ua Maichtene	,,
BB	227	Loman mc. h. Maigni	ep. Dál Maigin, Maigni
$\mathbf{L}\mathbf{L}$	367	Lonan m. h. Maigen	<u>,</u> ,
,,	,,,	Mo Chua m. h. Manche	
BB	227	Mo Chua mc. h. Manchi	
,,	<b>2</b> 26	Fintan mc. h. Milbae	
$\mathbf{L}\mathbf{L}$	367	Fintan m. h. Milbai	
Ad		Lugbeus mocu Min	cp. Menraige
,,		Lugneus mocu Min	;;
BB	<b>228</b>	Mo Shinu mc. h. Muind	"
$\mathbf{L}\mathbf{L}$	368	Mo Sinu mc. h. Mind	,,
AU	cxxxiii	Mosinu Maccumin	"
SL	335	Lugna maccu Moga Laim	
Ad		Laisranus mocu Moie	
BB	227	Mo Laisi mc. h. Naithre	
$\mathbf{L}\mathbf{L}$	368	Mo Lasse m. h. Naratha	
,,	356	Mo Lassi m. h. Nechti	Nechtarge, Corcu Nechtae
,,	,,	Mo Lasse m. h. Nechtai	,,
BB	227	Mo Laisi mc. h. Neachta	,,
MD	Jan. 19	Mo Laissi maccua Nechte	"
Ono	m 540	Moccu Necthin	
Ériv	tiii. 138	Moccu Nemongin	
MD	Jun. 9	Cruimther mac ua Nesse	
Ad		Oisseneus mocu Neth Corb	Dál Niath Cor
AU	exxxiii.	Mo Cuaroc maccu Neth Semon <sup>1</sup>	Semonrige, Semaine
,,	584	Abb Cluana moccu Nois	cp. Noisrige
$\mathbf{L}\mathbf{L}$	368	Mo Lóce m. h. Noise	"
BB	<b>228</b>	Mo Locae mc. h. Noise	٠,

1 "Tuath Mochtaine for Maig Macha," an aithechtuath in poem quoted by Mac Fir Bhisigh, Genealogies, R.I.A. copy, p. 55. "Mochthuinde" in Onom. Goed., p. 652.

<sup>2</sup> " Semuine na nDesi diata Mo Chuaróc," Onom. Goed., p. 594.

BB	223	Colman mc. h. Nuadchon	
AU	608	Quies Lugdach moccu Ochae <sup>1</sup>	Corcu Oche
AU	677	Daircill moccu Retai	Dál Riatai
Ad		Mailodranus mocu Rin²	cp. Corcu Rinn
,,		Erneneus mocu Fir Roide	Corcu Roide
$\mathbf{L}\mathbf{L}$	365	Tua m. h. Roida	* 3
"	368	Tua m. h. Roda	23
,,	,,	Mo Gobboc mc. h. Ruain	
BB	228	Mo Gobboc mc. h. Ruain	
Ad.		Trenanus mocu Runtir	Dál Runtir
,,		Colmanus mocu Sailni <sup>3</sup>	Dál Sailni
,,		Nemaidon (gen.) mocu Sogin	Sogin, Corcu S.
AU	548	Finnio moccu Telduib <sup>4</sup>	
$\mathbf{L}\mathbf{L}$	367	Finnian m. h. Thelluib	
BB	226	Finna mc. h. Tellduib	
$\mathbf{SL}$	335	Fidnian maccu Tellaig	
MD	Feb. 8	Colman mac ui Thealduibh	
,,	Dec. 12	Colman mac ui Thelduibh	
BB	226	Colman mc. h. Tuilduid	
Ađ		Luguid mocu Themne	Temenrige
AU	663	Comgan macu Teimne	3 3
MD	Feb. 27	Commán macua Theimhne	2.2
,,	Apl. 8	Luighthighern macua Trato⁵	Tratraige
$\mathbf{L}\mathbf{L}$	359	Luchthigern maccu Tratho	11

47. The collective names do not always appear to contain a personal or ancestral eponym. In Corcu Fásaig, Corcu Luachra, Corcu Maige Locha, Corcu Temrach, Corcu Tethba, the determining word is a place-name, so that these names are referable to a usage in which *corcu* is still a common noun in general use.

48. The eponyms which are found with *moccii* prove that the eponyms supplied by the genealogists cannot always be accepted as representing an

<sup>5</sup> Luchthigern . . . isé fil i Tuarm Findlocha i Tratrarge, LL 373 b 5.

<sup>&</sup>lt;sup>1</sup> Mo Lua Cluana Ferta m. Cartaigh m. Daigri m. Urchocho m. Fergusa Fogo. Mo Lua cr. mc. Daigri m. Erc m. Imchada m. Laime Fola m. Cliataire m. Focha m. Dubthaig Duinn. (BB 218 c.) "Fergus Oiche qui et Fogai." was epon. anc. of Corcu Oche, BB 169 b 44.

<sup>&</sup>lt;sup>2</sup> Variant mocu Curin, cp. Cuirenrige.

<sup>&</sup>lt;sup>3</sup> " Colman Elo .i. Mac Ui Selli," Onom. Goed. s.v. Dál Sailne. The eponym does not occur in his pedigree, BB 223 b, c, LL 352 f.

<sup>&</sup>lt;sup>4</sup>See Delduib above. The obit here is that of S. Finnian of Cluain Iraird, whose pedigree is given thus: --- "Finden Cluana Iraird m. Findloga m. Findtain m. Concruind m. Daircealla m. Seanaigh m. Diarmada m. Aedha m. Fergusa m. Oilella Duibh m. Cealtair m. Uideachair," BB 218 d, e. Similarly LL 348, last column. Ailill Dub is given as Ailill Telduib by Abp. Healy, Ireland's Ancient Schools, p. 194 (second edition). Teldub, Tuldub, cp. "Genelach Sil Eogain. Tudy m. Fuelain . . . m. Faelehon Tulchotait i. etan cruaid boi oca." LL 317 a.

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accurate tradition. Thus the genealogists tell us that the Ciarraige are the descendants of Ciar, son of Fergus MacRoig, but the Ogham form Mucoi Qerai (MS. Moccu Ciara) shows that the true eponym should have been Ciara in Middle Irish. The Artraige are said to descend from a male ancestor Art, while the moccu formula has genitive Arta, Arte. That Core Duibfind, as ancestor of Corcu Duibne, is a mere fiction of the genealogists would be sufficiently obvious if we had not the Ogham examples of Mucoi Dovinias and the MS. moccu Duibne. Láma, son of Conchobor macc Nessa, is the genealogical ancestor of the Lámraige, but the lists of saints have Mo Gobbóc moccu Laime. Laigsech Cennmór is the genealogical head of the Lóigse; Adamnanus has mocu Loigse. Neachtain ... a quo Neachtraide, Lecan 453; Nemangein mac Neachtain do Uaithnib diata Neachtraidi, ib.; but moccu Nechti, Nechtai, Nechte, Neachta, and Corcu Nechtae. Fergus Oiche qui et Fogai, BB 169 b, Fergus Fogo, BB 218 c, Focha, ib. is ancestor of Corcu Oche and of S. Mo Lua = Luguid moccu Ochae, AU 608. If the genealogists have not lost the genuine tradition, they must have deliberately substituted masculine for feminine eponyms.

49. Adamnanus, in mocu Fir Cetea, mocu Fir Roide, introduces fer ("husband of") before a feminine eponym. Cp. Conall mac Fhir Cheiti meic Deda meic Sin a quo Dal Ceiti la Mumain, Lecan 455.

50. Names in -rige appear sometimes to have the name of an animal for eponym. It is curious if Bibraige (cp. Corcu Bibuir) contains the name of the beaver (cp. Bibracte), for Dr. Scharff tells me that so far no remains of the beaver are known to have been found in Ireland, though it is known to have existed in Britain. Other instances are Bocc-, Catt-, Con-. Dart- (with moccu Dartada), Gabr-, Gaman-, Luch-, Molt-, Torc-. We cannot assert that the animal, even personified, was regarded as the ancestor, for the adoption of animal names (e.g. Conall Cú, Ailill Molt) was not rare. Moreover, as instances like Ciarraige show, the eponym may really have been a fuller form of the element which is retained in the people-name.

51. Some of the collective names appear to be based on the occupations of the people. Thus the Semonrige, Tuath Semon, or Semmuine, i.e. people of rivets, belonged to the coppermining district of the Dési, and the distinctive element in their name was not thought capable of forming an eponym; hence *moccu Neth Semon* = of the race of the Champion of the Rivets. In Bérre, Béarra, another mining district, were the Cerdraige. With this class of names we may perhaps connect Tuatha Taiden or Fir Taiden, people of mantles, and Fir Bolg, people of leathern bags. That Fir Bolg, commonly used as a name for the older subjugated race or races, was an extension of the genuine name of an historical people may be judged from the instances of Bolgthuath

and Bolgraige in Onom. Goed.<sup>1</sup> All these peoples with what seem o be occupation-names belonged to the *aithechtuatha*; and their vassal-rents may have been paid in the products of the industries indicated by their names. Cp. also Corbraige, Corbetrige, Sciathraige, Tuath Chathbarr.

## III. SEPT-NAMES.

52. A third order, arising out of the second or it may be out of the first, and no doubt later in time, consists of sept-names in which the genitive of the eponym is preceded by the word Aui, Ui, "grandsons, descendants," e.g. Ui Néill, Ui Fidgente. Indeed that this class of name belongs to a later fashion of nomenclature than the collective names appears from the fact that, while all the collective names originate in a purely traditional period, the origin of at least a proportion of the early names in Ui can be assigned to the beginning of the documentary period.

53. In the genealogies, but not in general usage, there is a partial revival of sept-names in Ui, probably in the eleventh century, perhaps due to professional familiarity with the early nomenclature. In popular usage the only such instance at present known to me is Íbh Laoghaire, which seems to be the surname Ua Laoghaire, dative plural, belonging to a family of the western Muscraige. It is now the name of a district in the west of co. Cork. Surnames in Ua commence to be used in the tenth century: AU 914-Ua Maelsechnaill, 918 Ua Cléirig, 946 Ua Canannáin. As titles, without the fore-name, Ua Ciarda 953, Ua Ruaire 953, 964, 998. Over 40 other such surnames are found in this century. The statement adopted by O'Curry (Ms. Mat., p. 214) that this usage was established by an ordinance of Brian Boroimhe, apart from the fact that regal decrees of the kind are unknown in Ireland before the Norman Invasion, is thus shown to be without foundation.

54. As in the case of the collective names, so in the case of sept-names in Ui, the eponym is sometimes feminine. Cp. Ui Bairrche, Ui Brigte, Ui Duibne (cp. Corcu D.), Ui Ercae, Ui Ferba (beside Ui Firb), Ui Ochrae, Ui Taisce.

55. In my paper on the Irish Ogham Inscriptions, R.I.A. Proceedings, vol. xxvii., p. 368, I adopted Barry's view that the Ogham ari points to the sept-ancestor. Of sixteen instances there collected, five appear to be followed by feminine names; in two others the gender is doubtful. Hence apparently the proportion of feminine eponyms for septs named in the Ui-formula was much larger in early times than in the later MS. record.

<sup>&</sup>lt;sup>1</sup> Cp. note by Mac Fir Bhisigh on a poem at p. 55, Book of Genealogies (R.I.A.): Di i ndubhairt an duain nach d' Feraib Bolg Gaileoin na Domhnannaigh 7c. fír sin tra iarna slonnadh ghnethech. Gidhedh iarna slonnadh coitchenn, as ainm diles dona tri tuathaibh remraite Fir Bolg.

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56. I know no instance of a sept-name derived from a female ancestor within the documentary period. Hence I think that the feminine septeponyms had a religious, not a genealogical, import. Cp. Ui Brigte and "Brigit banfile ingen in Dagda" (BB 34 b 30), Ui Ercae and the forenames Macc Ercae = Maqi Ercias, Dar Erca, Ercavicas.

57. In the same paper, p 369, I suggested that Anavlamattias mucoi Maqi Euri [Iari?] avi Axeras should be interpreted "Anblomaith of the tuath of Macc Iair and of the sept [thereof] Aui Acher." The sept-name has since then turned up: Ac Ailill Fland Beace comraices Hi Aicher 7 Mec Carrthaich .i. rigda [= rig] Desmuman, Lecan 454. "At Ailill Flann Becc [the pedigrees] of Hui Aicher 7 the MacCarthaighs, Kings of Desmond, unite." The genitive Aicher = Axeras seems to indicate an Irish r-stem outside of the nouns importing the family relation.

58. In Dál Niad Corb, to which most of the Christian kings of Leinster belonged, the eponyms of the principal septs appear in the genealogies as sons of Cathair Mór: Ros Fáilge (Ui Fáilge) Dáire Barrach (Ui Bairrche), Bresa Enechglas (Ui Enechglais), Cétach (Ui Cétaig), Fergus Luascán (Ui Luascáin) Crimthannán (Ui Crimthannáin), Eochaid Timine (Ui Timine), Fiachu Ba Aiccid (Ui Baicceda), Dercmossach (Ui Dercmossaig), etc. The instance of Ui Bairrche, mentioned earlier, warns us that we do not stand here on any ground of solid strict historical tradition. Least of all need we expect to find even an approximately true chronology. In Gilla Coemain's reckoning Cathair Mór should have been king of Ireland from A.D. 123 to 149. But in the Synchronism of 721, his reign requires to be placed quite a century later. Even this date appears too early, judged by genealogies.

59. The pedigree of Crimthann, king of Leinster in St. Patrick's time (c. 450), is traced thus: 1, Cathair. 2, Fiacchu Baiccid. 3, Bresal Belach. 4, Labraid. 5, Enda Cennselach. 6, Crimthann. Allowing three generations to a century, the floruit of Cathair should thus be placed quite at the close of the third century. The Four Masters give 435 as the death-date of Bresal Bélach son of Fiacha Aicidh son of Cathair Mór. AU concurs. The most that can be said is that the majority of witnesses assign Fiachu, ancestor of Ui Baicceda, to the fourth century. In his line sept-names in Ui continue to be formed for several generations. From Labraid son of Bresal Bélach are named Ui Labrada; from Dúnlaing son of Énda Nia son of Bresal, Ui Dúnlainge; from Énda Cennselach son of Labraid, Ui Cennselaig. Hui Maele Tuile, from Mael Tuile son of Ronan s. o. Colmán s. o. Coirpre s. o. Ailill s. o. Dúnlaing, supply a late instance. Mael Tuile should have lived in the latter half of the sixth century. See LL 315 c.

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60. The chief septs of the Eoganachta are traced to two sons of Ailill Flann Becc, Luguid and Dáire Cerba.



61. The Eoganacht of Cashel, the suzerain line, do not appear to have taken any sept-name in Ui. The pedigree of Oengus (killed in 489, AU) is given as follows: 1 Ailill Flann Becc, 2 Luguid, 3 Corc, 4 Nat Fróich, 5 Oengus. According to the genealogical account, Ui-names among the Eoganachta arise from ancestors two generations older than Oengus, and continue to arise until an ancestor is reached two generations later than Oengus. The eponyms would appear to date from about the beginning of the fifth until the middle of the sixth century. Of course it is to be borne in mind that a sept-name in Ui is at least two generations later than its eponym, so that with the Eoganachta, septs continued to be named afresh under this formula until the end of the sixth century.

62. In Dál Cuinn, the starting-point of all the septs is Cairbre Lifechar. From Fiachu Sraiftine son of Cairbre descend the Ui Néill and the Connacht septs Ui Briúin, Ui Fiachrach, Ui Ailello, and Ui Fergusso. From Eochu Doimlén son of Cairbre descend the Airgialla and Ui Maine.

63. In the genealogies, Niall, Brian (Brión), Fiachra, Ailill, and Fergus are sons of Eochu Mugmedóin. Their period is the close of the fourth
century and the beginning of the fifth. Lóiguire son of Niall was king of Ireland at St. Patrick's coming in 432, and died in 462 (AU). Eogan son of Niall died in 465 (AU), Conall Cremthainne son of Niall in 480. Nathi son of Fiachra succeeded Niall and preceded Lóiguire as king of Ireland.

64. The uncertainty of the genealogical tradition at this period is exemplified by the following counterstatements (Lecan 454):----

Sunt qui dicunt Fiachrach [read Fiachra] Brian Maine tri meic Domnaill meic Fiachrach Sraiftini. Sunt qui dicunt tri meic Fiachrach Fir Da Giall meic Cairpri Lifeochair .i. na tri Cholla .i. Colla Uas 7 Colla Mend 7 Colla da Crich a n-anmand.

65. The Ui Néill do not subdivide into further septs named in this formula. Under Ui Briún (BB 89) arise Hui Chanann from Cano son of Brión; Hui Du[i]b Dumach from Dub Dumach s. o. Annad s. o. Fothad, s. o. Conall s. o. Brión; Hui Baeithin from Baeithin s. o. Dui Galach s. o. Brión. Hui Cormaic from Cormac s. o. Fergus Cnoc s. o. Dui Galach. The eponyms in this line belong to the fifth and sixth centuries.

66. Under Ui Fiachrach (BB 107) arise Ui Amalgada (Amolngado) from Amolngid s. o. Fiachra; Ui Echach Muaide from Eachaid (recte Eochu) s. o. Nathí s. o. Fiachra; Ui Suanaig were a subsept of Ui Echach, but I have not found their pedigree. Excluding Suanach, the eponyms in this line belong to the fifth century. I have no account of subsepts named in the Ui-formula under Ui Ailello and Ui Fergusso.

67. Hence it appears, so far as has been investigated, that in the Connacht and Meath branches of Dál Cuinn, sept-names in Ui arise from eponyms referable generally to the fifth century.

68. Airgialla (BB 118): Ui Tuirtre from Fiachra Tort s. o. Erc s. o. Colla Uais s. o. Eochu Doimlén. Hui Echach from Eochu s. o. Feidlimid s. o. Fiachra s. o. Colla Da Chrích. Hui Bresail from Bresal s. o. Feidlimid aforesaid. Hui Sinaig from Sinach, fifth in descent from Feidlimid. Hua Nialláin from Niallán s. o. Fiace s. o. Feidlimid. Hui Cruind from Crond s. o. Feidlimid. Hui Méith from Muredach Méith s. o. Imchad s. o. Colla Da Chrích. Hui Fiachrach from Fiachra s. o. Erc s. o. Eochu s. o. Colla Uais. Hui Segain from Segán s. o. Tuathal s. o. Feidlimid. Hui Maice Cairthinn from Mace Cairthinn s. o. Eichen s. o. Fiachra Tort. Hui Maine from Maine Mór s. o. Eochu Fer Da Giall s. o. Domnall s. o. Imchad s. o. Colla Focrich (= Da Crích). Ui Cormaic Maenmaige from Cormac s. o. Bresal s. o. Maine. Hui Duach from Duach (Dui, Daui) s. o. Dallán s. o. Bresal s. o. Maine.

69. At 513 (AU) is recorded the death of Cairpre Daim Argit, king of the Airgialla, s. o. Eochu s. o. Crimthann s. o. Fiac s. o. Daig Duirn s. o. Reochaid

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s. o. Colla Da Crích. Colla should have flourished about two centuries earlier, i.e. at the beginning of the fourth century, and this date accords with the time usually assigned for the conquest of Mid Ulster by the three Collas. The eponyms of Ui Sinaig and Ui Duach are two generations farther than Cairpre Daim Argit from the common ancestor, and should belong to the latter part of the sixth century.

70. The septs of Dál Cuinn, the Eoganachta, and Dál Niad Corb were predominant throughout nearly all Ireland from St. Patrick's time until the Norman Invasion. Hence one may suppose that their traditions were more minutely recorded in the early MS. period than the traditions of less prominent groups; also that, so far as chronological checks were available, they were more operative in the history of these dominant lines. But it is evident that, even in their case, no anterior limit can be placed to the use of the Ci-formula except to say that it appears to mark a later classification than the collective names.

71. The Ui-formula is succeeded by one in which cenél precedes the eponym. This is conspicuous and of early occurrence in the case of the Ui Néill.

72. Cenél Conaill, C. Cairpri, C. Loiguiri, C. nEogain, C. Fiachach, C. Máini, C. nÉndai, C. nOengusso take their names from sons of Niall, and their origin therefore from about the middle of the fifth century.

73. From sons of Eogan, C. Muredaig, C. mBindig, C. Fergusso, C. nOengusso, C. nDalláin, C. Cormaic, C. Feidlimthe, C. nAilello, C. nEichein, C. nIllainn, C. nEchach.

74. From sons of Muredach, C. Feradaig, C. Tigernaig, C. Moain. From Forggus s. o. Baetán s. o. Muirchertach s. o. Muredach, C. Forgusso. Muirchertach died about 530 (533 AU, 527 FM, 531 Chron. Scot.), Baetán in 571 (AU), and a son of "Fergus" son of Baetán in 619 (AU). Hence we may regard the Cenél formula in the Ui Néill line as based on fifth, sixth, and seventh century eponyms.

75. In the Eoganacht line, the symmetrical numbers of 24 sons and 24 daughters are assigned to Oengus s. o. Nat Fróich, (BB 172 b). Eithne Uathach, the woman-chief of the Dési, was mother of three of the sons, and hence their posterity is called Cenél nEithne (sie 1. 26). From Cennlán sixth in descent from Oengus, is C. Cennláin. Cenél Fíngein from

<sup>&</sup>lt;sup>1</sup> Hennessy, except in one instance, reads the name Forggus, Forgus, Forcus, as Fergus. It is correctly printed Forggus in the poem at 562, but incorrectly as Ferggus in the translation, and is not found in MacCarthy's index. In Fergus = \*Virogustus, g is spirant; not so in Forggus = \*Vorgustus, earlier \*Vergustus.

Fingen, of whose son Maenach, king of Munster, the death is recorded at 661 (AU). There, as in the genealogies (BB 175), Fingen's pedigree represents him as fourth in descent from Oengus. Cenél Conaill (BB 176) from Conall eighth in descent from Oengus; and Cenél Caellaide (ib.) from Caellaide s. o. Conall. Cenél Cormaic (ib.), eponym fourth from Oengus. Cenel nDalláin (177), eponym third from Eochu Liathán. Cenél mBuiric (ib.), from a son of Eochu. Apparently the eponyms in this group range from the fourth to the eighth century.

76. The Cenél formula does not seem to have become customary in Dál Niad Corb. Two instances occur in the genealogy, BB 126  $\alpha$ , Cenél nAengusa and C. Croichni. Of C. nAengusa we learn only that they belonged to Hui Maenaig. At 127  $\alpha$  36, it is stated that Cenél Cruaicni (= Cróichni) were of the Eoganacht.

77. Cenél in turn gives way to a number of terms, cland, muinter, sil, slicht, teglach, tellach, used contemporaneously.

78. In AU, the earliest contemporary instance of Cland is Cl. Chathail, 912. At the obit of Cathal, 734, "a quo Clann Cathail" is of course a late gloss. At 617, muinter (Blatini) and síl (Mescain) are probably common nouns not fixed in the names. The next instances of muinter are M. Gerudain, 1159, M. Eolais, 1169. Síl Dluthaig 633; Síl Cathail, 815. Tellach Dunchadha, 1258; T. Echach, 1298 (both indexed under Telach = Tulach). Dúnchad's death, 822 AU. Eochu, his brother (BB 91, cols. 1, 2).

79. Clann and muinntear are still used to form sept-names from surnames e.g. Clann Chon Ceanainn, Muintear Mheachair.

80. Although, then, there is considerable overlapping in date, there is a quite definite order of succession in the formulae, as exemplified in the following table :---

I,	Plural names (origin prehistoric)	Lagin	(unknown) 🥤	(unk nown)
II.	Collective names (origin prehistoric)	Dál Niad Corb	Eoganacht	Dál Cuinn
III.	Sept-names in Ui (partly of historical origin)	Ui Cennselaig	Ui Liatháin	Ui Néill
IV.	Cenél-names (from fifth century mainly)	Cenél nAengusa	C. nDalláin	C. Conaill
V.	Cland, Muinter, etc. (from sixth century)	Clann Maelighra	C. Chárthaigh	C. Cholmáin (Colmán † 587)

# IV. THE TUATH.

81. We find the term *tuath* variously handled by modern translators. In the Annals of Ulster, Dr. Mac Carthy regularly gives "territories" as the English of *tuatha*. Others render *tuath* by "tribe," a conveniently vague word which covers everything from an ancient subnation like the Ulaid to a comparatively modern sept like Clann Aodha Buidhe. It is true that by a familiar figure of speech, *tuath* is often used of a territorial area, just as Norfolk, which once meant the North-folk, came to mean the district they occupied. By a different transference of idea, *tuath* came to signify the laity in contradistinction to *eclais* the ecclesiastical body or *cliar* the clergy, and still retains that meaning side by side with the meaning of "the country" in contradistinction to the town. In both cases, *tuath* represents the ancient native tradition and the native order existing under the Irish civil law *dliged tuaithe*, whereas the Church lived under its own law, and the towns inherited in a modified form the municipal law of Rome.

82. Anciently tuath < \*tota, touta (teuta) appears to have denoted a civil community, a people united under one government, a civitas. In Ireland and Britain such communities retained the early form of kingly rule in an almost patriarchal shape. The petty states of Gaul and Galatia, before their subjugation by Rome, appear to have been for the most part republics, each ruled by a senate. The Irish tuath, then, must at one time have been a petty kingdom, but at the beginning of the documentary period a new order has already widely spread. Powerful families, aristocratic septs, have entered on a career of conquest. The scope of their operations being practically limited to Ireland,—for the only known exceptions are the temporary Irish acquisitions in western Britain and permanent conquest of Scotland by the Dál Riada,--the consequence was the substitution of ascendant dynasties for the older petty states throughout the greater part of Ireland. Thus the dynastic septs of Dál Cuinn, comprising the Ui Néill, Ui Briúin, Ui Fiachrach, and Airgialla, have acquired permanent authority over nearly all the northern half of the island. In Munster, the Eoganacht septs, Ui Fidgente, Ui Liatháin Ui Echach, etc., and in Leinster, the septs of Dál Niad Corb, especially the Ui Cennselaig, have achieved a like position. All these families have set up many new kingdoms or petty states. Beside these states, and in a position of inferiority marked by the payment of tribute and furnishing of armed forces to them, a considerable number of small peoples remained, enjoying internal freedom under the government of their own dynasties. This is the condition of things described in the Book of Rights, and it will be noted there that, except in the north-eastern province, where the old order was less disturbed,

nearly all the free, i.e., non-tributary, states are known by the names of septs or families, and nearly all the tributary states by collective names or the older plurals.

83. In Munster, the free states are Eoganacht Chaisil, Ui Liatháin, Raithliu = Ui Echach Muman, Eoganacht Locha Léin = Ui Coirpri Chruithnecháin, Ui Chonaill Gabra, Ui Coirpri Aebda, Eoganacht Glennamnach,<sup>1</sup> Dál Cais. The tributary states are Dési Muman= Dál Fiachach, Muscraige, Dáirine or Corcu Loegde, Ciarraige, Corcu Baiscinn, Arai, Uaithni, Éli, Corcumruad, Corcu Duibne, Orbraige, the Sechtmad.

84. In Connacht the free states are: Ui Fiachrach, Ui Briúin, and their subdivisions. The tributary states are: Umall, Grecraige, Conmaicne, Ciarraige, Luigne, na Corca, Delbna, Ui Máine.

85. It is to the older groups especially that the term *tuath* is applied in early usage. Used with the name of a sept, e.g., Tuath Ua nAengusa, as the majority of the instances in Onomasticon Goedelicum clearly show, *tuath* denotes no longer a people, but a territory. In the list of vassal-communities *aithechtuatha* (BB 255 a Lecan 354), only two instances, Tuath Ua Cathbarr and Tuath Ua Carra, contain names of septs, and there are alternative readings which omit Ua, perhaps correctly, since Cathbarr seems to be genitive plural. In most of the rest, tuath is followed by a collective name, in some by a plural people-name.

86. In Gaul 44 *civitates* are named by Caesar. Subdivisions of these, or of certain of them, existed and are called by him *pagi*. He speaks of the *pagi* of the Helvetii, the Morini, and the Arverni. The Helvetii consisted of four *pagi*, of which Caesar names two, the *pagus Tigurinus* and the *pagus Verbigenus*. He also uses the plural *Tigurini* of the people of the *pagus*.

87. The fourfold subdivision of a Celtic people is also exemplified by the Galati of Asia Minor. Each of the three nations which formed the confederate republic of the Galati contained four subdivisions which the Greeks called  $\tau\epsilon\tau\rho\alpha\rho\chi(i\alpha)$ , and each of these was separately administered under its own chief or tetrarch. Instances occur in Ireland. The Lagin comprise *cethri* primisloinnte, Dal Niad Corb, Dál Messe Corb, Dál Corbmaic, and Dál Coirbbri, the four eponymous ancestors being sons of Cú Corb.<sup>2</sup> The Arai comprise four divisions na cethri hAraid .i. Tratraidi (recte Toeccraige) 7 Artraidi 7 Descert Cliach 7 Hui Fidban, Lecan 451a.

<sup>&</sup>lt;sup>1</sup> Wrongly printed gleann Amhnach by O'Donovan. The nom. is Glennamain.

<sup>&</sup>lt;sup>2</sup> Possibly there was but one ancestor commemorated under all five names. The various divisions of the Erainn descend from three ancestors all named Coirbbre; those of the Airgialla from three ancestors all named Connla (Colla).

88. The poem Caisil atcondarc ane, H. 3. 17, p. 724, has this quatrain :---

Ceithre Partraighe im Bri Ois, ceithre Gailinga o cis Chais, ceithre Cianacht cairde cneis, ceithre Delbna dal chis Cais.

89. A smaller subdivision among the Gauls is known to us by the Latin name vicus. Caesar, who captured a written census among the spoils of the Helvetii, says that this people, numbering in all 368,000, comprised 400 vici, so that each vicus averaged 920 inhabitants. The phrase vicani Segorigienses, found in an inscription of the Prussian Rhine-Province, seems to point to a vicus named Segorigion. The Irish equivalent would be Segr(a)ige, which may be actually represented in the late Middle-Irish spelling Sedraige, one of the vassal-peoples named in the Book of Ballymote. Nevertheless, it is hardly likely that the Irish names in *-rige* and the other collective names of coordinate import originated as designations of a population so small as that of the Gaulish vicus. Rather it is fairly obvious that the continental *-rigion*, which must have once meant a people governed by a king, had degenerated in usage.

90. We may probably best regard the Irish group bearing a collective name as corresponding to the so-called *pagus* among the Gaulish peoples. There are sufficient indications that the collectively-named groups arose as subdivisions of nations bearing plural names. The instances of the Lagin and the Arai have already been noticed.

91. The Cruithni in Ireland included Dál Araidi, Conaille, Lóigis, and Sogain. Do Chruithnibh Erenn do Dhál Araidhe na seacht Laighsi Laighen 7 seacht Soghain Erenn 7 gach Conuille fil in Erinn (Mac F. Genealogies unpaged, evidently a quotation from some early writer).

92. The Érainu included Muscraige, Corcu Baiscinn, C. Duibne, Dál Riatai, etc.

93. The Galeoin comprised three *tuatha*, Tuath Fidga, Tuath Ochmaine, and Tuath Aithechda.

94. The Mugdoirn included Dubraige or Corcu Duib, Papraige, Ciarraige, Sortraige, Artrige, Corcu Inomain, Suobraige. "Seacht maic Mu[g]doirn Duib i. Dubh a quo Dubhraidhi oc Imleach Corco Duib Papa a quo Papraighi la Creamthanna Ciaro a quo Ciarraidhe Sort a quo Sortraige la Crimthanna a quibus Espoc Ibair mac Luighne Lasar ainm a mathar duna Deisib Art mac Mugdhoirn a quo Artrighe la Ullto Inomon a quo Corco Inomhain la Laighniu de quibus Lochene in sui irero drocaidh Sues dubh a quo Suobraidhe la Mugdornu a quibus Espoc Ethern i nDomnach Mor Maic Laifthi sed cuius filius Mugdorn Dub d'Ulltaib ignoratus (ignoratur)." BB 110 a 38.

95. The Papraige here mentioned and the Partraige are the only known instances of peoples in Ireland whose name has P for initial. Note that the Mugdoirn were of unknown race. The Partraige, too, were regarded as aborigines. "Dona Partraigib annso. Partraige in Locha forsata Mag Thuireadh Cunga 7 Partraige Cheara 7 Partraige Clainde Fiachrach 7 Partraige Sleibhe .i. o Cruaith co Loch nOirbsen 7 Partraige Midhe forsambi Oilill 7 Meadhbh 7 do claind Genainn doib." H. 3.17, p. 724. A poem on the same page, already quoted, pretends that they were descended from Art son of Oengus, king of Cashel in the fifth century, but no son of the name is assigned to Oengus in the genealogies. "Partraidi Cera, cid re Cloinn Diallaid (la Claind Fiachrach?), ni dib doib, acht is do Sen-Chondachtaib .i. do Chloind Genainn maic Deala maic Loith. Partraidi in Locha, ait ita Mag Tuiread 7 Cunga, do Cloind Sreing maic Sengaind doib. Partraidi Ślebi .i. o Cruaich co Loch nOirpsen, 7 do Cloind Conaill Airisin maic Briain doib. Genelach Partraidi annso. Radnall m. Aeda m. Mail Ruanada m. Conaill m. Echach m. Diarmada in Lacha m. Domnaill na Tri Tuath .i. na tri Partraidi m. Setna otait Hi Setna i. taisich Partraidi m. Conaill Oirisin m. Briain m. Echach Muidmedeoin." Lecan 458  $\alpha$ . This genealogy is not authentic. Brian (Brion), being a brother of Niall Noigiallach, must have lived about A.D. 400. Ragnall would accordingly have lived about A.D. 700; but since he bore a name adopted from the Norse, this date is out of the question. Accordingly it is natural to find that the Ui Briuin genealogies, though they mention Conall Oirisen, do not give the pedigree quoted above and do not include the Partraige or their chiefs among the Ui Briuin.

96. In the following passage the *tuath* is regarded as a chief subdivision of a people whose early name was remembered in the plural formula : "Attiadso na tuatha asa fail an Gaileoin hi cuigiud Lagen Tuath-Gabair. Teora fodla foraib.i. Tuath Egdha ocus Tuath Ochmain ocus Tuath Aithechda." "These are the tuatha whereof the Gaileoin in the Fifth of Leinster North of Gabair consist, Tuath Fidga and Tuath Ochmain and Tuath Aithechda." (H. 3. 17, p. 740.)

97. For variants in the foregoing quotation see Duanaire Finn, Introduction, p. lvii. That Lagin Tuath-Gabair and Lagin Des-Gabair constituted two of the ancient "Five Fifths of Ireland" is clearly the ancient Ulidian tradition as told in Cath Ruis na Ríg, p. 22. The dividing locality was perhaps Gabair Lagen, which seems to be the valley between Sliab Mairge and the Wicklow Mountains, i.e. the southern part of Co. Kildare. Osraige, part of Lagin Des Gabair, anciently extended westward of the Suir. Airmuma, Ormond, i.e. *East* Munster, lay to the *west* of the Suir. Ancient Munster, bounded on the east by the Suir and on the north by the Shannon estuary, was much too small to have included two of the "Fifths," and the Dá

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Chúigeadh Mumhan must belong to a comparatively late tradition. Hence no doubt the varying accounts of the twofold division of Munster. In one version the dividing line runs north and south, in another east and west. Neither version can be fitted into the story which makes Uisnech in the middle of Ireland the meeting-point of the five Fifths. A synonym for Cóiced Lagen Tuath-Gabair is Cóiced Coirpri Niath Fer. Coirpre is king of Tara and north Leinster in the Ulster cycle, his brother Find being king of south Leinster.

98. Keating (Forus Feasa, ed. Comyn, p. 214) says that *tuath* is equivalent to *tighearnas*, and the proverb "*is treise tuath ná tigherna*" shows that this interpretation is correct—at least as regards later usage. Keating also (ib., p. 112) speaks of a *tuath* as smaller in extent than a *triocha céad*. The Glens of Antrim, i.e. the baronies of Upper Glenarm, Lower Glenarm, and Cary, are called *seacht dtuatha na nGlinne* in nearly modern documents. Each of these *tuatha* would occupy a square of about five or six miles. But I find no indication that the *tuath* in early usage at all corresponded to the population of such an area. It was in fact a division of people—not of land—and must have been very variable in extent.

99. That the whole population was regarded as made up of *tuatha* may be inferred from the words of "Fiace's Hymn," "*tuatha adoptais side*," though again the same poem speaks of the Irish as one *tuath*, "for tuaith Hérenn bai temel." The former phrase may have reference to a particular worship in each *tuath*, and that each of them venerated special gods is evident from the oath-formula "tongu na tongat mo thuath," "tongu do dia toinges mo thuath." This formula also shows that the *tuath* was the chief population-group with which the individual felt himself to be associated. Further instances of the use of the term follow here.

100. Corco Athrach ainm na tuaithi ara fuil Caisil ocus ise seo a fad.i. o Thibraid Foraind ac Mainistir Uachtair Lamand co Duma nDresa don taib bothuaid do Chnoc Grafand ocus do sil Aimirgin meic Miled Espaine di. Lecan, p. 458. "Corcu Athrach is the name of the tuath on which Cashel is, and this is its extent, from Tipra Foraind at Holy Cross Abbey to Duma Dresa on the northern side of Cnoc Grafann, and it is of the race of Amergen son of Míl of Spain."

101. This is an important passage, confirming the tradition that Cashel was a comparatively late seat of the Eoganachta. Not only was the name of the *tuath* previously in possession remembered, but this *tuath* is spoken of as a contemporary people, whose ancestry has to be accounted for. Apparently the territory of this ancient people is still represented by the barony of Middlethird, of which the most northern point is at Holy Cross, and the most southern point near Cnoc Grafann about two miles north of Cahir. All this

territory anciently belonged to the Osseirge or Osraige, since their bounds also extended to Duma Dresa and to Grian = Pallasgreen, co. Limerick, and the story of the Dési settlement represents the Osseirge as having been driven eastward across the river Andobor ("Anner"). The plantation of the Dési may be regarded as a concomitant of the occupation of Cashel by the Eoganachta. The Dési were settled partly in the baronies of Slieve Ardagh and Iffa-and-Offa East, thus forming, as it were, a buffer-state between the Eoganacht of Cashel and the dispossessed Osseirge.

102. Three grades of tuatha can be distinguished in early documents: (1) Soerthuatha, not subject to tributes; (2) Fortuatha, retaining internal autonomy but tributary to an external overking; (3) Aithechtuatha, vassal communities paying rent to local chiefs of free race. Genealogically, the fortuatha were held to be outside of the kindred of the overking and his people, and therefore subject to them; the aithechtuatha were regarded as of unfree race, descended from the pre-Gaelic inhabitants.

103. The genealogical doctrine, however, must be taken as often expressing political status rather than racial origin. For this fact, which otherwise might be inferred from a study of the genealogies, we have the testimony of Gilla in Chomded Hua Cormaic, a twelfth-century poet (LL 144 a 24):—

Failet se muid sain mebair · cummaiscit craeb ngenelaig totinsma daerchland ic dul · i-lloc saerchland re slonnud
Torrchi mogad mod mebla · ocus dibad tigerna serg na saerchland étig uath · la forbairt na n-aithechthuath
Miscribend do gné eolais · do lucht uile in aneolais nó lucht ind eolais ni ferr . gnitt ar múin miscribend.

Six ways there are of special note that confound the tree of genealogy: intrusion of base stocks usurping the place of free stocks by name; migrations of serfs, a way of shame; and decay of lords;

withering of the free races, dreadful horror; with overgrowth of the vassal folks;

miswriting, in the guise of learning, by the unlearned of evil intent,

or the learned themselves, no whit better, who falsify the record for lucre.

104. The three discrepant origins—two importing free descent—assigned to the Partraige exhibit one instance, from many that could be cited, of this process of "confounding the tree of genealogy." By "migrations of serfs" we may understand that, in time of conquest, unfree populations were enlisted among the invading forces and were rewarded with the possession of lands under

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 $[14^{\times}]$ 

free tenure, thus themselves rising to free status. In the very ancient and as yet unprinted story of how Conaire Mór became king of Ireland (BB 139 b), a great army comes unexpectedly to Conaire, who leads them to Tara and is chosen king. Thereupon  $(140 \ a 1)$  gabt(h)air gabail lais dia slogaib "he makes a settlement of lands for his forces." So Eithne, the woman leader of the Dési, gathers a force of every landless people known to her in Ireland (nach loinges rofitir Eithne hUathach la Heirind) for the war of conquest against Ossory, and twenty-five of these peoples obtain a land settlement (a cuic fichet dib tarthatar raind) in the conquered territory (Ériu iii., p. 138, 140). The right of migration was denied to vassal peoples by their lords, as is indicated in the story of the migration of the Sons of Úmór.

105. The following passage (Lecan, 450) indicates a people adscripti glebae : Catraidi ata fogal fuirri(=fodal forru).i. ata fogail ar aroile dib [is] in Sechtmad aroile dib isna Deisib aroile dib i Cnamros ni lecar asuidi[u] sin ac rig Caisil do gres ised bid. "The Cattraige are subdivided, i.e. some of them are distributed in the Sechtmad, others of them in the Dési, others of them in Cnamros. They are not allowed [to depart] thence. With the king of Cashel always they remain."

106. The Sechtmad, "the Seventh," was a tributary state of east Munster, possibly better known by some other name. Its precise location has not been determined by O'Donovan in his edition of the Book of Rights or by Dr. Hogan in Onom. Goed. In LL 382, col. 6, Arbura is said to be the ancestor of the Sechtmad, and as he is also ancestor of the chief sept of Dál Coirpri, whose chiefs in later times bore the surname Ua Duibidir, "O'Dwyer," we may fairly identify the Sechtmad with O'Dwyer's country, the two baronies of Kilnamanagh, especially since this territory is not otherwise accounted for in the Book of Rights. See Hogan's State of Ireland, Anno 1598, p. 208, footnote, where a quotation erroneously speaks of "O'Duire, descended from the O'Briens." Dál Coirpri was one of the "four chief stocks of the Lagin," and its location, like the traditions of the Dési settlement, bears evidence of the early predominance of the Lagin and Osseirge in the part of Munster now called Co. Tipperary. Cnamros is perhaps identical here with Cnámchoill near Tipperary town. The Cattraige are included among the allies of the Dési in the war against Ossory.

107. Atait da chenel deg soc[h]enelac[h] la Gaedealo a se dib a Leith Cuind .i. Dal Cuind Dal Cein Dail nAraide qui et Cruithnig Dal Fiatach qui et Ulaid Dal Riata Dal Nat Corp qui et Laigin A se aile a Leith Moga .i. Dal n[E]ogam Dal Fiachach Dal Fiatach Dal Ceide Dal mBardine Dal Cais., Ate sin saerthuatha Erend. H. 3. 17, p. 790). "The Irish have twelve kindreds of noble race. Six of them in Conn's Half, viz. Dál Cuinn, Dál Céin,

Dál Araidi who are the Picts, Dál Fiatach who are the Ulaid, Dál Riatai, Dál Nat Corp who are the Lagin. Other six in Mug's Half, viz. Dál Eogain, Dál Fiachach, Dál Fiatach, Dál Céte, Dál Barddeni, Dál Cais. These are the free tuatha of Ireland."

108. The foregoing statement is of great antiquity. Apart from the spelling, which has changed in transcription, the few distinctive forms belong to the Old Irish period, and are consistent with even the oldest written usage. Compared with the tenth-century account of the free and tributary states in the Book of Rights, this is evidently much earlier.

109. Dál Céin = Cianachta. It may also possibly include Luigne, Gailing, and Saithne, all claiming descent from Tadg son of Cian. In the Book of Rights, these states are tributary to Dál Cuinn, i.e. to the Ui Neill and Ui Briuin, the superior states of Ailech, Meath, and Connacht. In this respect they are on a level with Umall, Grecraige, Conmaicne, Ciarraige Connacht, Delbna, Dési Breg, Cuircne. In the early annals, Cianachta Breg are evidently a very strong state, often hostile to the kings of Meath and Brega. Cp. AU 534, 776, 816, 849, 850.

110. The inclusion of Dál Nat Corp (Neth Corb, Niath Corb, Niad Corb) in Conn's Half reflects the traditional claim of Dál Cuinn to the Bórama tribute from Leinster. Dál Niad Corb was the ruling race over Leinster during most of the early documentary period. Leth Moga in the passage cited is synonymous with Munster alone.

111. Dál Eogain = Eoganachta. Dál Fiachach was the dynastic people of Dési Muman. I can find no Dál Fiatach in southern Ireland, and take it to be a mistake for Dál Fiachach Éle, also called Corcu Echach (i.e. Féchach) Éle. There is frequent confusion between the genitives *ěchach*, of Eochu, and [f]*ēchach*, of Fēchu, Fiachu, in genealogies, etc. The conventional writing of silent f is not customary before the ninth century. A twofold pedigree of Dál Fiachach Éle = Corcu Echach Éle (Lecan 457) illustrates this confusion :—

Genelach Ele Descirt annso. Duineochaich mac Echach Ele cuius frater Cellach m. Dungaile m. Beicci

m.	Cermada	$m_{\cdot}$	Conaill	Nó	Conall
m.	Bleidine	m.	Nendtacair		meic Airt
m.	Enna	m.	Aililla		m. Fiacha[ch]
m.	Bresail Milairi	m.	Echach		m. Neill Naigiallaich
m.	[Maic] Cairthinn	m.	Feidlimid Rechtmair		

112. The most interesting names in the list of the free *tuatha* of Ireland are Dál Céte and Dál Barddeni. Neither is even mentioned in the Book of Rights. Of the location of Dál Barddeni, we only learn that it was at Dún Cermna, the Old Head of Kinsale, and there is no indication that this people held any considerable power or territory during the documentary period. Of the habitat of Dál Céte, Dr. Hogan has only been able to find that it was somewhere in Munster, and I am unable to supplement his information. The latest evidence of the contemporary existence of Dál Céte is the name of To Channu mocu Fir Cetea mentioned by St. Adamnan. All this tends to show that the list of twelve free *tuatha* is of great antiquity, probably not later than the eighth century, possibly even earlier.

113. Traditional corroboration of the early celebrity of these two peoples is afforded by the fact that, in the genealogies of the Érainn (the race of Conaire Mór BB 139), which occupy  $10\frac{1}{2}$  pages of the Book of Ballymote, the first place is given to the Érainn of Dún Cermna, Dál Barddeni, and Dál Céte. The pedigrees give only three or four generations of the descendants of "Cather by whom Dún Cermna was made." The accompanying legend says :—

En aieme dec do Dail Bairrdene .i. Sil Aengusa meie Echach meie Bairrdene meie Rigbaird ditat Martene iarna ndilgiund do Leith Cuind ar ba lethrann da Dal Cede 7 do Dal Bairrdene co sin ar is .x. catha ro mebaig re nErnaib for Ulltu 7 .uiii. catha fri hUlltu for Ernu. "Dál Bardeni (i.e. the race of Aengus son of Eochu s. o. Bairrdene s. o. Rígbard, from whom are the Martene) consisted of eleven septs after their extermination from (or by) Conn's Half, for until then it was an equal division (sc. of Ireland) between Dál Céte and Dál Barrddeni, for it is ten battles that the Érainn won over the Ulaid, and eight battles that the Ulaid won over the Érainn."

114. "Dál Araidi qui et Cruithnig. Dál Fiatach qui et Ulaid." Cp. BB 170 b 15: "... na hAirgialla, Dail nAraigi fri suide anair, ainm ele doib Cruthnich. Hulaith fri suide anair. Ind Ulaich seo tra asbertar Dal Fiatach indsin, do cloind Con Rai maic Daire maic Deadad a Coiced Con Rai la Mumain, is as a mbunad in Dal Fiatach so qui et Ulaith hodie dicuntur. Is dib Aed Ron ocus Fiachnu." "The Airgialla; Dál Araidi to the east of these, another name for them is Cruthnich. The Ulaid to the east of these. These Ulaid, Dál Fiatach they are called, of the posterity of Cú Rúi son of Dáire son of Dedu from Cú Rúi's Fifth in Munster, thence is their origin, this Dál Fiatach qui et Ulaith hodie dicuntur. Of them are Aed Róin and Fiachna."

115. The foregoing passage is from a brief general description of the ruling races of northern Ireland, obviously written by a southern writer. It probably dates from a time not long subsequent to the reigns of Aed Roin and Fiachna his son, who were kings of the Ulaid, and whose pedigree is given under Dál Fiatach. Aed Róin fell in battle with the Ui Néill in 735. With him

was slain Conchad, king of Cuib, i.e. of Ui Echach Cobo, the most prominent sept of Dál Araidi. In *Fragments of Irish Annals*, an. 732, Conchad is called "king of the Cruithni." (AU 734, editor's note.) *Fiachnae mac Aedho Roen*, rex Ulad, mortuus est, AU 788.

116. The following "kings of the Cruithni" in AU are found in the pedigrees of Dál Araidi : Eochaid Iarlaithe †665, Cú Cuaran †707, Cathusach son of Ailill †748. The genealogist in BB (168 col. 1) makes this Cathusach father of Cú Cuaran who preceded him. The father of Cú Cuaran must have been Cathusach son of Mael Dúin and king of the Cruithni †681 (AU).

117. I do not find a genealogy of Dál Fiatach from Cú Rúi or from Dedu, but their descent is traced to Sen, father of Dedu, and thence by the same line as the Érainn, Cú Rúi's people, up to Oengus Tuirmech and the line of Éremon.

118. The passage above quoted from BB is followed by a comment of a contradictory character: Ite fir-Ulaich immorro i. Dál nAraide ota Mael Breasail mac Ailella hi Conall Cernach arisesedar oeus im Iriel Glunmair i ngenelaich Dal Araide. "The true Ulaid, however, are Dál Araidi, of whom comes Mael Bressail son of Ailill. In Conall Cernach they originate, and in Iriel Glúnmar, in the genealogy of Dál Araidi."

119. Mael Bresail mac Ailello Cobo, rex Dal Araide, moritur, AU 824. The text of the passage in BB was probably written between the death of Aed Róin, 735, and the death of Fiachna, 789, or not long after the latter event; the comment during or soon after the reign of Mael Bressail. arisesedar = \*ara sissetar. The relative form ara of air, ar seems obsolescent in the Milan glosses (see Thurneysen, Handbuch, § 487, 4).

120. The Irish Cruithni of Dál Araidi are called Cruithni for the last time in AU at 773 (= 774). Half a century or so later, the claim is set up for them that they are not only Ulaid, descendants of Conall Cernach, but that they are "the true Ulaid," as if in protest against the belief that they are Picts. This claim was extended to all the leading branches of the Pictish race in Ireland (see § 91). Rather, I think, we can trace the claim as originating with another branch, the Conaille.

121. The chief section of the Conaille, forming the state of Conaille Muirthemne under their native kings, occupied a territory closely associated with the great hero of the Ulaid, "Cú Chulainn Muirthemne." It is not surprising that they sought to connect their own tradition with the epic tradition of the Ulaid. Accordingly we find in the genealogies, BB 152, under a section entitled in the margin, "De peritia Conaille Murthemne," two conflicting accounts of their descent. Their eponymous ancestor Conall Anglonnach is first described as a son of Dedu, and from the pedigree of their king Cinaed on

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the next page it appears that this Dedu is the son of Sen, i.e. the same from whom the Érainn of Munster, Clanda Dedad, trace their descent. But in the first pedigree appended Conall Anglonnach becomes son of Fiacc son of Russ son of Fachtna son of Senchad of the Ulidian hero-group. At the end of the pedigrees of their kings (153, col. 1), many of whose names can be identified in the annals, comes the statement: Do chloind Conaill Cernaich araili dib .i. in rigraid, "Of the posterity of Conall Cernach are some of them, i.e. the royal line," in contradiction of the pedigrees that precede. On p. 169 there is a further chapter headed, "Genelach Conailli Murtheimni," probably taken from another source. Here the eponymous ancestor is called Conall Casdamail, and he is made out to be seventh in descent from Conall Cernach. Thus, as Gilla in Chomded says, "the tree of genealogy is confounded." Conall Cernach supplied a tempting eponym to the Conaille, a Pictish race, and having been adopted by them was adopted by other Pictish kindreds, Dál Araidi, the Sogain, and the Lóigse of Leinster (BB 164 a 2).

122. Wherever the Ulaid are mentioned in vol. i. of the Annals of Ulster, they are the people of the Dál Fiatach dynasty, quite distinct from Dál Araidi and Conaille, often at war with one or the other. The Ulaid occupied the seaboard of Co. Down. The Piets of Dál Araidi occupied the interior of that county as well as a large part of Co. Antrim.

123. Ag Conn tra fogailter ( = fodailter) clanda Cuinn ocus it fortuatha Sil Cuind cach aen na berar genilaig [read genelach] co Conn eter naem ocus cleirech amail ata Lugaid [read Luigne] ocus Dealbna ocus Gailinde [read Gailing] ocus Cianachta. Ag Cathair didiu fogailter saerc[h]landa Laigean ocus it fortuatha eoicid Cathair can [read cach] aen na berar co Cathair amail atait secht Laissi [read Lóigsi] ocus secht Fotharta. Ag Ailill Olom fogailter saerc[h]landa Mumhan : can [read cach] aen na berar genelach go Ailill, it fortuatha Sil Eachach Mumo amail atait Eirna [read Érainn] ocus Ciarraige. (H. 3. 17, p. 774.)

"At Conn the [pedigrees of] Clanda Cuinn are divided, and all [in Leth Cuinn] whose pedigree is not traced to Conn, not excluding even saint and cleric, are *fortuatha* of the race of Conn, for example the Luigne, Delbna, Gailing, and Cianachta. At Cathair [Mór] are divided the free races of Leinster; all who are not traced to Cathair are *fortuatha* of Cathair's Fifth, as are the seven Loigsi and the seven Fothairt. At Ailill Olom are divided the free races of Munster; all whose pedigree is not traced to Ailill are *fortuatha* of the race of Eochu Mumo, as are the Érainn and the Ciarraige."

124. The same statement occurs more briefly in the Book of Lecan, p. 459:---

Ag Cund Cetchathach mac Feidlimid Rechtmair fodailter saerclanna Leithi

Cuind oeus it forthuatha<sup>1</sup> Sil Cuind acht sin nama. Ac Cathair Mor mae Feidlimid Fhir Urglais fodlas saerclanda Laigen uili ocus it fortuatha Laigin acht sin nama beous. Ag Ailill Olum mac Moga Nuadad fodailter saerclandu na Muman ocus it forthuatha<sup>1</sup> acht sin.

125. In the lists of *aichechtuatha*,<sup>2</sup> by far the larger part of the names are collectives in Dál, etc. The remainder are in various forms, e.g., Tuath Raisen or Ruisen, Tuath Fer Morc, Tuath mac nUmoir. Two, T. Ua Cathbarr and T. Ua Carra, exhibit the later nomenclature of septs, but even these have variants omitting Ua.

126. Instances occur of the application of the term tuath to populationgroups with plural names, not in a vague and general way like tuath Hérenn = the Irish, tuath De = God's people, the Israelites, but apparently as a customary and appropriated designation of local groups.

127. Bolgthuath: There are two groups so named. Bolgthuath Badbgna of Sliab Badbgna or Bodbgna (" Slieve Baune," co. Roscommon), and Bolgthuath Echtge of Sliab Echtge ("Sl. Aughty," co. Galway). Cp. Bolgraige, an aithechtuath in Tír Conaill. Mac Fir Bhisigh (Genealogies, p. 54) quotes among the branches of the Fir Bolg, besides "Bolgthuath Bagna for airther Connacht" and "Bolgraighe for criochaibh Conaill," "Fir Bolg for Mhagh Nia Benntraighe" and "Fir Bolg ar Mhagh Luirg." As all these names occur in what is evidently a consecutive list of the aithechtuatha of Connacht, the Magh Nia in question is the plain also called Mag Tuired Cunga, at Cong, co. Mayo. It is evident that Fir Bolg (= Bolgthuath, Bolgraige) was the name of a known historical population existing in various parts of Connacht and in north-western Ulster. Its location and its vassal status, importing early conquest, as well as the traditions of its existence in Ireland before the Góedil, show clearly that the Fir Bolg must not be equated with the historical Belgae. The name was extended in the Irish history-legend at an early period so as to denote the whole or main population of Ireland before the Góedil.<sup>3</sup>

128. Cruithentuath: This seems to be a general name for the Picts in Ireland and in Scotland. But it is also used as a special name for the Picts of Dál Araidi, "Cú Chuaráin ri Ulad 7 Cruthentuaithe," (Onom. Goed., p. 312; for Cú Cuaráin see § 116), and for Tuath Chruithnech, a Pictish vassal people "round Cruachain," the old capital of the Connachta. There was also a vassal people or rather a scattered population so named "in the country of the Ulaid and in Mag Cobo" and "between Sídán Slébe in Chairn and Loch Febal and between Bernas Tíre Aeda and the Bann" (Onom. Goed. 650), these four places

<sup>&</sup>lt;sup>1</sup> Read fortuatha.

<sup>&</sup>lt;sup>2</sup> Lecan 350, BB 255, 256, MacFir Bisigh, genealogies (R.J.A. copy) 54, etc.

<sup>&</sup>lt;sup>3</sup> See my account of "An Irish Historical Tract dated A.D. 721," Proceedings R.I.A., vol. xxviii. **B.I.A. PROC., VOL. XXXX, SECT. C.** [15]

being merely the ancient extremities of the large territory of the Airgialla. Tuath Chruithnech is thus assigned to a region equal to modern Ulster except the counties of Donegal, Antrim, and Cavan.

129. Tuath Fer nDomnann or Tuath Domnann, a vassal people throughout Ui Fiachrach and Ui Amalgada in northern Connacht.

130. Tuath Fer More or Tuath More, a vassal people in Ui Conaill Gabra 'in co. Limerick); ".*i. fir mora batar immon Luachair nDedad thiar.*" (LL 269 a.)

131. Tuath Fer Ruisen or Tuath Ruisen (Resen, Raisen), in Cera (bar. Carra. co. Mayo) and from Ath Moga (Ballymoe = Bél Átha Moga, on the r. Suck) to the sea. Also Raissin separately, "cath Raissen in Connacht," Onom Goed. s.v. raisse (*recte* Raissin). Cp. also Sliab Raissen or Rusen = Slieve Rushen,<sup>1</sup> bar. Knockninny, co. Fermanagh. Cp. Corcu Ruisen.

132. Tuath Sen-Érann, a vassal people at Sliab Luachra in west Munster. " Sen-Erna mor (read Sen-Érainn Móir?) na Muman ar slicht Heir meic Eibir Find meic Miled Espaine." (Lecan 349.)

133. These instances, with Corcu Ulad, Dál Ulad, Corcu Sogain or Suigin, Corcu Ele, mucoi Sogini, mocu Sogin, moccu Elich, seem to indicate that the various collective formulae might be applied to ancient peoples named in the plural formula, perhaps chiefly when these had not subdivided into groups bearing collective names.

134. Tuatha Fore ocus Iboth : " Na tri Fothaid .i. Fothad Aircteach Fothad Cairpteach Fothad Canand. Tri maic Fainche ingene Nair maic Irmora d'Aruib Cliach. Berid Fainche eamnu ter (tri?) fermacu. D' Ibdachaib di Ulltaib a mbunad .i. da mac Irel Glunmair Fore ocus Iboth. Dos-faqaib Rechtaiq Rigderg i nAlbain oro (= coro) muigedar eatha remhaib consealgadar cricha mara i nAlbain comdar fasa. Giallsat Fir Alban do Rechtaid Rigderg comba ri Erenn oeus Alban. Is de atait Tuathu Fore oeus Iboth allai do lodar iiii. l. fermacuib for longeas tairis anall for gabail ro gabsat Cluchrin ocus ni fortad gabsat crich Muine ocus crich Fiachrach Aidhne gabsat Baisgind a comarbus a seanmathar Uaithne ingean Eachach maie Luchta. Tir ele ota Sinaind siar ocus Dere fo thuaid conadh de anmannuib na mban dingarter a cencl ocus a ngenelaiche ar luidh indara nai go Caela Rigderg .i. Eli conid de gairter Eli luid araile cu Fergus Foltiebur .i. Uaithne conid de gairter Uaithne ocus robadar na ceatraimide do claind Uaithne .i. Uaithia ocus Druithnia ocus Cainnia ocus Decnia. Tri braithri .i. Uaithnia ocus Druithnia ocus Cainnnia. Sunt qui dicunt Maonig i, athair na mac i, na Fothad mac Cairbri maic Cormaic maic

<sup>&</sup>lt;sup>1</sup> So named in Phillips' County Atlas. Dr. Hogan gives Rushel and Russel as the anglicized equivalents.

<sup>°</sup> cethri niaid.

Mesi Suad maic Mesin Fuire maic Mesin Fuircill maic Cairbri maic Iboth Alii dicunt tri Fot[h]aid .i. tri maic Feidlimthe maic Maic-Niat[h] [maic] Gnathail maic Ere maic Cairbri Niath Fer maic Feidlimthe Foltcaim. Is de ata Lecht Glind Ere is de ata ro ced no orabi rig-domna bad mo Ere mac Feidlimte .i. i loc ro baite. Huc usque de Salterio Caisil.

Aliter cland C[h]onaill C[h]ernaich .i. Eogan ocus Oilill ocus Fen Fer Tlachtga Caithnia ocus Druithnia [ocus] Uaithnia .i. Uaithni Thire ocus Uaithni Cliach quod fortasi uerius. (BB 164 b.)

"The Three Fothads, i.e. Fothad the Silvern, Fothad the Chariot-rider, and Fothad Canann, three sons of Fainche daughter of Nár son of (Fer Mora?) of the Arai of Cliu. Fainche gives birth to three manchildren at one birth. Of the Ibdaig of the Ulaid was their origin, i.e. Fore and Iboth were two sons of Irial Glúnmár. Rechtaid Red-arm leaves them in Alba and they won battles and utterly wasted great territories. The Men of Alba submitted to Rechtaid Red-arm, so that he became king of Ériu and Alba. Hence are the Tuatha Forc and Iboth (on the other side ?). They came with four times fifty manchildren on a voyage across from that side to settle on lands. They occupied Cluchri,<sup>1</sup> and they no longer dwell there. They occupied the country of (Ui) Maine and the country of (Ui) Fiachrach Aidne. They occupied (Corcu) Baiscinn in succession from their grandmother Uaithne daughter of Eochu son of Luchta. (They occupied) another territory westward from the Shannon and northward from (Loch) Derg. So that by the names of the women are distinguished their kindreds and their genealogies. For one of them went to Uaela Red-arm, to wit Eli, and hence the Eli are named. Another went to Fergus Longhair, to wit Uaithne, and hence the Uaithni are named. And there were four champions (?) of the family of Uaithne, namely Uaithnia, Druithnia, Caínnia, and Decnia. Uaithnia, Druithnia, and Caínnia were three brothers. Sunt qui dicunt Macnia, father of the boys, i.e. of the Fothads, son of Cairbre s.o. Cormac s.o. Mes Suad s. o. Mes Fuirc s. o. Mes Fuircill s. o. Cairbre s. o. Iboth. Alii dicunt, the Three Fothads, three sons of Feidlimid s. o. Macnia s. o. Gnáthal s. o. Erc s. o. Cairbre Nia Fer and Fedelm Foltcoem.<sup>2</sup> Hence is [named] Lecht Glinn[e] Erc. Of him it was sung (?), 'there was no (?) prince of the royal line greater than Erc, Fedelm's son.' That is, where they were drowned (is the Grave of the Glen of Erc). Huc usque de Psalterio Caisil.

"Aliter the children of Conall Cernach, i. e. Eogan and Ailill and Fen Fer Tlachtga (or Fénfer 'Fian-man' of Tlachtga), (also named)

 $[15^{*}]$ 

 $<sup>^{\</sup>rm t}$  Otherwise Cluithri, north of Long Cliach = Knocklong (co. Limerick) = Druim Dámgaire, Onom. Goed.

<sup>&</sup>lt;sup>2</sup> Called Fedelm Noichruthach in Cath Ruis na Ríg, p. 54.

Cathnia, Druithnia and Uaithnia, i.e. (the ancestors of) Uaithni Thíre and Uaithni of Cliu, quod fortasse uerius (est)."

135. With Tuatha Forc cp. Insi Orc. Tuatha Iboth are doubtless the old traditional inhabitants of the Hebrides, Ebudae Insulae. Ibdaig = \*Ebudaci.<sup>1</sup> They are said here to be of the Ulaid. Iubdán (= \*Ebudagnos) in the "Death of Fergus," Silva Gadelica, is king of an oversea country of dwarfs.

136. Uaithnia, Druithnia, and Cainnia appear to be artificial eponyms of the Uaithni (hence the baronies of "Owney" in Tipperary and Limerick), Dál Druithne in Ui Máine ("west of the Shannon and north of Loch Derg"), and Caenraige (hence "Kenry" barony, co. Limerick). These Irish Ibdaig, like the Irish Picts, have Conall Cernach assigned to them as ancestor. Their traditional habitat (Kenry, Owney, Aidni, Ui Maine, Corcu Bascinn) seems to correspond with the position of the Auteni or Auteini (= Uaithni?) in Ptolemy's account.

# V. THE TRICHA CÉT = THIRTY HUNDREDS.

137. The term 'tricha cét' in late usage denotes a certain measure of territory. Keating (Forus Feasa, ed. Comyn, p. 112) gives the extent of the provinces of Ireland in this measure as follows: Meath proper (an Mhidhe féin), 13; Breagha, 5; Cúigeadh Connacht, including Clare, 30; Cúigeadh Uladh, extending southward to the Boyne, (35 or) 36; Cúigeadh Laighean, 31; Cúigeadh Eochaidh (*sic*), i.e. eastern Munster, 35; Cúigeadh Con Raoi, i.e. western Munster, 35. Total 185.

138. Keating adds (p. 128) that Ulster at one time contained only 33, the other three having been ceded by Leinster in the time of the Pentarchy (aimsear na gCúigeadhach), i.e. in the Ulidian heroic period. There is evidently a cross-division somewhere; and the total of 185 must be excessive. The Ulster and Leinster fifths meet at the Boyne, so that these provinces must include the five tricha-céts of Brega. Mide, too, i.e. central Ireland exclusive of Brega, is traditionally a province of late origin, and there must be an overlap in its case also.

139. The whole account suggests an ancient (perhaps theoretical) division of Ireland into five provincial kingdoms, each fifth (cóiced, cúigeadh) containing thirty-five tricha-céts.

140. The thirtieth part of a tricha-cét, says Keating, is a baile or baile

<sup>&</sup>lt;sup>1</sup> For Ui Dachua, Ui Dachaigh, Ui Daich, in Onom. Goed., read Ibdachu (?), Ibdachaibh, Ibdaich. Cp. also Inis Ibdan (Ibdone, Sibtond, Sipont, Ubdain), on the Shannon estuary, Onom. Goed. "Garbraid do Fearaib Eboth a quo Garbraidi, cona coibnesaib," Lecan 451.

biataigh. Since tricha cét means "thirty hundreds," the baile must represent the hundred. This at once suggests the Germanic hundred and the Latin centuria, as divisions of the people. The original Roman populus contained thirty curiae. The principle of organization appears to have been at once genealogical and religious, each curia having its own rites presided over by a priest called curio. The thirty curiones formed a priestly college of the whole state. Traces of a similar unity of the genealogical and religious principles are also indicated in ancient Ireland (see § 56). The female eponyms in Ireland have their analogue too in the Roman curiae, some of which were said to have derived their names from the Sabine women who were the mothers of the Roman people.

141. The Roman centuries, forming the comitia centuriata, were a civil organization on a military basis. This, we shall see, was also the original character of the Irish tricha cét. It denoted not only the civil organization of the people, and the corresponding division of the territory, but also the armed levy of each state.

142. There are many ancient statements bearing on this point which still require to be collected. For the present, one passage in Táin Bo Cuailngi will serve as a locus classicus. It occurs at the episode in which Medb takes note of the smart discipline and warlike efficiency of one section of her allies, the Galians of Leinster. Their superiority to her own troops evokes in her mind only a jealous dismay, and she decides to order a treacherous massacre of the Galians. Her Ulster comrade, Fergus, resolutely opposes this design, and threatens to lead the allies against Medb if she persists in it. This argument prevails, and Medb contents herself with separating the Galians into small troops and distributing them throughout the army.

143. "'By the truth of my conscience,' said Fergus, 'no man shall do death to them but the man who will do death to me.'

"'Thou, Fergus, must not say that to me,' said Medb, 'for I am strong enough in numbers to slay and overwhelm thee with the thirty-hundred of the Galians around thee. For I have the seven Maines with their seven thirty-hundreds, and the Sons of Magu with their thirty hundred, and Ailill with his thirty-hundred, and I too have a like force. There we are, strong enough to slay and overwhelm thee with the thirty-hundred of the Galians around thee.'

"'It is not fitting to tell me so,' said Fergus. 'For I have here the seven petty kings of the Munstermen with their seven thirty-hundreds. There are here the thirty hundred of the best fighting men of Ulster. There are here the best of the fighting men of Ireland, the thirty-hundred of the Galians. I am their security, their guarantee, and their safeguard from the day they left their own native territory, and by me they will stand on the day thou challengest."

144. The allied forces under Medb thus consisted of nineteen separately organized bodies, each under a local king and each consisting of thirty hundred men. Thirty hundred, in fact, was the traditional complement of the army of a petty state.

145. The technical name of the whole levy of 3,000 men was *cath*. Where the Annals of Ulster (1222) have the entry : ro thinolsat Gaill Erenn cethri catha fichet co Delgain, co táinic Aedh O Neill ocus Mac in Uga cethri catha na n-aghaidh, the D text says : numerati 24 eompleta bella, qui faciunt Hibernica numeratione 72 millia armatorum ... 12 millibus armatorum, numeratione suprascripta.

146. The Irish *cath* or *tricha cét* has its exact counterpart in the *legio*, originally the whole army or normal military levy of the Roman state. The Roman tradition was that under Romulus, i.e. in the earliest times, Rome had but one legion, and this legion numbered 3,000 men, i.e. 100 men from each of the thirty tribes.

147. The Romans divided their fighting population into two classes, *juniores* and *seniores*. It seems clear that they originally regarded the younger men as forming the normal fighting strength of the population, and the older men as forming a reserve which might be called out to meet an emergency. *Juventus* is an habitual term for the folk of age to serve in arms. Precisely the same usage is found in Irish. In the passage cited above from Táin Bó Cuailngi, the word which I have twice translated "fighting men" is *óic* = (juvenci) *juvenes, juventus*, and numerous examples of this usage could easily be collected.

148. As the Romans grew into a great military power, they did not abandon the ancient constitution of their army, but retained and developed it. Instead of expanding their army indefinitely with the growth of their state, they could only think of forming additional bodies on the model of their primitive army of 3,000, and this they continued to do even under the Caesars.

149. In the Spartan army, we can trace the same tradition. The army consisted of six  $\mu \delta \rho a$ , and the  $\mu \delta \rho a$  at one period numbered 500 men, giving a total of 3,000 men. Each of the three Dorian tribes of Sparta before Cleomenes contained ten  $\dot{\omega}\beta a i$ , making thirty  $\dot{\omega}\beta a i$  in all. In Athens, in the age of Theseus, each  $\phi \rho a \tau \rho i a$  contained thirty  $\gamma \epsilon \nu \eta$ .

150. "The phalanx soldiers in the army of Alexander amounted to 18,000 and were divided ... into six divisions, each named after a Macedonian province from which it was to derive its recruits." Each province would thus

<sup>&</sup>lt;sup>1</sup> Smith's Smaller Dict. of Antiquities, p. 163.

correspond to the Irish *tricha cét* and the army of each province to the Irish *cath* of 3,000 men.

151. The century remained the theoretical basis of the Irish military organization until the final overthrow of the Celtic system at the battle of Kinsale, Christmas Eve, 1601. In the proclamation issued in that year by O'Neill, it is ordered that "the constable of the hundred shall have eighty-four men on the strength, allowing an abatement of sixteen men, and this abatement shall be expended as follows : the constable of the hundred shall have the hundred shall have the men thereof, and the marshal of the territory shall have the pay of five men, and the lord's galloglach shall have the pay of one man."<sup>1</sup>

152. The facts here brought together appear to establish that the Irish tricha cét, its thirtieth part the baile, and the Irish military organization embodied a tradition common to many peoples of ancient Europe, and going back to a time when these peoples formed one community or a group of neighbouring communities. I trust that this superficial examination may lead to a more thorough investigation at competent hands into the earliest traditional form of the civil and military organization among the various branches of the Indo-European race.

153. Keating says that, "according to the ancient record (do réir an tseanchusa), the baile contained 12 seisreacha, and the seisreach 120 acres." The word for "acre," acra, is not of Irish origin, and must have replaced some older term. Later on, Keating says that "the acre of Irish measure is twice or thrice greater than the acre of the present foreign measure." "The acre of the present foreign measure" probably means the Irish "Plantation acre," which is greater than the statute acre in the ratio 196:121. Ireland is said to contain 20,819,928 statute acres, equivalent to 12,853,114 Plantation acres. According to Keating's statement, the 185 tricha-céts should be equal to 7,992,000 acres of (the older) Irish measure. But since his total of 185 is too much by at least 5, probably by more than 5, his total of acres must also be reduced. Moreover, by the statement "twice or thrice greater" we are to suppose, not that Keating was unable or neglected to give a more exact ratio, but that in fact the Irish measure varied according to the nature of the land. The Irish tradition of land-measurement, still by no means obsolete, was based on the quantity of live stock that a given areà could support.

<sup>1 &</sup>quot;D' fhiachaibh ar an chonsabal céid beith ceathrar is ceithre fichid ar a gcosaibh agus d' fholmhughadh sé fir déag, agus is é ceal a dtéid an folmhughadh sin, cuid deichneabhair ag consabal an chéid de, agus cuid cúigir ag marasgal an tíre féin agus cuid fir ag gallóglach tighearna." The whole of this interesting document will be found in "An Léightheoir Gaedhealach" (Gaelic League publications), p. 85, printed from the facsimile in Gilbert's National MSS. of Ireland. The Roman centuria also in actual service suffered a customary abatement, and contained only sixty men.

Hence no doubt the extent of the tricha cét was variable according to the fertility and population of the district.

154. The rise of the great septs, about the commencement of the Christian period in Ireland, must have greatly changed the older political subdivision of the country, sometimes dividing and sometimes combining the more ancient petty states. In some instances the tricha cét appears to have survived as a petty state. In others, it is divided between two distinct political organisations. In others as many as ten tricha céts form the kingdom of a single sept. There may well have been instances in which the early territorial state was split into fragments, though there is a visible tendency down to the seventeenth century, when the baronies of the English regime were marked out, to adhere to remotely ancient territorial delimitations. The following passage (Lecan, 460), describing the territories possessed by Dál Cuinn, is instructive :—

155. Cland Chuind andso fo Erind i. Fir Breg ocus Fir Midi ocus Fir Thulach ocus Corco Roeada a n-ingnais a buil do deoradaib acu. Is iadso iadside .i. Luigne ocus Gailenga ocus na Saidne ocus Hui Aeda Odba ocus na seacht nDealbna ocus leth-tricha cét Cuircne ocus leth-tricha chet Teallaig Modaran ocus tricha chet Fear mBile. Cland Chuind .i. fiche baili na Colaman ocus tricha chid<sup>1</sup> Fini Gall ocus Airgialla<sup>2</sup> imorro seacht tricha chet dec indti<sup>3</sup> ocus deich tricha Ceniuil Eogain ocus deich tricha Ceniuil Conaill ocus leith-tricha Ceniuil nEnda ocus leith-tricha Ceniuil nAengusa ocus leith-tricha Fer Tulach ocus deich trichaid cét Breifni ocus deich tricha Hua Maine acht tri tuatha nama .i. Sodain ocus Dal nDruithne ocus Muinter Mail Findain. Sil Muireadaig Muilleathain ocus Sil Briain meic Each[ach] Muigmedoin in cach du itait ocus in da Chairpri .i. Cairpri Mor Droma Cliab la cloind Fiachrach meic Echach Muidmedoin ocus Cairpri O Ciarda la Firu Midi. Sil Dathi o clad Chonachla co Codnaich Cloindi Puint. Muinter Murchada cona coibnesaib ocus Cland Coscraig. Fir Umaill cona ngablanaib.

156. Sil Fiachach Sui[g]di meic Feidlimid Rechtmair .i. Corcortri la Corand i Condachtaib dia mbai Diarmaid Hua Duibne ocus Hui Chuind cona fineadaib .i. uirrig Corcorthri cor dichuirsed cland Taide meic Cein meic Aililla Ulaim a Mumin ocus is do Corcortri Hui Dobailean scus Hui Duindchaichig ocus Hui Ailella dia roibi Mac Liag .i. in fili. Na Deisi imorro do cloind Fiachach Sui[g]di .i. deich tricha cet intib cona fochenelaib i n-egmais Semaine .i. leithtricha cet ita ar slicht Semuine meic Cechaing meie Celtair nó Semaine meic Cealte[h]air meic Uitheochair dia ndeachaid ar cend Cealtchair diaid marbtha

3 Read intib.

<sup>&</sup>lt;sup>-1</sup> kead *chét*. The writing, which had become dim, has been inked in at this place by a later hand. <sup>2</sup> Here ends a page. The leaves have been misplaced in binding, and the continuation is found at

<sup>349</sup> a 1. The particulars of Clann Chuind in Onom. Goed. are to be amended accordingly.

Blai Brugad do Cealtchair tre et na dun ocus na Deisi Breg cen airem andsin. Fir Bili ocus Fir Asail is do cloind Fiacha[ch] Sui[g]di atat.

157. Fotharta dochodur co Laigniu do chloind Echach Find Fuath nAirt meic Feidlimid Rechtmair .i. na .uii. Fotharta in each baili itait.

158. "The following are Conn's race throughout Ireland: Fir Breg and Fir Midi (the men of Brega and Meath), and Fir Thulach and Corcu Roide, apart from what they have of immigrants. The latter are these: Luigni and Gailing and the Saithni and Ui Aeda of Odba and the seven Delbnai and the half tricha cét of Cuircne and the half tricha cét of Tellach Modaran and the tricha cét of Fir Bili.<sup>1</sup> The race of Conn, [to resume]: the twenty townlands (hundreds) of the Colamain, and the tricha cét of Fine Gall, and the Airgialla moreover, containing seventeen tricha céts, and the ten tricha céts of Cenél nEogain, and the ten tricha céts of Cenél Conaill, and the half tricha cét of Cenél nÉndai, and the half tricha cét of Cenél nAengusa, and the half tricha cét of Fir Tulach,<sup>2</sup> and the ten tricha céts of Breifne, and the ten tricha céts of Ui Maini, except three tuatha, namely Sogain and Dál Druithne and Muinter Mail Findáin. The race of Muiredach Muillethan and the race of Brian son of Eochu Muigmedóin wheresoever they are, and the Cairbres, namely Cairbre Mór of Druim Cliab belonging to the Ui Fiachrach maic Echach Muigmedóin and Cairbre Ua Ciarda belonging to the Men of Meath. The race of Dathi from Clad Conachla to Codnach of Cland Puint. Muinter Murchada with their kinsfolk, and Cland Choscraig. The Men of Umall with their branches.

159. "The race of Fiachu Suigde son of Feidlimid Rechtmar, namely: Corcu Fir Tri at Corann in Connacht, of whom was Diarmaid Ua Duibne, and the Ui Chuinn with their families, [formerly] petty kings of Corcu Fir Tri until the race of Tadg son of Cian son of Ailill Aulom from Munster dispossessed [them]; and of Corcu Fir Tri are the Ui Dobailén and Ui Duinnchaichig and Ui Ailella, of whom was Mac Liag the poet. The Dési, moreover, are of the race of Fiachu Suigde; they, with their under-septs, contain ten tricha céts, not reckoning the Semaine, i.e., a half tricha cét who are descended from Semuine son of Cechang son of Celtar or from Semaine son of Celtchar son of Uithechar<sup>3</sup> when the consequence of slaying Blai Brugaid through jealousy in his fort went against Celtchar; and the Dési of Brega are not reckoned therein i.e. in the ten tricha céts). Fir Bili and Fir Asail are of the race of Fiachu Suigde.

<sup>&</sup>lt;sup>1</sup> This tricha cét appears to be the modern barony of Farbill in Westmeath (35,447 statute acres).

<sup>&</sup>lt;sup>2</sup> Fartullagh barony in Westmeath contains 37,552 statute acres.

<sup>&</sup>lt;sup>3</sup> A genealogical fiction, since their traditional eponym was Nia Semon, see under moccu Neth Semon.

160. "The Fothairt who went to Leinster are of the race of Eochu Find Fuath nAirt, i.e. the seven Fothairt in every place where they are."<sup>1</sup>

161. Compared with the account in Keating, the foregoing contemplates a much smaller extent of the tricha cét. Cenél Conaill, Cenél nEogain, and Airgialla comprise 37 tricha céts. These occupy much less than the modern Ulster, as they do not comprise the counties of Antrim, Down, and Cavan. The ancient Ulster of Keating's account, somewhat larger than the modern province, contains only thirty-six tricha céts.

162. We can assign a period to the Lecan statement. It is earlier than the Norman occupation of Meath at the close of the twelfth century, and later than the death of Mac Liag in 1016. It is likely that the tricha cét varied according to the population at different periods, and that Keating's account is referable to a time when the country was less populous than in the eleventh and twelfth centuries.

163. Two modern baronies retain the name tricha, Trough (an Triúcha, Trícha Cét Cladaig), 37,377 statute acres, in co. Monaghan, and Trughanacmy (T. an Aicme), 195,282 statute acres, in Kerry.

164. Other instances from Onom. Goed. are :---

Trícha Baguine = baronies Boylagh and Banagh, co. Donegal.

, Cairbri = bar. Carbury, co. Sligo.

..

Trícha cét Cera, apparently somewhat larger than bar. Carra, co. Mayo.

- " " Cianachta = ancient kingdom of Cianacht Breg.
- " " Cualnge, perhaps = kingdom of Conaille.
- " " Énna mic Neill = trícha Énna = two bars. of Raphoe, co. Donegal.

" Fer nArda = bars. of Corcomroe and Burren, co. Clare = ancient kingdom of Corcu Mu Druad.

- " " Mugdorn, perhaps=bar. Cremorne (Crích M.), co. Monaghan.
- ., ", na nOilén = bar. Islands, co. Clare.
- " " na Soillse = bar. Lecale, co. Down.

Trícha Eogain = two bars. Inishowen, co. Donegal.

- " Luigdech = bar. Kilmacrenan, co. Donegal.
- " Medónach = bar. Barryroe, or part thereof, co. Cork.

165. O'Donovan's Supplt. to O'Reilly's Dict. has: "Rig: 'ri rig,' rex regulorum, a chief whose authority was recognized by seven petty chieftains.

<sup>1</sup> This is a frequent phrase with reference to peoples scattered apart in various territories.

H. 3. 18, p. 14." Ri rig here seems to be an etymological gloss on ruiri = ro + ri. For "chief" and "chieftains," read "king" and "kings."

166. The tradition that suzerainty over seven petty kings conferred a special grade is elsewhere exemplified. Cp. §143, above, where, besides the sons of Magu who were chiefs of the vassal Fir Domnann, the seven Máines of Connacht are subject to Medb, and in Munster also there are seven uirrig. The earlier and lesser Munster of the Érainn is here implied. In the defeat of the Irish Picts by Ui Néill at Móin Daire Lothair (an. 562 AU), when the Picts lost their territory west of the Bann, their king Aed Brecc is spoken of as leading seven other Pictish kings. In the Book of Rights, Ireland is divided into seven chief kingdoms, whose kings have no suzerain except the king of Ireland. This division seems to represent an ideal rather than an actuality, for as far as one can judge from other evidences, the kings of Osraige, Tuadmuma, Breifne, and Cenél Conaill, perhaps also the kings of Iarmuna (Eoganacht Locha Léin) and Brega, were quite as independent as the seven chief kings in the Book of Rights. In O'Maelconaire's Munster Annals (R. I. A. copy), the kings of Cashel are usually called kings of Cashel and Desmond, indicating that they were not suzerains of west and north Munster. From an early period in the ninth century the Airgialla seem to have admitted the suzerainty of Cenél nEogain: Airgialla .i. daergialla .i. Cenél nEogain rocuirsead fo dairchis iad o cath Leithe Caim amach (BB 249 b 15, H. 3. 18, page 580, and see AU 826). Hence perhaps the absence of any statement of tributes due to the king of Airgialla in the Book of Rights. Flann Mainistrech, in his poem quoted by me (R. I. A. Proceedings, xxvii, C. 6, p. 138), names seven chief kings in his time. Six of these accord with the Book of Rights. For the seventh he omits Airgialla and substitutes Brega. Cuán O Lothcháin, referring to the alleged contents of the "Psalter of Tara," says that it tells of "seven chief kings of Ireland," who are "the five kings of the Fifths, the king of Ireland and her high king (subking)" BB 351 b 3 (orrig is a marginal amendment of airdri). Perhaps the peculiar designation, in Sechtmad, 'the Seventh," applied to one of the petty kingdoms of Munster, had its origin in this way (see § 106).

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# V.

# THE MONASTERY OF TALLAGHT.

#### BY E. J. GWYNN AND W. J. PURTON.

Read MARCH 16. Published JULY 21, 1911.

THE two vellum manuscripts<sup>1</sup> in the Academy's collection, numbered 3 B 22 and 3 B 23, are companion volumes; it is probable that they originally were parts of a single manuscript, as they are numbered continuously in pencil by a modern hand. There is also another numeration in pencil for each volume separately. They are written on folios of the same size and by the same scribe who signs himself "Tade ua Rigbard[a]n" at page 51 of 3 B 23. One other MS. in the Academy's library, 24 P 1, was written by this scribe; his signature occurs on p. 52 "Tadg ua Rigbardan qui scribsit": on p. 14 of the same MS. he gives the date 1473.<sup>2</sup> All three manuscripts are entirely occupied with material of a religious or ecclesiastical character, except for a few marginalia.

Some light upon the later history of the two companion volumes, 3 B 22 and 23, may be obtained from entries scribbled in the margins in English. These occur mainly in 3 B 22. This volume (and no doubt its fellow) belonged for a time to a family of Egans. At p. 68 is written, in a handwriting apparently of the early seventeenth century, "These are to certyfie y<sup>t</sup> this booke longed to margery Egan." At foot of pp. 6–7, in a later hand, "Allive (?) Egane is y<sup>e</sup> possesser of this Booke & I pray God." On page 24, "Stephen Egan"; p. 40, "Cor. Egan"; p. 50, "m<sup>r</sup> Stephen Egan" (these last three entries seem comparatively recent). Towards the end of the seventeenth century the manuscript came into the hands of a family of Kennedys. On p. 13 of 3 B 22 is written: "Daniell Kenedy his hand & seale the 24<sup>th</sup> daye of Junii 1682 (altered from 1692)." Immediately below this is another name, in a different handwriting, as if it were the record of some agreement. On p. 47, "Philip Kenedy his booke and seale as witness

<sup>&</sup>lt;sup>1</sup> These volumes were examined and described by Mr. Purton while working at the Calendar of Manuscripts now in course of preparation. The description of 3 B 23 is mainly his work; he first called my attention to the Tallaght document, and he has helped me in the translation. I desire to acknowledge gratefully many useful suggestions received from the Rev. Charles Plummer, who has kindly read this paper in proof.—E. J. G.

<sup>&</sup>lt;sup>2</sup> He is also the scribe of part of H.2.12. T.C.D. (Nos. 1304 and 1309): see Abbott's Catalogue, pp. 323, 324.

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my hand ye 9th april 1684." On p. 68 (top margin), 'Mr. Philip Kenedy 1699." Philip Kenedy's name is also written at foot of p. 58 of 3 B 23. On p. 44, "To  $M^{rs}$  Magrett Kenedy att Bellafinvoythe . . ." On p. 84, at foot, "Jo. Kenedy his booke . . ." Later the volumes came into the possession of one Torralagh ó Brin (Turlough O'Brien<sup>1</sup>), who has written his name at p. 30 of 3 B 23; and he is probably the father of the Randol mac Torr[alaig] whose name occurs at the foot of p. 26 and on p. 28 of the same volume.

Other names scribbled in the margins of 3 B 22 are Tumultaugh O'Haanly (p. 5), William Chisers (p. 45), William O Brin (p. 49), Bradstreet (p. 69), "Owen Coulahan his mark" (p. 80). These persons may not have been owners of the book, but merely witnesses to some legal transaction.

The two volumes afterwards belonged to General Vallancey, as is shown by a slip from a sale catalogue pasted on the first folio of 3 B 22. It runs thus: "1270 Two Vols beautifully written on Vellum at least 600 years past. These are in excellent preservation and most elegant penmahship [*sic*], small Folio." Mr. R. I. Best has identified this slip as an extract from the catalogue drawn up for the sale of Vallancey's collection in 1813.

We are here concerned principally with 3 B 23. This volume consists of 41 vellum folios, written in double columns, with from 28 to 36 lines in a column. The average size of the folios is  $23 \times 15$  centimetres. Here follows a full description of the contents; the volume is numbered by pages.

1. Page 1, column a. Diuerte a malo et fac bonum inquire pacem et sequere eam .i. Soi à duine o ulc 7 dena maith, etc.

A homily on the Eight Arrows of Sin, with which the Devil seeks to conquer the citadel of Man.

After page 6 one or more folios are lost.

2. P. 7a. immalle re hihesu isa comarli rogabsat, etc.

It is not clear whether this is the conclusion of the above homily, or of a different one : it ends  $(7\alpha)$ 

roísam roaitrebam in saecula saeculorum amen.

3. P. 7*a*. Cum ergo facieis elimoysinam noli tuba canere ante te .i. ind tan didiu dogné almsain nachus commaeid amal dogniatt na breccaire, etc.

A homily on almsgiving, a good deal of which closely resembles the tract edited by Atkinson, *Passions and Homilies*, 6047 et seq. Ends p. 12b:

roisam roaitrebam in secula seculorum Amen. FINIT.

<sup>1&#</sup>x27;O Brin usually = O'Byrne or O'Beirne, but Turlough (Toirdelbach) is a name very common among the O'Briens, while it is not used by the O'Byrnes, if one may judge by the indices to the Annals.

4. P. 13a. Dona harraib indso.

This is the treatise *De Arreis* published by Meyer in Rev. Celt. xv. 485. For a collation of this text with Meyer's see Eriu v, 45. There is no break in the manuscript between this and the next item.

5. P. 16a25. De luxoria. Luxoria tra hissed ainm inna dualcha tanaisi marbas anmain duine . . .

Two distinct documents are here combined in alternate sections. One is the Old-Irish homily printed by Meyer in Zts. Celt. Phil. iii. 25 from Rawl. B. 512; the other consists of extracts from an Old-Irish penitential, based apparently on the Penitentials of Theodore and Cummian. An edition of the whole document is in course of preparation. Ends (p. 28a) with the section of the homily which treats of Vana Gloria: cf. ZCP iii 28.

Most of p. 28 is left blank.

6. P. 28b. Some memoranda in a poor hand, dated 1729-1735. Here occurs the name Randal mac Torralaig.

After p. 28 there is a gap in the manuscript.

7. P. 29a1. ni corab meinic bís can a fis aici cred doní sé fein na nech ele.

Part of a homily on the Atonement (?), the beginning of which is lost. Ends (p. 29b):

an urnaigti so. Domine ihesu Christi cor meam et Reliqua.

8. P. 29b. Some verses, partly illegible, in a somewhat later hand.

Bo beres buar o rigaib	bo na truag bit g
bo an dil[echt]a bo	bo an tsirmeta ni erig
b[ofectnach failig	bo an firerabuig (?) bo in cleirigh

9. P. 30a 1. Hicc incipitt speclum pecatoris i. is annot indecainter speclair in pecethaig, etc.

Another copy of this moral tract<sup>1</sup> is found in R.I.A. 23 N 15, p. 59. After p. 30, which ends with the words "mona gradaigem cach ní teccusces Dia" (= 23 N 15, p. 60, 14), there is another gap in the manuscript. The *Speculum* is continued on p. 31, which begins "annsa leis na lebur saegulta ana (nó *superser*.) an cod dorindi Plato" (= 23 N 15, p. 66, 1).

P. 32 ends in the middle of a sentence with the words "oir is annsa n-aitsin tecait lucht oifici ifern docum" (corresponding loosely to 23 N 15, top of p. 68; but the two texts vary widely).

10. P. 33a. Athlaoch boi hi comaidecht ...

Here begins the document which is printed in full below. It is interrupted on p. 47 by a copy of the *Abgitir Crabaid*, but is resumed at p. 51.

11. P. 47 $\alpha$  22. Incipiunt uerba Colmani fili Beognae uiri dei .i. abbgitir crábaid.

<sup>1</sup> It is an adaptation of Pseudo-Augustine, Speculum Peccatoris (Plummer).

See Zts. Celt. Phil. iii. 447 and Mart. Oeng. Preface x, xi. Ends p. 51a16. After the *Finit* there follows a note by the scribe:

Is fó cech ní sluindess ind lebarsa día tuicmis hé. 7 a comaldad tadce ua rigbardn qui scribsit 7 ni hanmfis tuc ind a. b. c. d. eidir na riaglaib acht dhegla a facebalae. "Good is everything that this book sets forth, if we understood it, and good it is to fulfil it: Tadg O'Riordan *qui scripsit*, and he placed the Alphabet among the Rules not in ignorance, but for fear of omitting it."

12. P. 51a21. Is hed dano dohuce Colccu ho Eogun . . .

See below, p. 161, 13.

13. P. 53a1. Labrum don bochtainecht . . .

A homily on poverty. Ends with p. 57a :--

Qui uiuit agradnad [et regnat] deus per omnia secula seculorum amen. FINIT.

14. P. 57b1. Labrum anos don trocaire, etc.

A homily on mercy.

After p. 58 one or more folios are lost. Ends at foot of p. 65a:

iarr sith 7 lean dia qui uiuit ad ragnad [et regnat] deus per omnia secula seculoram. Amen.

15. P. 65b1. Legthar andsa ix caibidil xx do lebur Matha co tainic duine ócc, etc.

This is the homily on the Ten Commandments which is printed in Atkinson's Passions and Homilies, p. 245. Ends p. 80:

da tucais toil egoir sa domanso let coic cetfadaib corporda (= P. & H. 7821).
16. P. 80α15. Selus domus tue cometit me .i. romgab étt mo tegdais a

dia, etc.

A homily beginning with a story from the Book of Maccabees about the priest Mathias and his resistance to idolatry: cf. *Pass. and Hom.* 6534 *seq.* It is continued to the end of p. 82; but the last page is only partially legible.

17. The following marginalia are scattered through the volume: unless otherwise specified, they are written by Tadg O'Riordan.

P. 13, at foot:

indleac ind inis cathaig dixit:

[Bean]nacht beannacht for Máolbridde

tabraid, na bad gair som :

beannocht cach trath, rád nád ceil seom,

for cach dodofair som.

The stone in Inis Cathaig said : "Blessing, blessing give to Maelbrigte; let it not be scanted : a blessing for every hour (a saying he conceals not) on each that he comes to aid." P. 14, at foot:

Biad terc, codla gairit eirgi moch, slechtain menic, ocus fegad na carat bis fod chosaib sa railic.

"Spare diet, short slumber, early rising, frequent obeisance, and gaze fixed on the friends that lie in the churchyard beneath thy feet."

P. 15, at foot :

Doman dian, cid bethir air ní bad cian, is baeth do neoch renus fír ar ascnam a tir na pían.

"The fleeting world, though one live on it, 'twill not be for long; foolish is he who sells truth to win a place in the land of torment" cf. ZCP. vii. 498.

P. 16, at foot.

is mairce breichem beres gáoi ar an truadan ac nach bi ní, ar atchonnacsa a loce ruad anbad mór don tsluag dusgní.

"Woe to the judge who judges falsely against the wretch that has naught; for I have seen in the fiery place a great multitude of people that do the like." This stanza is found also in T.C.D. MS. H. 1, 11, f. 124 verso.

P. 17, at foot:

is truad fáoid focerd cadla ind diaid a láoigh: o tosach domm*ain*, ní brece, ata écc ar ciond cach aoin.

"Sad is the cry the goat utters for her lost kid: from the beginning of the world—it is no lie—death awaits each and all."

P. 23, at foot:

Cid bé le bud emeilt doscribus mar do fuarus ind lebur so nó fós

"Whoever finds it tedious, I have written this book as I found it. . .'

P. 24, at foot, in late hand : Torgalach o brin. . .

P. 26, at foot, scribbled in faded ink: Anso det . . . Randol M<sup>c</sup>Torralaig anso an beag ud (?) . . . tigerna mille 7 seacht cced 7 . . . fichid . . .

P. 27, at top:

 $\mathbf{E}$ manuel

P. 27, at foot:

ni tucais mo croide dam a libuir re cois caich ga breith uaim.

"Thou hast not given me back my heart, O book, while everyone is being carried away from me." (?)

P. 28, at bottom:

 $\ldots$  +  $\ldots$  7 da fag  $\ldots$  do biad mar an cetnai.

P. 30, at foot, in late hand:

Torralagh ó Brin sealmór en labor so.

P. 44, at foot:

Finit : do scribus sin dom doig 7 inddí sceol so, 7 ni hainfis acht dia necar doniam ind nos.

Pp. 58 and 66: scribbles, in a late hand, in English.

P. 75, at top:

mallacht dib fein

P. 78 at top :

ataid sluag i briain ac techt cugaind deis durlais do gabail, "O Brien's army is coming towards us after taking Thurles." This may refer to the battle of Thurles, A.D. 1174, in which Domnall O'Brien defeated the English; if so, the note must be copied from an older manuscript. If, on the other hand, it is set down by O'Riordan himself, this would indicate that he was writing somewhere not very far from Thurles.

P. 81, at foot:

Marthin duit a croch . .

The document with which we are mainly concerned runs from p. 33 to p. 47, and from p. 51 to the end of p. 52. The script differs in certain respects from that employed in the rest of the volume. The chief peculiarities are (1) an unusual form of  $\circ$ ,<sup>1</sup> closely resembling  $\diamond$ , with which it may easily be confused; (2) an unusual form of m, used mainly on p. 33, but occurring two or three times in later pages : it resembles a capital H, having the cross-bar depressed in the middle; (3) a contraction, consisting of a  $\tau$  with a wavy stroke over it, which stands sometimes for *tir* (*ter*), sometimes for *irt* (*ert*?); (4) the spelling, which is described below.

For the reasons given above, however, we must assume that our document is written by the same scribe as the rest of the volume. The peculiarities just noted are probably copied by him from the archetype which he had before him.

Our text is principally occupied with the traditions of the Monastery of Tamlachta (now Tallaght, a village situated within a few miles of Dublin),<sup>2</sup> and with the teaching and practices of two persons—Maelruain, the founder of the monastery, and his disciple Maeldithruib. There is nothing to show who the writer was; but he must have been for some time an inmate of the

<sup>&</sup>lt;sup>1</sup> This  $\sigma$  is found also in the scribal note at the foot of p. 23.

<sup>&</sup>lt;sup>2</sup> As to the fortunes of this foundation, see Handcock's *History of Tallaght*, and F. E. Ball's *History of County Dublin*, Part III.
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monastery. He speaks of its usages as things within his own knowledge; he is familiar with minute details of its daily routine, and even records a penance inflicted on himself for breach of a rule (§ 45). It is not clear whether he had known Maelruain: if the text could be trusted, there is one passage which seems to show that he did: in § 5 we have the words *asrubart-sai fri Maolruain*: this would naturally mean, 'I had said to Maelruain' (*asrubart-sa*); but it is probable that we should read *asrubart-som*, "he had said": the same corruption has apparently taken place in § 46, where *asrubart-sai* cannot well refer to the writer. At all events the document was written after Maelruain's death, as is made clear by the words "in Maelruain's lifetime," § 6; besides, the references to Maelruain are in the past tense throughout. The phrase used in § 27, "this we received (*tucsam*) from Maelruain," merely implies that Maelruain is the ultimate authority.

But the author certainly knew Maeldithruib : in § 40 he says expressly, "This I heard from Maeldithruib." All the explicit references to the opinions and customs of Maeldithruib (with one exception) are couched in the present tense: the usual formulae are *issed fognt laiseom*, "this is his practice"; *issed* as choir lais, "he thinks it right"; and so forth. The single exception occurs in one of the last paragraphs, § 86 : Maoldithruib in quadragesimis in aqua et pane usque ad nouissimum tempus pro anima patris sui. Fobithin ba de a urnichte dogrés in quadragesima. Here usque ad nouissimum tempus seems to mean "to the last, to the end of his life," and this agrees with the tense of ba in the next sentence. The natural interpretation of these facts is that the main part was written during the lifetime of Maeldithruib, and that § 86 was added after his death. The supposition is quite consistent with the disjointed character of the document, which is not a biography, nor yet a Rule, but a collection of memorabilia, probably jotted down from time to time.

It will be noticed that in a great many cases the writer records sayings and opinions without mentioning by name the person to whom he refers. These references are all (again with one exception) framed in the present tense: the one exception being the verb dognid in § 28; but this is a mere slip for dogni: in the same paragraph doleici is present. It is natural to suppose that in all such cases the person referred to is Maeldithruib. If so, the incident recorded in § 45 is proof that the writer had been under his rule at Tallaght.

Who was Maeldithruib? Although he seems to have been a personage of considerable importance in his own monastery, the references to him in the usual sources of knowledge are curiously scanty; but they are fortunately sufficient to fix his date. On p. 370, column 3, of the Book of Leinster, immediately after the Martyrology of Tallaght (properly so called), there is a

brief list of persons belonging to Maelruain's community (*Lucht oentad Maelruain*: versified in column 4), and among these is named *Maeldithrub* anchorita Tiri da Glas. We are therefore justified in identifying the Maeldithruib of our document with the Maeldithruib, "anchorite and sage (sáoi) of Tir da Glas," whose death is recorded by the Four Masters anno 840.

One other reference to him, though of later date, is worth recording. Among the spurious "Prophecies," published by N. O'Kearney in 1856, there is one (p. 95) which is attributed to "Maeltamlacht," who addresses his utterances to "Maeldithridh." These names evidently disguise Maelruain of Tallaght and his disciple Maeldithruib. There is a copy of this poem in a Trinity College manuscript H. 1. 10. p. 167; it is of no interest except as showing that the connexion between Maelruain and Maeldithruib was not forgotten in later times.

We have thus obtained a lower limit of time. Most of the document was written before 840, the year of Maeldithruib's death; a little was added later. An upper limit can be fixed by the references to Diarmait, abbot of Iona, in §§ 47, 65, 80. He was Abbot from 815 till 831 or later (Reeves' Adamnan, 388). The phrase in § 47, "Three words that Diarmait *left* to bishop Carthach," seems to imply that he was dead at the time of writing. If so, we have 831 as an upper limit, 840 as a lower limit.

These dates agree with the notes of time supplied by references to other persons, so far as they have been identified. The bishop Carthach mentioned in § 47 may be the Carthach, Abbot of Tir Da Glas, who died in 851 (Four Masters): there is nothing to show whether the person referred to by our author was alive or dead. Several of the other personages mentioned are known to have been contemporaries of Maelruain; such are Samdan, Mocholmocc, Mac Oige of Lismore, Cainchomrac, Fer Da Chrich, Helair, Dublitir, Eochaid ua Tuathail, Blathmac; also probably Colchu and Clemens mac Nuadat.

The few facts hitherto known about Maelruain have been put together by Reeves in his work on the Culdees, p. 7; see also O'Hanlon, Irish Saints, vii, 98; Contents of Bk. Leinster, p. 66b. His name is still familiar in the traditions of Tallaght (see F. E. Ball, History of Co. Dublin, iii, 43). He is remembered mainly as founder of that monastery and author of the so-called *Rule of the Céli Dé* which exists in the Leabhar Breac, pp. 9–12, and was published by Reeves, with a translation by O'Donovan. Our text has a close affinity with this Rule. The particular points in which the two documents coincide with or illustrate one another are indicated in our Notes. Which of them borrows from the other, or whether they draw from a common source, it is impossible to say. Reeves (on O'Donovan's authority no doubt) speaks of the *Rule* as being in its present form a production of the twelfth or

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thirteenth century; but as Strachan has remarked (Deponent Verb 517, note), it is really in substance an early document; it probably belongs to the ninth century.

Our text supplies some fresh information as to the Céli Dé and their practices. They are referred to by name in two passages (§§ 40, 45); in many other places vague phrases, such as *fogni leusom*, "it is their practice," may refer either to the Céli Dé in general or to the community of Tallaght in particular. In § 6 Maelruain is quoted as speaking of "my Rule," and in three other places there is mention of "the Rule" (§§ 12, 63, 78); but there is nothing to show whether this is the Rule of Tallaght only, or a Rule binding on all Céli Dé. From the varieties of practice noted in various places where they were established, it would seem that there was no fixed Rule generally accepted by them.

It is noticeable that several of the anecdotes introduced relate to places where the Céli Dé are known to have been established: Clonmacnois (§§ 67, 85), Devenish (§ 60), Monahincha (§ 4), Iona (§§ 47, 52, 65, 85). Our text shows that there were also Culdees at Terryglass (§ 12). Evidently there were close relations between this place and Tallaght, since Maeldithruib is described as "anchorite of Tir Da Glas"; no doubt he went thither from Tallaght.

Although our document is principally concerned with questions of discipline and observance, it does not display the spirit of exaggerated asceticism which so often pervades the later Lives of the Saints; on the contrary, excessive severity is discountenanced by Maelruain and Maeldithruib. See §§ 63, 68, 77, 80. There is also a general absence of the miraculous and supernatural, and such stories of this kind as are introduced are of a comparatively sober character: such are the tales of Colum Cille and the sinful monk, § 66; of Maelruain's fasting against Artri, § 72; of the angel at Mag Lena, § 73; of Adamnan and the monks of Clonmacnois, § 85; of Eochu ua Tuathail and the layman's ghost, § 85.

### LANGUAGE.

Except for §§ 66, 67, and 73, and the passages which coincide with the Rule of the Céli Dé (see *ante*), no second copy of our document has as yet come to light.<sup>1</sup> This is much to be regretted, as a good many passages seem to be corrupt, and even where the corruption is not sufficient to obscure the sense, the

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<sup>&</sup>lt;sup>1</sup> When this paper was already in proof, I was led by a bint from Mr. Plummer to examine the so-called Life of Maelruain contained in a portfolio (No. 36) in the Franciscan Library. This proved to be a seventeenth-century paraphrase corresponding to parts of the Rule of the Culdees and of our document. It has cleared up some difficulties, and I hope to publish it *in extenso.*—E.J.G.

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old Irish forms have undergone more or less alteration. Certain eccentricities of spelling are worth noting, particularly the scribe's fondness for writing ld for ll, nd for nn: e.g. *ildius*, *caildech*, *andos*, *anttos*, *indni* (= *ani*), etc. He sometimes treats the symbol 7 as = t or d: hence such a spelling as al7essa = aldessa = al-lessa, *figil*7 = *figil*d = *figil*.

The language is unquestionably Old Irish, but it has naturally undergone a good deal of alteration; for the most part, however, this is limited to an eccentric method of spelling, combined with such lawlessness in the treatment of terminations as one expects to find in a fifteenth-century transcript of an ancient document. There are not many signs that the scribe of our MS. deliberately altered the forms which he found in his original.

With a text of this character it is impossible to rely on the exacter tests of age. But a summary of the main points of grammatical usage will make it clear that the language as a whole is late Old-Irish.

### Article.

Gen. sg. fem., acc. pl., and gen. pl., usually *na*; but *inda*, g. s. fem. 128, 16; 133, 20; *inda*, acc. pl. 160, 22; *ionda*, *inda*, g. pl. 147, 4; 151, 15, 21.

Nom. mas. pl. generally ind, once inda 134, 11.

#### Pronouns.

The infixed pronoun is regularly used, though the forms are sometimes incorrectly transmitted. The later substitution of the independent pronoun is found twice: congraid he 150, 3; corroloise he 157, 11; noduslen 129, 2 is a late form.

The affixed pronoun occurs in gabtiseom 129, 7; gabtisom 140, 2; ibthi 129, 33; clandti 150, 27; roberbi (?) 147, 8; gabta som (= gabthus) 128, 38; gaibthus 138, 29; gabtus 139, 1; bertus 158, 6.

Prep. with pron.: note the forms essiv, eisse 149, 28, 32 (Mid. Ir. esti).

The demonstrative pronoun *suide*, *-side*, is frequent; the unaccented *-ede* occurs in *gaibthus som eidi* 138, 29; *gabtus edi* 139, 1; *dolluigter eidi* 139, 5.

The demonstratives ón, són are frequent.

'Other': ind alae fecht ... fecht naild 138, 13; ind ala hi 161, 10; cach 'la cein 146, 29: cach 'la sel ... ind tale 147, 16.

'Self': 2 singular fein 148, 27; fadein 142, 3; 3 sing. fadesin (5 times); buddesin 152, 10; fadein 161, 11.

Relative -n- is kept (1) after *intan* (11 times, but is also frequently omitted); (2) once after *uar* (= hôre) 147, 14; *amail* (*amail nach* [n]*dentar* 148, 3; (3) in other cases, marking a dependent clause, 135, 19; 148, 13; 142, 23; 144, 19; 150, 9, 14; 160, 23 (?); 162, 37.

Numerals: teor menadcha 158,1; teora biadi 129,8; teora bliadna 134,36: incorrectly, di mer 150, 32; cethtri cridiscel 136, 19.

#### Noun.

The neuter is preserved : tarsa ceim 130, 7; addurtaig 132, 12; loim nais 136, 9; fecht naild 138, 13; frisa cedna 138, 12; cet moaille (= mbuille) 142, 10; a naccobar 149, 9; ass ningnama 156, 9; a nas 156, 12; ochtmad imbairgine (= mbairgine) 155, 33; etach n-etracht 163, 24; aldind (= al-lind) 152, 1; a trian sin 147, 8; anaild 146, 16; 151, 26.

The old datives: *imbim* 147, 9; *uamim* 149, 18, are worth noting; also the genitives: *Maoilidithraib* 135, 26; *Maoiliruoin* 131, 29; but *Maolruaoin* 129, 16; 136, 5.

### Adjective.

D. pl, rætaib tricib 157, 2; riagailib ailib 156, 17.

Comparative: móo 133, 10; 147, 1; moa 156, 27; mou 160, 23 (never mó). Adverbial: in déniu 162, 37.

Superlative: fuirbthium 136, 24: and som 136, 16.

### Prepositions, Articles, Conjunctions.

nicon passim (never nocon, nochon).

inge 131, 29 (but the reading is doubtful).

ceni 129, 28; 135, 13, etc.; but cen co 159, 37.

is "under" is uscu 158, 16.

ol passim; but once ar sé 159, 5.

inddá 'nor' 150, 41; indás 128, 22; 142, 25; 146, 18; 152, 31; 156, 28; 160, 17.

anda lim 150, 25; anda leosom 152, 28.

Signs of lateness are *var* (for *hóre*) 147, 14 (but *úare* 155, 23); *amáin* (*ambain*) for *namú* 127, 17, etc.; *aicc* (for *naicc*: so Thurneysen, Handb. 491). *immurgu* occurs frequently and in various forms, but never with assimilation of *rg* (*imorro*).

The Verb.

The distinction of absolute and conjunct forms of the simple verb is better preserved (even in passive and deponent) than might be expected in so late a manuscript: thus we have:

absolute: canir, canair, dlegair, gabthair, canitir, cantir, fosnather. conjunct.: -canar, -marb[t]har, -moladar, -cloadar, -corat[h]ar, -berar. relative: bongar, berar (but also berair).

The deuterotonic forms are well preserved, but there are exceptions: the most notable are several forms of *-comairlecim*, which seems to be regarded as a simple verb (perhaps under the influence of *comairle*): we get *nochomairleictea* 

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129, 20; rocomarleced 143, 24; cid comarlecther 147, 22; but cotarleic 137, 9. Other examples: cid chodala 161, 27; nach oen déraich 133, 21.

Conversely, ind arfaomad 150, 19; ní fogní (fogní) passim: see note on 127, 16.

In two instances a compound verb has an absolute termination : *congraid* 150, 2; *tabrait* 148, 21.

Perfective -ad- in conatil 155,10; conatallad 130,10; condatecht (= conaitecht) 144, 16; -ess- in niconesbed 129, 15; -com- in conescomriter 136, 33.

Ro. The strongest sign of comparative lateness is the apparent neglect of the perfective force of ro: asbert, asrubart, etc. seem to be used at times without distinction: see, for instance, 133, 9; 144, 9, 12, 15, 20; 158, 28, 29, 31. On the other hand, the ro of possibility is found, e.g. 136, 26; 148, 13; 159, 31. In a few cases ro- stands first in non-enclitic compound verbs: rotairrngirt 146, 20; rotuit 157, 10; rotinol 157, 15.

Signatic future and subjunctive :

téis 137, 14; tési 136, 17; tiasat 147, 21; tiagsad (for tiasat) 134, 13; -tesed 159, 19; docoiset 128, 10; cometestar 152, 7; cometesta? 151, 12; -conetis (for cometis) 160, 13; tecme 143, 24; doteceme 160, 10; tecmaised 133, 9; dondeemised 143, 6; donecmai 146, 19; dondeeme 161, 10; -tta 159, 35; toitsitis 157, 32; gesti 158, 22; condesar 133, 2; rostir 137, 12; -rorosind 136, 26; -sesed 140, 9; danctarred 143, 4; foreissed 164, 22; conmesar 129, 30; -lúsad 143, 1; nolústis 129, 21; adlúsat 147, 24; -ralúsa 145, 21; -imthisi (?) 150, 23; arindbo 134, 18. Add -fael 157, 20; -roenastar 155, 1; fuirestar 155, 28 from other manuscripts.

Non-signatic: arna himfoilnged 145, 1; cona tormaigfed 150, 14.

The Deponent is still in vigour: the following forms occur:---

nicon feddar 127,1; nicon fetadar 147,13; ara coratar 159,6; docuiridar 135, 1; aridralastar 153, 27; conmesar 129, 30; conmidir (pret.) 141, 24; conidmidetar 149, 14; rocloither 136, 15; dia cloadar 137, 6; ni [co] molathar 155, 26; nico romolastar 131, 22; forcomedar 129, 35; ni mor tolnathar 124, 19; fosnather 141, 23; manataigter (for mani-t-ágathar) 142, 3; atluchestar 150, 17; conidairsir 150, 28; atgladastar 154, 4; nad cobradar 164, 24 (but cobrid 162, 8); roairgsetar 147, 12; airigetar 152, 28; roortigsetar 133, 6; notlortaigetar 152, 13; dia fercaichther 141, 21; manatfercaichther 142, 2; nachadfercaigther-su 142, 7; dana coibsenither-su (for coibsenigther) 160, 9; suidigestar 162, 13. Also the deponent preterites:—domcaomnacuir 144, 7; tocaomnacuir 153, 11; teemoneuir 153, 19; teemongur 162, 11; rothuthamir 153, 13; nicon fordamar 162, 26.

The corrupt form *co treicigur* (v. l. *co tretigur*) 155, 22 looks like a deponent. Non-deponent :--*taithmenam* 158, 24, 26.

Relative forms: -file 152, 16; ata 158, 7; bite 132, 1; biti 156, 33; marbthai (for marbte) 132, 4; teiti 151, 6.

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The text of our manuscript is here reproduced without alteration except that contractions are expanded, and words as a rule are separated, except in cases where it seemed desirable to print them as they are grouped in the MS. The punctuation of the original (which is often misleading) is carefully preserved. The scribe often marks the beginning of a fresh paragraph by writing the first word *en vedette*, encroaching on the left-hand margin: but he frequently does this wrongly, when there is no break in the sense; as, on the other hand, he often begins an entirely new subject without any stop or break in the line. Words (or single letters) thus written *en vedette* are here signalized by bold-faced type thus:—**IAR**facht.

The more serious emendations are noted at the foot of each page; but it has not been thought desirable to point out the countless minor corrections which are necessary.

§1. [33<sup>a</sup>] Athlaoch bói hi comaidecht meic bethad. asbert niconfeddur cid fil do sirgabail na bíaide 7 cantaci maire (.i. magnificat). Ní handsai ém ol sessomh .i. Fer indorsa fri bun cruche ind molad ocus ind nemeli noferfad frisind rig immo 1 saorad. is foion iondas sin fermaidni nemeli fri rig nime isind bíaid immo ar sáorad. IMarchide iarom dano andíol<sup>2</sup> dichoid de muldach 10 muire ingini iar compert din spirad naob la tasce ind aingil .i. la haithise Cethe cathbarr nogabtha forsind cetul hi fil molad dé 7 nemeli fris

§ 2. Indtí tra dotháod día accaldim 15 som ni fogni laisim fachmarc scel dóib acht atorbai frisa tíagad ambain. Fobíthin fobenad 7 doairmescad menmain iond caich día naisnedtar. Manip lór

§ 1. A former layman was in company with a "son of life." He said : "I do not understand your continual singing of the Beati and the Canticle 5 of Mary (i.e. the Magnificat)." "That is not hard to explain, truly," said the other. "As a man, being now at the foot of the gallows, would pour out praise and lamentation to the king, to gain his deliverance; in like manner we pour forth lamentation to the King of Heaven in the Beati, to gain our deliverance. And it is fitting also that the song (?) which came from the head of the Virgin Mary, when she had conceived by the Holy Ghost at the angel's announcement (i.e. at the message) :- that this should be set as a crown upon the chant which contains praise of God and lamentation addressed to Him."

§ 2. As for those who come to converse with him, it is not his usage to ask them for news, but to see that they profit in those matters only for which they come. Because it might harass

1 Read imma

<sup>&</sup>lt;sup>2</sup> Read perhaps int ilach

dano reim iond áosa coimsi bess isind eclais imbé 7 maescai cách deit cena cosc. Focheird deit chubus ammain la slemni 7 roithini ma dagnet ní airi is fó IS dech allecud ammain manini aithriged<sup>1</sup>

§ 3. A forbí tra dano for lortaid na muindtire bís id choimidecht. ised is choir laissom di thabairt donda bochtaib ar nistá leó leth docoiset do chuincid neich. acht is dual duitsiu cena<sup>2</sup> narrabae let sentaisc de dia de na mbocht<sup>2</sup> de chrochaib saildi 7 di rusccaib imme 7 reliqua

locha cre tiri daglais § 4. IAR facht maoldithruib do helair manipad lor reim iond aosa i senchellaib 15 dús ind gebad ní do thorad ionda cildi huadaib. [33<sup>b</sup>] ISsed asbert helair a airidiu. arnit corpsiu manibe cuid deid inda gabail nó inda fostud isna hord*aib*. arced coirpti sium olsessim ni corpat 20 torud ind erlamai. Ar is disliu he dúini olsessem inddas doibsim. IS se arán dobeirti dosom fadesin cid ina insi fadessin amáin arán ruis cree. aran mochue olsesim (.i. elair) ba hé dobertar 25 dúin

§ 5. Sailm aurnaichti 7 biait fogníad madin la sochuidi acht ni madin gabta som ar antan dognisom (.i. elair) figild matin is fri ní dona salmaib dognid a figild dáig cudnuda na salm and disturb the mind of him to whom it was told. If the persons in authority that are in the Church where thou art have not fully performed their duties, and

5 if each ... from thee, without correcting himself, merely send him away from thy confession gently and kindly; if they do anything [that they have been told] thereupon,—it is well. If they do not repent, it is best to dismiss them merely.

§ 3. Whatever remains over after the monks that live with thee are satisfied, this he thinks it right to give to the
10 poor, for they have nowhere that they can go to beg anything. But it is meet for thee, even if thou have no old leavings, [to feed] the poor with flitches of bacon and firkins of butter and so forth.

§ 4. Maeldithruib (of Tir Da Glas) asked Helair (of Loch Cre) whether, 15if the folk in the old churches had not properly performed their duties, he ought to accept from them any of the produce of the church? Helair replied that he should accept it, "for it does 20 not defile thee, if thou have no share in receiving them or in confirming them in orders: for though they be defiled" (said he), "yet they defile not the patron's fruits. For that belongs to us" (said he), " rather than to them." The only bread that used to be brought to himself, and into his own island, was the " bread of Ros Cré." " Let it be Mochua's bread," said he (that is, Helair) "that is brought to us."

§ 5. Psalms of prayer and the *Beati* are used by some in the morning, but he does not recite them in the morning : for when he (that is, Helair) performs a morning vigil, it is with some part of

<sup>1</sup> Read mani aithriget

fobithin iond forcetail 7 ind crosfigeild fri biad cond neoch noduslen. [Nongebad matin iar ceilebrad . . . anigi (?) is ann gabtais figill dogen . . . ]1 Iond sailm aurnaigi déulái is fri bíaid i curp lai dusgnidsom 7 gaibid a salmu aurnaigti iarum oc celebrad Gaibti seom tra teora biadi 7 magnificat la cach naí post palmos biad cech cáocad. Achd ni maolrúoin imargu asrubart frissim 10 Asrubartsai<sup>2</sup> fri máolruain. Roón. cualai olsessem is hi figil7 fogní la duiblitir. Na tri.l. inda sesam 7 slechdain hi forciund cech sailm

§ 6. Niconesbed bandai cormmai hi 15 tamlachdai i mbethu maolrúoin cid a muindtersom indtan noteigdis nach leth aili niconibdis bandai cormmai i tír cualand cía bith ara tecmainged dóib Nochomairleictea immargu doib indtan 20 noteigdis i céin cena lústis<sup>3</sup> (.i. ebtais) hisudiu. Nicodoes mír feolai dano hi tamlachdai inda bethusom ..... mad oss no muc allaid. no . . . [34ª] oigid ánanobid and de feol. Dolluid iarum 25 duiblitir dochum maolrúoin do urail fair combed tuaslucud do muindtir ar na tri soldomnaib. cenibed iarum na riam IS sed asbert maolrúoin. cene conmesarsa olseseom 7 céne connoither 30 mo thimnasa isin purtsa. níconibthar lind dermait dé and. Maith ol duiblitir ibthi mo muindtersa 7 bíad ind nim láad muindtirsiu. Nach oen ol maolrúoin contuasfe frimsai, accus forcomedar 35 mo riaguil de muindtir nípa hécen tene bratha dia nglanad nó hadall messai

the Psalms that he performs his vigil, (in order to keep the order of the Psalms, because of the instruction) and the crossvigil is performed with the Beati, 5 together with the part [of the Psalms] which follows . . . . . The evening Psalms of prayer he performs in the middle of the day, with the Beati, and afterwards he recites his Psalms of prayer at the office. He recites, however, three Beati, and a Magnificat with each of them, after the Psalms, a Beati to each fifty. It was not, however, Maelruain that had told him to do this. He had said to Maelruain : "I have heard," said he, "this is the vigil Dublitir practises: the three fifties standing, and a genuflection at the end of every Psalm."

§ 6. Not a drop of beer was drunk in Tallaght in Maelruain's lifetime. When his monks used to go anywhere else, they used not to drink a drop of beer in Tir Cualann, whomsoever they might happen to meet. However, when they went a long distance, in that case they were allowed to drink. Not a morsel of meat was eaten in Tallaght in his lifetime [unless] it were a deer or a wild swine. What meat there was [at Tallaght used to be consumed by] the guests.

Then Dublitir came to Maelruain to urge him to grant his monks relaxation on the three chief feasts, even if it were not allowed after nor before those days. Maelruain replied : "As long as I shall give rules," said he, "and as long as my injunctions are observed in this place, the liquor that causes forgetfulness of God shall not be drunk here." "Well," said Dublitir, "my monks

<sup>&</sup>lt;sup>1</sup> The words in brackets are written in top margin <sup>2</sup> Read asrubartsom <sup>3</sup> Read ce nolústis

dóib dáig bed glana chenai. Bes biaid imm*urgo* láad muindt*ir*isiu ní nodglanai tene brathai

§ 7. Bói alaili espscop dandéis<sup>1</sup> i findglais caoncomrac a ainm is hesim ba hanmeharai do dublitir. Doloddursom láa inddís asind gurt riasna brathrib tarsa ceim isind faichti Bui alaili cail7ech doim oc ernaide duiblittri isind faichti. Do guide dosom conatallad hillis callech Tromde iarum robúi frisim ind chaillech oc atach dé co mór Colláa thais tra ol sesem forraib ammarthan do gnuis. Lasodoin fochedoir slechtais caoncomrace dochum láir Cid so ol duiblitir 15 hé. is gniom mór forrórpart cáonchomrae<sup>2</sup> caoiniud na tróge. Slechdaissom iarom statim. Do riarsu ind ém ol duiblitir [345] ISsí mo riarsa ol caonchomrac a dulsi isind les caillech 7 lulgach 7 dechelt do thabairt di. Rochrúfemne<sup>3</sup> immurgu ifus ind pennit bes chóir fortsu bed cet ol dublittir.

§ 8. Canith tra maoldithruib etir cach<sup>4</sup> salm deni trib cáocad Sancte michaol ora 25 pro nobis. Sancta maria ora pro nobis. acus ind náob asa feil bís for ind láo. O roscithet celebrad iarmergi is and canith maoldithruib Celebra iuda 7 shall drink it, and they shall be in Heaven along with thine." "Anyone of my monks that shall hearken to me," said Maelruain, "and keep my Rule, shall not need to be cleansed by the fire of Doomsday, nor to come to judgment, because they shall be clean already. Thy monks, however, shall perchance have somewhat for the fire of Doom to cleanse."

§ 7. There was a certain bishop of the

5 Deisi at Findglas, named Cainchomrae: he was Dublitir's confessor. One day the two came in front of the brethren out of the garden over the stile into the field. There was a certain poor

10 old woman waiting for Dublitir in the field to pray him to let her sleep in the nuns' hostel. Presently the old woman wearied him with her loud praying to God. "Be off with you

15 then!" said he; "misfortune take your face!" Instantly thereupon Cainchomrac bowed himself to the ground. "What is this?" said Dublitir. "Alas! it is a dreadful deed thou hast com-

20 mitted," said Cainchomrac, "to revile the poor old woman." Then he bowed himself statim. "Thine award therefor?" said Dublitir. "This is my award," said Cainchomrac, "that she go into the women's hostel, and be given a milch cow and a cloak. Moreover, we will settle here and now the penance that is meet for thee." "It shall be done," said Dublitir.

§ 8. Now Maeldithruib sings between every two psalms of the hundred and fifty Sancte Michael, ora pro nobis, Sancta Maria, ora pro nobis, adding the saint whose feast falls on the day. When the office of nocturns is over, then

<sup>1</sup> dona deisibh Franc. <sup>2</sup> Read ol cáonchomrae <sup>3</sup> Read rocruthfemni <sup>4</sup> Supply dá

cantemus 7 auis aue 7 reliqua 7 ymnum dicat iarum i crosfigeill son. Biad iarmergi iarum 7 magnificat lee. Bíad prainddigi immurgu canir magnificat 7 vmnum 7 unitas Lasuidi 7 ego uero orationem 7 reliqua Canir dano biad fri aitherruch aidchi lúoin Cantir dano salm aurnaigti aidei ndomnaich 7 aidehi lúoin im espartan." Fogní dano ailli mési 7 altugud laissom aidchi lúoin. 10 ISsed canir leisim fochetoir iar praind auis aue for lex inda diaid oróit Columbai sancte súme nos in gremio. caritatis tutela tuze sit nobis inda diadsin A stefan dommairi sén lat cend 15 mo cridi ar chuidachaib báis a breó náob sáor teglach mo trebi. nipá pene na régi 7 reliqua send<sup>1</sup> iarum.

§ 9. Nech loingis ríasind trath cóir troscud ind nó bith for usciu ocus 7 20 bargin ind aidchi dara heisi.

§ 10. Niconromolastar máolrúoin dano cotsechd fri sceola.<sup>2</sup> Cornan alaili cuislendach robói ind deisciurt lagen os hé anchore. Cornan glindi (.i. esa) leosom 25 fer corrath. Doberdis audpartai dosom o máolrúoin illi dixit ailiquando contra falmilam maoiliruoin [35<sup>a</sup>] Ingé<sup>3</sup> ropad limsa ol sésim adpand do seinm don cleiriuch. ISsed iarum asrubart maolrúoin aprit si fri cornan Na cluasasa nicontairbertar fri ceolu talman co tairbertar fri ceolai nime

Maeldithruib sings Celebra Juda and Cantemus and Averte faciem, and so forth, and thereafter Hymnum dicat, this last in a cross-vigil. Then the Beati of nocturns, and along with it the Magnificat. As to the Beati of the refectory, however, the Magnificat and Hymnum and Unitas are sung with it, and Eqo uero orationem, and so forth. But on Sunday night the Beati is sung twice over. The Psalms of prayer are sung on Saturday night and Sunday night at vespers. It is also his custom to recite on Sunday nights a table grace and thanksgiving. Immediately after dinner he sings Averte faciem to a chant; after it a prayer, Columba sancte, sume nos in gremio. Caritatis tutela tuae sit nobis. After that, O Stephen, help me! guard with thy head my heart against the snares of death ! O holy fire, save the household of my dwelling ! Let there be no pains nor torments, et reliqua. Then he crosses himself.

§ 9. If anyone eats before the proper hour, a fast is the penalty for it, or to be put on bread and water the next evening.

§ 10. Also Maclruain did not approve of listening to music. There was a certain piper, Cornan, who lived in Descert Lagen, and he was an anchorite. They called him Cornan of the Glen (that is, of Glen Essa), a man of grace. Presents used to be sent to him from Maelruain. He said once to Maelruain's monks, "I would crave a boon," said he, "to play a tune to the cleric." Then Maelruain made answer, "Say to Cornan," said he, "these ears are not lent to earthly music that they may be lent to the music of Heaven."

g 11. Aos aith	rigi tra	ındi	chetamus	35	§ 11.	Now	as	to	penitents :	first
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<sup>1</sup> Read sénaid (Plummer) <sup>2</sup> Read ceóla <sup>3</sup> Read perhaps itge R.I.A. PROC., VOL. XXIX., SECT. C. [19]

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bíte fri tnúith 7 adellad ilsétchi 7 duamberar cland .uii. bliad*na* dóib oc pendaind **IN**dhí da*no* doeismet fuili 7 marbthai duine .uii. mbliad*na* doib ind dúrpendid

§ 12. ISsed rochualai laisim cid indhí nad caodet<sup>1</sup> feoil dogres dogníad pars isind chaise de feoil fre terci 7 gorti do teemung isind bliadain. ISsed rochualai laisim. ISed fogníd i tír da 10 glas indtan rombúi ind riaguil and. asenad uli amail notreigtis addurtaig medón láoi dia caise dochum na chuchdiri dóib fochetoir co ndenad cách díob and pars de feoil fri foimtin terci no bochde 15 in ando ar mani thuaslaicea isind chaise nipo assa doib iarum cosin caisee naili post andum

§13. Luss bongar ind domnuch nó braisech nó arán fonither nó mérai nó enoi bongar dia domnaich ní fogní leisim a cathim na ráod sin nach lasna firelerchiu.

§ 14. indtí do áos tuatha (no e) arfaom anmcairdini a chongbail dó ab uxore 25 sua in his tribus noctibus .i. aidchi dardáoin aidchi sathairn 7 aidchi ndomnaich. Cid aidchi lúoin ma dorona Accus indtan mbís galar míostai for bandscal dlegar do neuch a chongmail 30 uadi iar nanmchardini petir ind libris clementis

§ 15. Epscuip dano 7 dúini sruithi doberad súiri figli is coir [35<sup>b</sup>] a denam airriu. ma beith láa sechdair corgus 7 35 those that are given to lust, and that frequent various mates and have children born to them, seven years of penance for them. Also those that shed blood and commit homicide, seven years' strict penance for them.

§ 12. This I have heard from him: even those who do not eat flesh regularly take a particle of flesh at Easter to guard against scarcity and hunger

o occurring in the course of the year. This I have heard from him; this was the practice at Tir da Glas when the Rule was there: the whole congregation, when they left the oratory

15 at noon on Easter Day, used to go straight to the kitchen that each of them might take a particle of flesh there, as a precaution against scarcity or poverty during the year; for unless a man relaxes at Easter, it would not be easy for them to do so afterwards until the next Easter a year later.

§ 13. A herb that is cut on Sunday, or kale that is cooked, or bread that is baked, or blackberries or nuts that are plucked on a Sunday, it is not his practice, nor the practice of true clerics, to eat these things.

§ 14. If one of the laity accepts
spiritual direction, he is to keep himself from his wife on these three nights, Wednesday night, Friday night, and Saturday night. As to Sunday night, he is to do so if he can. And when a woman
so is in her monthly sickness, a man ought

to keep away from her according to the ghostly counsel of Peter *in libris Clementinis*.

§ 15. When bishops and elders grant exemption from vigils, it is right that is this should be done for their sake,

<sup>1</sup> Read chaithet

ma beith féil sruith. Manip illocthiu choir condesar int súiri figli. Cé att maither hí fíad chách dogní nech inda chubacuil iarum **N**icon choir etir laisim do nach cleriuch **T**uaslucud neich roortigsetar sruithi

§ 16. IA rmoracht maoldíthruib do máolrúoin dus imbad lór cáocai do gabail ma thecmaised forcetal indarrad. Asrubart máolrúoin nibu móo dan lais 10 arrobúi isind tsaltir nuli. IS hí immurco foropir cáich lindi indsin. Fer immurgu indorsa na serre 7 na susti 7 na forchae 7 ind claid. issi foropair caich díob na trí cáoca. Ní théid do méis ol 15 sesem nech díob co roglea dó a foropoir indhí sin

§ 17. **IS**sed rochualai máolrúoin la sruthi di dérgu ind tíri is diultach pattraic ind nim 7 inda hirsi ind erind 20 nach oen déraich a tír *acht* is<sup>1</sup> airthiur inda iarthur 7 asa tuaisciurt inda deiscert.

§ 18. Ní fil ní dogné dune dar cend indtí adbail nad cobair dó et*ir* figill 25 7 abstanit 7 gabail necnairci 7 almsanæ 7 bend*achtæ menci* Bliadain lán dano do moedoc a muindt*ir* uli for us*ciu* 7 barg*in* ar tuaslucud anmæ brandaib m*ai*c echach filii pro mortuis parentibus 30 debent poénitere. 7 cetera.

if it should be a day outside Lent, or if it be the feast of a saint [during Lent], and if it be not in order to shirk due observance that the exemption is sought. Although the performance of the vigil in public be remitted, the person concerned has to perform it in his own cubicle afterwards. He does not hold it right for any cleric to excuse any duty which his seniors have imposed.

§ 16. Maeldithruib asked Maelruain whether it were enough to recite fifty psalms, if there chanced to be instruction along with them? Maelruain replied that he considered the whole contents of the Psalter not too much of a task. "This, indeed, is what we consider to be the additional labour of each man. There is, indeed, at this moment [among us] a man for the sickle, for the flail, for the measuring-rod, and for the ditch; but the additional labour of each of them is the Three Fifties. None of them," said he, "goes to table till that man's special business be finished."

§ 17. This Maelruain heard the elders say of the desertion of the land : "Any one who deserts his country, except to go from the east to the west, and from the north to the south, is a denier of Patrick in Heaven and of the Faith in Erin."

§ 18. There is nothing that a man does on behalf of one that dies that does not help him, whether it be vigil or abstinence, or reciting intercessory prayers or almsgiving, or frequent benediction. Moedoc and all his monks were a full year on bread and water to obtain the release of the soul of

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§ 19. IN gen ind rig isna tirib thair adodpart ferand do fursu IS hed asbertsi fri fursa. Céta indas fir ol sisi. Cumme olsesim 7 sengobi cona indeuin fora muin. Indeuin erábid ol sisi. Fos oc etli olsesim [36ª] Cesc acus ma doberad dia deid cepp i clandta do indeuin ind ainfedea oca Ba dóig ém olsesim. IS iarum adopartsi dó ind maigin imbui.

§ 20. ISsed is choir lais dano inda sacairt doellad ceith dichrai a ndaithrigi arna tiagsad<sup>1</sup> fo graid nepscuip. Ar is hé gland<sup>2</sup> lousom tairmtechdaich ind graid sacaird dul fo grad nepcoip.

§ 21. ISsed dano as maith laisim indtí dogní ní do maith fria menmain fadesin ariondgel7a 7 arindbó neoch gabti.3 Fobithin ní mór tolnathar di día ind digní neuch fria menmain fadesin IS sed asbert mocolmóce ua lítan do bith fúr iond rétai sin Dolluid alaili túati do freemure anmchardi dosom. Cindas ám ol mocholmóc do reimisiu ind hí lanamnus atái béus Niconed olsesim. 25 attaad teora bliadna and. Niconcomracamar dioblionaib Cesc ind derbgelsid ol mocolmóc / Nató.1 sesom4 / Tune dixit mocholmocc. Ba rofattai ind re sin do scarad fri diabul 7 do nephtuidechd co dia. Ar is and dothaod som im muindterus ndé intan asindgel7ai.

Brandub mac Echach. Sons ought to do penance for the souls of their departed parents *et cætera*.

§ 19. The daughter of the king in the eastern country bestowed land on Fursa. She said to Fursa, "What manner of man art thou?" said she. "Like an old smith," said he, "with

his anvil on his shoulder." "The anvil of devotion?" said she. "Perseverance in holiness," said he. "A question!" [said she], "if God should

10 give thee a block where thine anvil might be planted, wouldst thou abide there?" "It would be likely, indeed," said he. Then she bestowed on him the spot where he was.

§ 20. He considers that priests who go astray, however fervent their penitence may be, should not be allowed to enter episcopal orders. For they consider that to enter episcopal orders is a purification for one who transgresses the priestly orders.

§21. He thinks it well that if a man makes a resolution to do anything good, he should openly vow and proclaim whatever resolution he has taken. Because 20 what a man does merely in intention is not greatly pleasing to God. This is what Mocholmoc úa Litan said of the continual intending to do a thing. A certain layman came to ask him for ghostly counsel. "What sort of life dost thou lead?" said Mocholmoc : "Art thou still in the married state ?" "Nay, said he, "it is three years since we two had intercourse." "A question : have ye taken a vow ?" said Mocholmoc. "No," 30 said he. Then said Mocholmoc : "That is too long a time to part from the

§ 22. Feil sruith docuiridar echdar corgus for sathurn amail chaindech indorsai. Atcondaircsom ind figeill na nóine hi sathurn do dílgud i tamlacti do chaindech Nifacai<sup>1</sup> immurgo máoldíthruib túaslucud for selind nimbe. La muindtir máolrúoin hisind aidchi domnuich arái na feli caindich. IMbom[36<sup>b</sup>]mannaib arberad bith ind lítain a cuid uli

§ 23. **IS** lór la fairind im chaingin ind anmchairdini ma doradad a coibsin namá cenis pendid iarum ní moladar som sin. IS maith immurgo lais do neuch doinchoisc a l7essai dóib cení 15 freemaire coibsina Issed dorigni helair indroet som sochaidi hi tús roslá úad uli fo deoig. Fobith adcondaire narbo díchrai ind pendaid leú 7 nombith forcleith leo dano for tabairt a coibsen. 20 Nicon arroet iarum duine etir asenath do anmchairdiu. Arfoemad immurgu aitheomare neich dond áos fuirbti.

§ 24. Ceth máolruoin nipo calad arnadafuimed Nirbo asendad mór 25 accubar laisim  $\operatorname{ceth}$ airitu maoili-IS sed asbertsom didiu ind díthraib. raibi athcomarc lat iar do chúl ria tudechd húc. Τó ol máoldithruib Ceth ind táos dánae ol máolrúin in 30

Devil without coming to God. For it is when he makes such a vow that a man comes into membership of God's family."

§ 22. The feast of a saint that falls outside Lent on a Saturday, as, for instance, Cainnech's—he has seen the noonday vigil on Saturday excused
5 in honour of Cainnech in Tallaght. However, Maeldithruib never saw relaxation as to a *seland* of butter granted to Maelruain's monastery on Saturday evening on account of
10 Caindech's feast-day. He used to consume all his portion of porridge in morsels.

§23. Concerning the matter of spiritual direction, some think it sufficient if they have merely made their confession, though they do no penance afterwards. He does not approve of this. He thinks it well, however, that one should show them what is profitable to them, even though he does not ask for confessions. This is what Helair did in the matter : at first he had received many, but he ended by sending them all away, because he saw that their penance was not zealously performed, and also that they concealed their sins when making confession. After that he finally refused to receive anyone at all to spiritual direction. However, he would sometimes allow holy persons to consult him.

§ 24. As for Maelruain he was not stiff in refusing to receive them finally. He had no great desire even to receive Maeldithruib. This is what he said : "Didst thou ask permission of those whom thou didst leave before coming hither?" "Yea," said Maeldithruib.

<sup>&</sup>lt;sup>1</sup> The f is added above the line

gobuid ind tsáoir 7 reliqui ní maith lá cách díob a fer muindtiri do daul connech hailé. Fotroich lethsú ol máoldithruib Tuccusæ lictiguth 7 comarleccud IS iarum slechtois som fo reir máolrúoin Tune dixit maolrúoin. Bliadain aithglantae lindi olsesim. Do trib cethorchait aidei ammain1 for usciu 7 bargin acht loim nais ind domnaichib 7 comarlecud dó lom di mide do chumuse ar usei hisind tsamcorgus nammǽ Fo anmchairdini ectguidi dano robúisom cosin anald ISsed dano asrubart maolroin frissim intan tra rocloither imtecht duini olsesim tene bas and som lat dod loscud bat cuici tési

§ 25. [37<sup>a</sup>] Adbert maoldíthruib fri máolrúin robadar cethtri cridiscél liomsæ de chianaib. Ropa cridiscél dam cedamus a tanic do néblégund a tír do legund 7 do chor súlæ taris. Ropo cridiscél dam dano tech sruithi bet fuirbthium hisind tír co mbeim<sup>2</sup> oca timtirecht na sruithi sin oc tuildem a mbendachtan. Acus cororosind mo saith for tacaldaimsiu acus co toroildind bendachtain do muindtirisiu huli etir indní díob adgladmis 7 nad nacaldmis díob. Atbert ar sruithi fründi fer da crich<sup>3</sup> de bithúr<sup>4</sup> ind rédæ sin ol máolruin. Ernitir dona macaib bethad na cridi scelæ maithi conescomriter doib a fochrici amail forfertis a cridiscelæ nahí sin.

"Even artisans, said Maelruain, the smiths, the wrights, etc., none of them likes a man of his household to go to anyone else." "What thou sayest has been looked to," said Maeldithruib; "I obtained authorization and permission." Then he made submission to the authority of Maelruain. Then said Mael-

ruain: "A year of repurification shalt
thou have among us," said he. "Thrice forty nights shalt thou be on bread and water, save for a sup of milk on Sundays only," and he had permission to mix a cup of whey in the water in the

15 summer-Lent only. Now till that time he had been under the spiritual direction of Echtguide.

Now this is what Maelruain said to him: "When thou hearest of a man's decease," said he, "then [say to thyself that] the fire thou most dreadest to burn thee, to it shalt thou go."

§ 25. Maeldithruib said to Maelruain: "I have long had four darling
20 wishes. My first wish was to read and to cast my eyes over whatever sacred reading had come into the country. Then it was a darling wish of mine, wherever there is the household of
25 saintly men that are holiest in this country, to be busied in attending on those saintly persons and earning their blessing. And [my next wish was] that I might attain to have my fill of

30 discourse with thee; and [the last was] that I might earn the blessing of thy folk here, both those of them that we should discourse with and those we should not." "Our saintly friend,
35 Fer da Chrich, said to us, speaking of

<sup>·</sup> Should come after domnaichib

<sup>&</sup>lt;sup>3</sup> Read ar sruith .i. fer dá chrích frinni

<sup>&</sup>lt;sup>2</sup> Read co mbeinn

<sup>&</sup>lt;sup>4</sup> Read bithfúr

§ 26. Iarmor*acht* iarom maoldith*ruib* dosom dús imbat imarcidi laissim fíach naidei lúoin do tabairt isind sathurn fobíthin ol máoldíth*ruib* is becc rand áos túate 7 lucht na sencheld mór ucut. accus dia cloadar som indí sin do denam dúini isind lúaon<sup>1</sup> ní fil ní de nach tairmtechd na dénat som isin domnuch **C**otarleic iarum máolrúaoin dosom hi<sup>2</sup> tabairt hisin tsathurn.

§ 27. Ord bertha día mís ind dardaoin dognitir mani rostir isind dardaoin dognither día háoine dídine no satharn. Mani<sup>3</sup> téis immurgu tar domnuch ní bertar co tí a ord berti iterum día míos 15 ised indsin tucsam o máolrúaoin

§ 28. IMman michel laisim ró<sup>4</sup> codlad 7 immun maire matin. Cuaird comgi michíl 7 cuaird comgi muiri a nainm laisim icen nale.<sup>5</sup> IMman michíl 20 iarum laisim for bíat 7 ymnum dícat medon láoi día domnuich IMman muiri immurgo forsind bíait aidchi lúaoin IS head doleici cét slechtain crossfigeld [37<sup>b</sup>] fri bíat 7 ymnum dícat 7 unita nó cantemus Na crossfigeil7 dognídsom<sup>6</sup> immon michil lasin crosfigillso immon muiri lasind crosfigell naile immasech. continual contriving of that same thing," said Maelruain, "Let the good desires of their hearts be granted to the sons of life, so that their rewards may be paid them according as their desires should bring about those results."

§ 26. Thereafter Maeldithruib inquired of him, whether he held it allowable to perform Sunday night's penance on the Saturday, "because,"
5 said Maeldithruib, "the laity and the people of the great old churches yonder are of little worth; and if those folk hear that we perform it on the [Sunday night], there is no sort of transgression
10 they will not commit on the Sunday." Then Maelruain gave him leave to perform it on the Saturday.

§ 27. The regular time of tonsure. It is performed once a month on a Thursday: if it be not reached on the Thursday, it is performed on the Friday or Saturday. If, however, it pass the Sunday, there is no tonsuring until the regular time of tonsure comes again that day month. This is what we received from Maelruain.

§ 28. He sings the Hymn to Michael before sleeping, and the Hymn to Mary in the morning. He names them the Invocation of Michael's Protection and the Invocation of Mary's Protection respectively. Afterwards he sings the Hymn to Michael, as well as the Beati and Hymnum dicat, on Sunday at midday. The Hymn to Mary, however, he sings, as well as the Beati, on Sunday evening. This is what he performs a hundred genuflections, [and] a crossvigil with the Beati and Hymnum

<sup>&</sup>lt;sup>1</sup> Read aidchi lúain <sup>2</sup> Read a thabairt

<sup>&</sup>lt;sup>3</sup> Read ma

<sup>&</sup>lt;sup>5</sup> Written icenna with le superscript ; read in céin naili

<sup>&</sup>lt;sup>6</sup> Read dognisom

<sup>\*</sup> Read re

§ 29. An cetharleb*ar* sosceli do aurleg und oc praind co cend bliadnæ lebar cachæ tremsi. Leb*ar* mati isind erruch 7 cetera síc in ordinem

§ 30. Cetheoræ crosfigell laisim. Crosfigell fri biat 7 ymnum dicat imman/irt1 Canid iarum na salmu cosind cáocat ndegenach. Crosfigeld fri biat iterum i foreiund ind eaocaid medonaich sechis cantemus hisuidiu. Crosfigild iarum oc domine probasti frisa cedna sechis imun michíl indd alæ fecht immon muiri a fecht naild crosfigild iarum fadeud frisin .xxx. pater. Biait michil lasim in biad forsa canar immon michil. Bíad muiri laisim in bíat forsa canar immon Muiri Biat becc laisim ind bit forsandene ind crosfigild deirid láoi. uar nád canar unitas no cantemus furri. Canair 20 immurco magnificat furri 7 vmnum dicat. Ni dentar tra eadar dí nodlaic 7 etar di chaise ni tabar fíach aibne and. Ní dentar ceth crosfigill fri himnum dícat im ermergi etar dí nodlaic 7 etar di cháise. Mathidsom dano and salmu aurnaigti do chetal fescur etar dí nodlae. In .xxx. pater canæ<sup>2</sup> som iccrosfigill diúláoi. Gaibthussom eidi ceth etar dé notlaic cení denæ crosfigill friu. Dognisom immurgu ind figild la matain día tairri di notlaic steild 7 dia lúain minchase 7 dogní ind crosfigild fri ymnum dicat im iarmergi aidchi tairridi notlaic steill 7 aidci lúaoin minchase. In biat dano frisa ndene a

dicat and Unitas or Cantenus. The cross-vigils he performs thus: Hymn to Michael with one cross-vigil, Hymn to Mary with the next, and so alternately.

§ 29. The four books of the Gospels are to be read aloud at meal time till the end of the year, a book to every quarter: the book of Matthew in the springquarter, and the rest similarly in their order.

5 § 30. He uses four cross-vigils : a cross-vigil with *Beati* and *Hymnum dicat* at prime; then he sings the Psalms as far as the beginning of the last fifty; next, a cross-vigil with *Beati* again

10 at the end of the middle fifty, that is, Cantemus at this point; then a crossvigil at Domine probasti in the same way: that is, Hymn to Michael one time; Hymn to Mary the next; finally,

15 a cross-vigil at the end [of the Psalms] with the thirty paternosters. He used to call the *Beati* after which the *Hymn* to Michael is sung, "Michael's Beati" and the Beati after which the Hymn

20 to Mary is sung, "Mary's Beati." The Beati, after which he performs the cross-vigil of eventide he calls "little Beati," because neither Unitas nor Cantemus is sung after it. Howbeit, Magnificat and
25 Hymnum dicat are sung after it. Now, the cross-vigil is not performed between the two Christmases, or between the two Easters, and flagellation is not inflicted at that time. Even the cross-vigil

30 with Hymnum dicat at nocturns is not performed between the two Christmases nor between the two Easters. He excuses also at that time the singing of the psalms of prayer at vespers, between
35 the two Christmases. The thirty paternosters he sings at the cross-vigil of even-

<sup>1</sup> Read imm anteirt

<sup>2</sup> Read canaid

figild matin<sup>1</sup> gabtus edi  $[38^{a}]$  etar da soldamain cení deni figild. ISsed fogní laisim andí frisa nden na figlae Canair son ce beith tuaslucud forsind figild acht sailm aurnaigti dolluigter eidi etir di notlaic 7 di chaise im espartain **N**i dligiter<sup>2</sup> immurgu o minchaise co cengigis

§ 31. IS amlaid tra canithsom na salmu. Randaich<sup>3</sup> cach caocad hi 10 cethair. IS hí and cétna gabal lais. Otha beatus corrici domine quis slechtain iarum hisuidiu 7 canit pater1 deus in adiutorium usque Festina ria cach ngabail IS hí in gabail tanaisi otha 15domine quis corici dominus ilduminatio 7 benedicite as dedenach pater iarum. Otha iarum dominus hilluminatio. usque dixi custodiam 7 pater 7 slechtain and. O dixi custodiam iaram co díad pater  $\mathbf{20}$ Otha iarum quid and 7 slechtan. gloriatur.usque té decet 7 pater and 7 slechtan. Othá tế decet usque uoce. Otha uoce corrici misericordias. Othá misericordias corrici diat acht is and sin 25 canith a pater otha domine exaudisti usque inexitu issrael Otha in exitu up<sup>5</sup> in conuertendo Otha in conuertendo

He sings them even between the tide. two Christmases, though he does not perform a cross-vigil with them. However, he performs the vigil at matins the day after Epiphany, and the Monday following Low Sunday, and he performs the cross-vigil with Hymnum dicat at nocturns on the night following Epiphany and on the night of Low Sunday. Also the Beati with which he performs his morning vigil, he sings it between two solemn feast days, even though he does not perform the vigil. This is his practice in regard to the canticle wherewith he performs the vigils: it is sung, though there be a relaxation as to the vigil itself. But as to the psalms of prayer, they are excused between the two Christmases and the two Easters, at vespers. They are not excused, however, from Low Sunday to Pentecost.

§ 31. He sings the psalms as follows : he divides each fifty into four : the first division he makes is from Beatus to Domine quis: then a genuflection at this point, and he sings a pater [and] Dominus in adjutorium as far as Festina before each division. The second division, from Domine quis to Dominus illuminatio, and the last Benedicite and a pater thereafter. Then from Dominus illuminatio to Dixi custodiam, and here a pater and genuflection. From Dixi custodiam then to the end: here a pater and genuflection. Then from Quid gloriaris to I'e decet, and here a pater and genuflection. From Te decet to Voce. From Voce to Misericordias. From Misericordias to the end; but it is there he sings his pater. From Domine exaudisti to In exitu Israel. From In exitu

<sup>&</sup>lt;sup>1</sup> Read maitne <sup>2</sup> Read diigatar <sup>3</sup> Read rannaid <sup>4</sup> Read pater et <sup>5</sup> Read usque R.I.A. PROC., VOL. XXIX., SECT. C. [20]

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usque domine probasti<sup>1</sup> usque diat. Magnificat isand gabtisom iarmbiad statim, ni iarsalmaib cantici m<sup>2</sup> Cach<sup>3</sup> gabal traissuidiu araile hisesam isamlaid canitir in pater gebesim i forciund cacha gabala is dia forciullsom ón

§ 32. Bui araile caillech ocaild uatne. Duine corrath dé niconeirged<sup>4</sup> cen pater Niconsesed cen pater do cantain. dochetul. Antan atraiged som<sup>5</sup> iarum do gabail na gabail nogebed pater statim iar neirgi 7 is iarum tindscanad a gabail 0 roscithet iarum ind gabail hísin nósuided 7 nogebed pater statim iarsuidiu 7 iarum toinscanad ingabail di cétul ina suidiu [38<sup>b</sup>] IS de tra do forgillsom ind pater hi forciund cacha IS bés laissim dogres pater gabali. do chetul nach tan atraig 7 pater nach dand suides.

§ 33. ISsed rochualæ ol máol díthruið Fri máolrúaoin isí figeld fodgníod la duiblitir na tri cáoca inda sesam 7 slechtain iar cech salm. Ní apur frit ol maelruaoin ní fodgní lind. Occus ind chantaici cindus nodngebtar ol máoldithruið ninsa ol maolruaoin atat tri altai leusom for ind gabail .i. a cétul uli fadeoid iar ngletin na salm. Nó a tri inda degaid cach caocait. Nó a cantaic ind degaid cecha gabalæ **IS**sed ón fogní la maoldithruið. Israel to In convertendo. From In convertendo to Domine probasti. [From Domine probasti] to the end. The place where he sings the Magnificat is immediately after the Beati, not after the psalms.

Every [other] division is sung sitting, the next standing. The pater noster which he recites at the end of each division, this is to mark the divisions.

§ 32. There was a certain nun from Caill Uaitne endowed with the grace of God. She would not rise without singing a pater. She would not sit down 10 without chanting a pater. When she rose to recite the divisions [of the psalms | she used to recite a pater immediately after rising, and then she would 15 begin the division. Then when that division was finished she would sit down and she would recite a pater immediately after sitting down, and then she would begin to recite the [next] division sitting down. It is by her example that he 20 appoints [?] the *pater* at the end of each division. It is his constant usage to sing a pater whenever he rises, and a pater whenever he sits down.

§ 33. "I have heard," said Maeldithruib to Maelruain, "that the vigil which Dublitir practised was as follows: the three fifties standing and a genuflection after each psalm." "I 25do not tell thee [to do so]," says Maelruain, "such is not our practice." "And the Canticles, how shall they be sung?" said Maeldithruib. "Not hard to say," said Maelruain : "they may 30 be used in three ways after a division [of the psalms]: that is, either the whole number may be sung at the end after finishing the psalms; or three of

<sup>1</sup> Supply Otha domine probasti	<sup>2</sup> A gloss	<sup>3</sup> Read cach 'la	4 Read eirsed	<sup>5</sup> Read si

§ 34. Búi alaile anchore i cluain úa duban hé. Mór iarum a sáothar. da cet slechtain matin ised dogníd 7 cét cacha tratha 7 cet im ermergi secht cet ule. Adfes do maolrúaoin indní Asbir 5 mo bríathar ol maólrúaoin. Beith ré dosom ríanecaib 7 ní dognéa cid oenslechtain. Doronad ón rogabtha a cossæ cona dernæ figild rée mór ria necaib lasind forcrid dorigni día naild. 10

§ 35. Muim doberthar o thuatib is faitciu laissom a nemfairitiu. Arisfemat araile do fodail leusom do bochtain (nó b) iarum Fobithin arna fodlat ind tuati do bochtaib. Ata lasna tuati iarum beith lór dóib do ascnam nime acht doratat ní dona hanchairtib<sup>1</sup> 7 bidsom iarum fria toil. IS ferr a nemgabail iarum acht ontí bass formbthi nótí<sup>2</sup> addaim anmeartine 20

§ 36. Día fercaichther tra fria nech cid sechtair eid frit muindtir ma fosnather trist do tabirt for nech nó aithis troscud ind. issed conmidir máolruaoin do máoldithruib 7 dígde ind caich ro cradis manip muindter accus eid fer muindtiri mad forbtiu 7 mat cias<sup>3</sup> a maith riasind aurd [39<sup>a</sup>] dara gaib tresind dochradsa fris is ferr a dígde them after each fifty; or one canticle after each division."

Now this is Maeldithruib's practice.

§ 34. There was a certain anchorite at Cluain ua Duban. Great was his labour: two hundred genuflections he used to perform at matins and a hundred every canonical hour, a hundred at 5 nocturns-seven hundred in all. This was told to Maelruain. "By my word," says Maelruain, "a time will come to him before his death when he shall not perform a single genuflection." This came to pass: his feet were seized so that he could not perform a vigil for a long time before his death, on account of the excessive amount he had performed in other days.

§ 35. Wealth (?) that is given by layfolk, he is careful not to accept. Some accept such things to be distributed by them to the poor thereafter: because the lay folk do not distribute to the poor. The consequence is that the lay folk deem it enough to win a place in heaven, if only they have given something to their confessors, and after that they think it will be at their pleasure. It is better then not to accept anything, save from one that is holy, or from one that submits to spiritual direction.

§ 36. Now if thou art angry with anyone, whether a stranger or one of thine own monks, if thou art wroth so as to lay a curse on anyone, or revile him, fasting is imposed for it: (this is what Maelruain prescribed to Maeldithruib); and to beseech pardon of everyone thou hast offended, if he be not one of thy monks; or, if it be one of thy monks, if he be a holy man, and if his virtue was reported before [he reached]

<sup>&</sup>lt;sup>1</sup> Read dia nanmchartib

 $<sup>^{\</sup>circ}\ Read$  nó óndí

§ 37. Gille dano nó timtirid ní hecen aithrigi disuidiu arnachoarda eislis acht troscud deit fadéin tantum. Manataigter ind gille lasna bía omun dé nipa mor do brig lais 7 dotberae eislis dianderne aithrigi dó. IArfuacra a chore<sup>1</sup> dó issed as cóir anord<sup>2</sup> dipendit dosom 7 arnachadfercaigthersu etir siue site siue insite **M**anatfercaichther frit gilla dano 7 nibí trist na hathis cet moailli<sup>3</sup> fort laim primitus dé abaind. Manitcoiscea son bith for usci 7 bargin ind aidchi iar fercugud

§ 38. Mad doairli sale dano ind laim oc praind imberar usei leosom iarum iar comrue ind crontsale frisind laim.

§ 39. Fri saltair do géss nogebad mac bethad a salmu **IS**sed asberedsom desuidiu atat tri foglaide oc mo fogail mo suil 7 mo tengæ 7 mo menme dosnaircelæ hule int saltair **IS** sed immurgu asrubart maolrúaoin fri maoldithruib ni lugæ mbis ind menme hisin cheill dia gabail ind tsailm de memur indas cid fri saltair.

§ 40. Ni fogní lasna celiu dé ól neich iar tab*irt* do neoch a fuail. IS sed rochuala la maol dith*ruib* ised fogníd la siadal mæc testa o aird móir ba diching

<sup>1</sup> *Read* chaire (Plummer)

the orders which he transgressed by this ill-behaviour against them, it is better to beseech him.

§ 37. As for a servant or attendant, penitence is not necessary on his account, lest thou increase (?) his carelessness, but only fasting for thyself. If the

- servant who has no fear of God be not in awe of thee, thou wilt not have much hold on him, and he will treat thee negligently if thou show penitence to him. This is what is right, after admonish-
- 10 ing him of his fault, that he should do penance for his misbehaviour, and that thou shouldest not be angry in any way, either consciously or unconsciously. If thou art angry with thy servant, however, and there is no cursing nor reviling, a hundred blows on thy hand in the first place with a scourge. If this do not check thee, then thou shalt put thyself on bread and water for the night after getting angry.

§ 38. Now if spittle falls on a man's
15 hand at meals, their use is to pour water thereupon, after the spittle touches the hand.

§ 39. A "son of life" should always recite his psalms by the psalter. This is what he used to say of this: There
20 are three adversaries busy attacking me, my eye, my tongue, and my thoughts: the psalter restrains them all. Howbeit, this is what Maelruain had said to Maeldithruib: The thought is no less
25 occupied with the meaning when one is reciting the psalm by rote than it is when he is reading it with the psalter.

§ 40. It is not the practice of the Celi De for one to drink anything after making water. This is what I have heard from Maeldithruib. This was the

<sup>3</sup> Read mbuilli

<sup>&</sup>lt;sup>2</sup> Read a anord

aralúsad fer a muindt*ir*i banne iar mbrith a fuail immach **IS** sed dano forógeni la cumine fotai. IS sed dano fogni la clemens mac nuadat ma danetarredsom dagmenme no mesce tre ol cormæ no chingiti medæ inddand dondecmised. Troscud darahesi aidchi arabarach statim.

§ 41. Screpul doberar do gilli no óclig ar comaitecht do neuch o pecad étraid no do mnáoi má doní aithrigi iarum ind 10 gilde [39<sup>b</sup>] nó ind mnaoi<sup>1</sup> don pecad sin ised is imarcidi laiseom den scribul sin a thabirt a loge do bochtaib. Ni aurtet ní laisim cetamus a tabirt iterum dondhí hua taberr riam Ni hidan dano 15 lais dondhí da taberr a thaechtad quod im pretium peccati datur.

§ 42. Ní haurchail dano laisim eid dognether ess usei dondhí bís for useiu 7 bargin. IS sed atbert máolruaoin fri 20 maoldithruib. Bliadain glantai lindi so ol sesem. Na tri .xl. aidchi do bith for useiu 7 bargin. lom medcusei ind domnaich ma tecme. Rocomarleced immurgu do loim mide do chumase ar 25 useiu isind tsamchorgus.

§ 43. IS sed fogní leusom indmat lam iar nimbirt aibne cid do aurlégund soscele teis neuch iar tab*i*rt feich cid do cucin nó do nach ráod aliu indaim a 30 lama.

§ 44. IS sed tucsom dano o maol-

practice of Siadal mac Testa of Ard Mor:—It was forbidden (?) that anyone of his monastery should drink a drop after passing his water. This had
been also the practice of Cumine Fota: this is also the practice of Clemens mac Nuadat—if he were overtaken by jollity or tipsiness through drinking beer or a goblet of mead, when this happened to him, he had to fast the next night immediately thereafter.

§ 41. A groat that is given to a lad or young man for accompanying someone in a sin of lust, or to a woman; if the lad or the woman do penance thereafter for that sin, he considers it proper in regard to that groat to give their price to the poor. He does not hold it admissible, however, to give it back to the person by whom it was given in the first instance. But he does not consider it clean dealing for the person to whom it is given to keep possession of it, because it is given as the price of sin.

§ 42. He does not consider it forbidden that an ewer of water should be provided for one who is on bread and water. This is what Maelruain said to Maeldithruib: "A year of cleansing with us here," said he, "to be on bread and water for the thrice forty nights: a sip of whey-water on Sunday, if it chance to be ready." However, it was permitted him to mix a sip of whey with water in summer-lent.

§ 43. This is their practice: to wash their hands after plying the scourge, whether it be to read aloud the gospels that a man goes after doing penance, or whether it be to the kitchen, or to any other matter—he washes his hands.

§ 44. This we received from Mael-

ruaoin. Aithrus ind anmcharat dia bliadna beus mád hi céin beith. Cid mencui immurgo maith ind occus is cet.

§ 45. Ni fogní lasna celiu dé ni di nach ret do denam iar nesp*ar*tain domnaich. Fecht robúi damsæ domchaomnacuir airisem hi fothrucad sel bec iar nesp*ar*tain domnaich. Asrub*ar*tsom buith cen anland de saill na him aidchi ndomnaig 7 dia domnaich t*ar*a heis.

§ 46. IS sed asrubartsa<sup>1</sup> fri nech bad craibdech conabat mór fair deithitiu na coilnidi manip fri toil dé dosmerat. IS sed atrubart maolrúin fri sechnasach espiscopus ochild golpin. Condatecht a mathair cucisom aggaire 7 tamen noluit auerti a pecetis. Iarmfacht iarum sechnasach do máolrúaoin. Cindus nombíad etir an déde sin **IS** sed asbertsom cenis tucasu chucud dochom betad hisi ni rucasi tussu ad  $[40^{\circ}]$  mortem si uero conuersa fuerit debes curare eam **M**ad fir doim tra nech bess coldnaide dlegair airchisecht de amail cech doim

§ 47. Teoræ briathra forfaccaib diarmaid app iæ la cartach nespiscopus. Fit foss figell .i. ní bé erchailiud lat. is hé so fit nocaithiub dogres. Bíat i fus cen scucht. **IS** si figell indso dogen

§ 48. IS sed fogníd la máolrúin intí día maccleirchiu forsa mbeith ítu mór comarlecud digi usei no midee dó o trath teirt co hiarmergi **A**ccus dogníd trichoit pater hi crosfigild tara héisi. ruain: To consult his confessor once a year regularly, if he be at a distance: if he be nearer, however, it is allowable to consult him oftener.

§ 45. It is not the practice of the Celi De to do anything whatever after evensong on Saturday. Once it happened to me that I chanced to stay in the bath a while after evensong on Saturday.
10 He told me to go without condiment of bacon or butter on the Saturday evening and the Sunday following.

§ 46. This is what he said to one that was devout : that concern for carnal things should not weigh on him, unless they led him to oppose the will of God.

15 This is what Maelruain said to Sechnasach the bishop from Cill Gulbin. His mother besought him to take care of her, and yet would not turn from her sins. Then Sechnasach asked Maelruain, 90 "How shall I at all manage these two things?" This is what he said: "Though thou bring her not to thee to life, let her not carry thee to death: but if she be converted, thou art 25 bound to take care of her." If anyone that is carnal be really poor, he deserves pity, as every poor man doth.

§ 47. Three words Diarmaid, abbot of Iona, left with bishop Carthach: pittance, perseverance, cross-vigil: that is, do not make a resolution—" This is the pittance I will always eat. I will say the *Beati* perseveringly without desisting. This is the vigil I will perform."

§ 48. This was Maelruain's practice: any of the clerical students who suffered from great thirst had permission to take a drink of water or whey from the hour of tierce to that of nocturns, lest

<sup>1</sup> *Read* asrubartsom

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Arnahimfoilnged imned dó ind roítu. Othá immurgo iarmergi co teirt ní comleced<sup>1</sup> dig do neuch cid fri geld bais nobeth. 'Aos labor tra 7 senoire nistimsaich greim riaglad do beith gen ní amail áos sonairt ISsed rochuala2 maoldithruib ised fogeni ildius mór Aos cacha tratha indtí bád rolabur ní do denam do im teirt arale i medon láoi Araile im nóin Araile im íarnóin amail 10 nobíd lobre caich. Gilde 7 ócláoich dobered a colaind do máolruaoin doluigti troscad dóib indtand nombid cin troiscid leo. Feli napstal<sup>3</sup> i samchorgos ni aurchoil som4 inn figill nach5 15 do logud indib.

§ 49. Teclaim ubald dano dia domnaich no gluasacht oen ubuild díob de lar ní fogni leusom **IN**dtí dano nad caithe feóil ised is imairchidi laisim 20 conaralúsa<sup>6</sup> a henbraithe **D**enam seillne dano ind domnuch ni cóir laisim acht a ndenam ríam.

§ 50. Reim aósa lanamnasa forsambí anmcharti. O anteirt día luaoin co 25 matin dia cetaoin [40<sup>b</sup>] Suiri 7 dilmaine dóib in his diebus duobus 7 noctibus etir praind 7 lanamnais Abstinit foraib iarum fri feoil 7 lánamnas. O matin día cetaoin co matin día 30 dardáoin Suire dóib iterum o matin dia dardáoin co matin día aoine. A

excessive thirst should cause him suffering; and he was to perform thirty paters in cross-vigil thereafter. From nocturns to tierce, however, none was permitted to take a drink though he were at the point of death. As to the infirm and old, however, the rigour of the rule does not bind them to go without any thing, like healthy persons. This is what I have heard from Maeldithruib: this was the practice in Lismore :- Different folk for different hours: if a man were very infirm, he was to do some duty at tierce, another man at midday, another at none, and another in the afternoon, according to each man's infirmity. A lad or youth that gave up his body to Maelruain, such would be excused from fasting when they had made themselves liable to fast. The feasts of the apostles in summerlent: he does not forbid the vigil to be relaxed on these days.

§ 49. Now gathering of apples on a Sunday or lifting a single apple from the ground is not allowed among them. In the case of one who does not eat meat he thinks it proper that he should not be allowed to drink the broth thereof. He does not think it right to prepare a *selann* on a Sunday, but that it should be done beforehand.

§ 50. The course prescribed to a wedded couple who are under spiritual direction. From prime on Monday to matins on Wednesday, for these two days and nights they are given exemption and licence both for meals and conjugal intercourse. After that time abstinence is imposed on them both from flesh and intercourse, from matins

<sup>1</sup> Read comairleced	<sup>2</sup> Supply la	<sup>3</sup> Read na napstal
<sup>4</sup> Read ní aurchoil laisseom	<sup>5</sup> Something lost here	<sup>6</sup> Read coná rolúsom

congmail iterum doib o lanamnas o matin dia aoine co matin dia luaoin .i. tribus diebus 7 noctibus in separatis Apstinait praindi inciunio foraib cum nocte scanti 7 in sabato cum nocte dominica die Suire dóib ar prainn tantum dia domnuich 7 aidchi luaoin.

§ 51. Intí dano arbir bith oss nallaid no muc naldaich 7 nad caith aliam carnem in pascha non manducat aliam carnem usque ad aliud pascha et nisi necesseitas aliqua coegerit illum. Ar ní ar feoil adrime indísin Mani chaithea dano feoil 7 saill in pascha cid gortai no genti dodnimaircet do chaithim feolæ 7 nimbe anaild arbera bith is ferr laisim 7 is inildiu dó daul do ecaib ar comaldnad a ingill inddás tuaslucud for feóil 7 is ar martrai atrimther d6 ced donecmai bás ind ar comalnad androtairrngert do anmeharait. Ar níco dlegar tuaslucud for feoil cid isind chaise conidtoslicea ind anmchara 7 is do laim ind anmcharat is cóir laisim cith airitiu in tsacrafaic 7 ised bud coir laisim combed 25 de laim anmcharat arfemad sacrafaic

§ 52. **IS**sed as chóir laisim i pendit ind áosæ galrich de bithbúr praindea. Beomarbad<sup>1</sup> forruib cachlacein arnara<sup>2</sup> fochand báis dóib in sircharcrad 7 ma dorontar ón is cen a fis doibsom .i. a rád fria thimthirid inda timchol doberar seland dóib hi tiuglagin nó for on Wednesday to matins on Thursday. They are given exemption again from matins on Thursday till matins on Friday. They must keep themselves again from intercourse from mating an

again from intercourse from matins on Friday till matins on Monday, that is, they are to live separately for three days and three nights. Abstinence from meals is imposed on them on Friday and the following night, and on Saturday and Saturday night. They are given exemption, for meals only, on Sunday and Sunday night.

§ 51. Now he that eats the flesh of a wild deer or wild swine and who
10 eats no other flesh at Easter, must not eat any other flesh until the Easter following, unless constrained by some necessity (for he does not reckon this as flesh). Now if he does not eat flesh

- 15 and bacon at Easter, even though hunger or heathen constrain him to eat meat, and he has nothing else that he may eat, he thinks it better and safer for him to face death for the sake of ful-
- 20 filling his vow than to relax in regard to meat; and it is reckoned to him as martyrdom if he chance to die for it, to fulfil what he had promised to his confessor. For there ought to be no relaxa-
- 25 tion as to flesh even at Easter, till the confessor grant it; and he thinks it right that it should be from the hand of his confessor that he should receive the sacrament.

§ 52. In the case of penance laid on sickly persons, this is what he thinks right, as to the continual preparing for meals: alternate reviving and mortifying is practised on them, lest the perpetual confinement should cause their death; and this is done, if it can be

<sup>1</sup> Read perhaps beogud 7 marbad (Plummer)

aran acht is móo [41ª] fogní a tabirt dóib isind tiuglagin Fecht robai atconnaire ind tapp robói ind hí ropo ole a mblath inda reclesach . luid som iarum dochum in coci 7 dogeni fadesin ind tiuglagin allae sin dobert trian forcridi de usci ar chuid cach lae sin<sup>2</sup> 7 roberbi ind usee am dechaid<sup>3</sup> a trian sin la bruith 7 doratt enoc de imbim ar chuid cach ae 7 roberbi ar ind usci 7 is 10 iarum dorad min aire is amlaich sin cech día roairgsetar som iarum caomclód a mblatha 7 niconfetadar cid fodruair uar rombi ind fit cetne atcitis cin cumscugud Antan tra dontic aitherriuch blath 7 15 beogud ammarbad cach la sel iarum do ambeogud indtale dia marbad ind cruth sin.

§ 53. Aos trog dano nad ebat amail cach manip mall<sup>4</sup> beti occae 7 dia ndeine 20 galar gabail ara fual mani tiasat immach is deithbir laisim cid comarlecther foraib do daul immach arnarap galar doib gabail foraib acht ropa techtae adlúsat .i. ni argara itid díob. Mad fri roebaidecht 25 immurgo non permittitur ire.

§ 54. **IS** ferr dano lais 7 is inilliu doneoch na rofaomæ coibsena neich mani pendea areir *acht* ní bes etir la neoch do tab*i*rt fair di maith cen airitin a cobsen **30** si quis uero sua peccata alicui confitiatur (vel e) o<sup>5</sup> lanpendait fair nó a indarpæ mani penda.

managed, without their knowledge, by telling his servant privately, "Let a seland be brought to them in their pottage or on bread" (but it is more usual to bring it to them in the pottage). Once it happened that the abbot who was in Iona saw that the recluses had a bad colour. Thereupon he went to the cook and himself made the pottage for that day. He added one-third of water to the daily allowance and boiled the water. When this third had boiled away, he put a lump of butter on each man's allowance, and boiled it on the water, and then put meal over it, and so he did every day. Then they noticed the change in their colour, and knew not what had caused it, since they saw the usual ration unchanged. So when their colour came back and they revived, he continued alternately to mortify and revive them from their dving state after this fashion.

§ 53. Now as to invalids who do not drink like other people, if they do not loiter over it, and if retention of urine causes disease unless they go out, he thinks it reasonable that they should be allowed to go out, lest the constraint upon them should induce disease; always provided that they drink a proper amount, that is, as much as quenches their thirst. If, however, excessive drinking be the object, they are not allowed to go out.

§ 54. Now he thinks it better and safer that one should refuse to receive confessions from anyone, unless he does penance at [the confessor's] bidding; but one should do [the sinner] all the good that lies in one's power, short of receiving his confession : if, however, a

<sup>1</sup> Read choca	<sup>2</sup> Omit	<sup>3</sup> Read amail docóid	<sup>4</sup> Read maill	<sup>5</sup> Read a
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§ 55. Nodlaic stéill ni coir lais berrad na fothruc<sup>1</sup> na scoltad *con*naid nó nach gníomrad ale amail nach dentar dia domnaich. Eductio Christi ex egipto 7 a tabirt dochum tempuil 7 cloud diabul. Celebrad domnaich [41b] indib ni accammar praind indi<sup>2</sup> fri díe

§ 56. IS sed dano is choir la colchin sacrafic do tabirt dond aos bís illobrae fri huar mhbáis acht doratat fretech cech espi Lecsiu immurgo ildeth nde mess for a menmainsom dús ind fircomtúd acus mad ed ón rombeir ind sacrafic sláne doib den chursin. Ni doig immurgu sacrific doatarrachtar3 iterum fri deg- 15 enca<sup>4</sup> iarsin

§ 57. Ni haurcul laisim dano cid arfaomtar ní o lex áos 7 a tabirt detsiu iarum do bochtaib neich forbé lortid do muindtir<sup>5</sup> de fobithin maith<sup>6</sup> leisim bess 20 ni tabrait ní de dena bochtaib.

§ 58. Antand donecmaing aircend praindo 7 suscitatur corpus ad cupidinem ceith mín cid anmín Ni hecoir laisim ind praind sin do adcor forsind comdid ar bruc friss ut dicat aliquis. Doselbi fein tra do praind accus is cretem laisiom nipa menic dogentar fris iarum an eola<sup>7</sup> sin. No digbail neich den

man confesses his sins to some one, full penance must be laid upon him, or he must be banished if he does not do penance.

§ 55. At the Epiphany he does not consider it right to tonsure or wash or split wood or do any other form of work, just as such things are not done on a Sunday. The bringing of Christ out 5 of Egypt and the presentation in the Temple and the defeat of the Devil: on these days Sunday's office is to be said: we never saw dinner in the davtime on those feasts.

§ 56. This is what Colchu approves, to give the sacrament to those that are lying sick at the hour of death, provided 10 they have made a renunciation of every vanity. Leave it, however, to God to judge the mind of such, whether it be true conversion; and if it be so, [be sure that] the sacrament can bring salvation to them in that moment. It is not proper, however, to repeat the sacrament

thereafter in extremis. § 57. He considers it not unlawful that somewhat should be accepted from idle folk, and that thou shouldst afterwards give to the poor anything that is left of it when thine own monks are satisfied, because if it is in the hands

of the idle, they give none of it to the

§ 58. When at the end of a meal the body happens to be roused to lust, slightly or strongly, he considers it not amiss to cast that meal back 25 upon the Lord in displeasure at him, as if one should say "There, keep thy meal for thyself!" and he believes that this trial of him will not often be

<sup>1</sup> Read fothrucud	<sup>2</sup> Read indib	<sup>3</sup> Read do aitherracht	4 Read dedenchu
<sup>5</sup> Read muintire	<sup>6</sup> Read mad	7 Read eolas	

poor.

praind 7 attag nde fris 7 ut ne nos indducas ind temtationem 7 deus in adiutorium usque festina.

§ 59. Aos duanat foibdi<sup>1</sup> a tolæ bes la coibsenugud no imradad tantum no la oitid. Abstinit dedirn doa traothad fobithin is roimmad fola inda cuirp ised adrali. Andand fofeiscren iarum ind fuil is and fofeiscren ind tol 7 an accobar.

§ 60. Malaisi daimindsi Sur laisiom 10 copar a ainm Ropo trom iarum accobar forsind ingin ar ita trian foreraid de accobur in mulieribus sech na firu Conidmidethar som iarom ammod 7 a fit co cend mbliadnæ .i. fit mesraigti som.2 15 [42ª] Doluid iarum cuci som día bliadna 7 cupidinem suam confessa est adhuc permansisse. Bui siom oc huamim ara cind. Sadais iarum ind snathaid fo tri inda dernaind co toltnadar<sup>3</sup> na tri srotha 20 folæ asind laim Is jarum atbertsom is deithbir olse cid ansa don curp hitá a tóla morasa a congbal Dorragab som iarum ind praind iterum. Roboisi dano forsuidiu co cend mbliadna 7 cupido 25 adhuc permansit Sadidsiom dano ind snathat fo tri inda laim isuidiu co tultatar dano na tri srothe fole eisse Dogabsom dano ind praind iterum co cend mbliadna 7 sadais and snathait 30 isuidiu. Nicotolid immurgu bandæ fola essiu isuidiu Is iarum asbert som frie congab tra i fechtsa olseisiom forsind fit sin cot ec

§ 61. Arale cendaigi taithigit<sup>4</sup> hi

made thereafter. Or else, to subtract a part of the meal, and to pray God therewith [and to repeat] "lead us not into temptation," and *Deus in adjutorium* as far as *festina*.

§ 59. Persons whose desires are excited, it may be through hearing confessions, or merely with meditating, or through youth, need strict abstinence to subdue them, because it is excess of blood in their body that is the cause. Afterwards, when the blood fails, then lust and desire fail.

§ 60. Molaise of Daiminis had a sister named Copar. Now desire lay heavy upon the girl, for it is a third part as strong again in women as in men. Then he regulates her portion and her pittance for a year : that is, a measured pittance. On that day year she came to him, and confessed that her desire still persisted. Now he was busy sewing before her. Then he thrust the needle thrice into her palm, and three streams of blood flowed from her hand. Then said he. "No wonder," said he, "if it is hard for the body, wherein are these strong currents, to contain itself." Then he diminished her meals a second time. She was on that ration for a year, and her desire still persisted. So after that time he thrusts the needle into her hand thrice, and three streams of blood flowed from it. So he reduced her meals again for a year, and at the end of that time he thrust the needle [again into her hand]. This time, however, not a drop of blood came out of her. Then he said to her : "In future," said he, "keep on this pittance until thy death."

§ 61. There was a certain itinerant

<sup>1</sup> Read dianat foibthi	<sup>2</sup> Read són	<sup>3</sup> Read tultatar	4 Read taithigthe
			$\lfloor 21^*  brace$

tir muman ind amsir samdine dobered huadisi imchomrac na mac bethad ind tíre congraid<sup>1</sup> iarom disi hé 7 ronáil fair cona tormaigfed nó na digebad cid a oen focul dia briathraib si no di briathraib ind cáich cossa fuided. Asbertsi fris iarum conarbera<sup>2</sup> dam olsisi fri maolruain no fri fer da crich acus is dóchu ón fobith isuidiu<sup>3</sup> rombói maolruaoin quam samdan. Is si mo sansercsa di cleirchib 10 ind deiscirt 7 ni conebera fris dús ind airim banscala for a cubus 7 dus and geba mo anmeairdessa. Negotiator hæc retulit. Andand' immurgo frisiom romba si sainserc samdine hé atrecht fochetoir 15 7 dohuargaib a dé laim hi crosfigill 7 atluchestar buis do dia. Anddond iarum atbert fris dus ind aithcomraictis banscale [42b] fris 7 dús ind arfaomad a anmchartisi imdercad corrici a ucht 7 slechtais fo trí 7 spatio magno siluit. Is iarum atbertsom apur siu friesi tra olsesem conimthisi comarli hude Postea narrauit negotiator omnia haec uerba do samdin 7 illa dixit anda lim ol sisi dorraga ni don mac sin. Is iarom doticsa6 a delg asa brut 7 clandti inda gruaid conidairsir isind chnaim 77 da srenga ais iarom. Nicontuilid immurqu cid a oen bande folæ ass. Fecais ind cendaig for qui 7 torrsi oca faicsin sin Gabesi iarum ind crecht eitir a dí mer 7 fecais for a fáscud rée mór 7 nicontaldad banna as Asendad iarom dolduid bannan bec bec as lasind fascad fottai. Banna bec son de usci 7 robúi buidetai bec fair do caomelod a datha. Dobertsom for a hingin iarum in dibúrsin mbic sin. Asbertsí tra airet bés iarum olsí a cutrumesi do súg inda curpsom ni be mundteras indda taobatu dó fri banscala.

pedlar in Munster in the time of Samdan, who used to carry greetings from her to the "sons of life" in that country. Once she called him to her and bound him

5 not to add to nor take away a single word that she said, nor a word that anyone should say to whom he was sent. Then she said to him : "Say to Maelruain for me," said she (---or to Fer Da Chrich, and

10 this latter is more likely, since Maelruain was more venerable than Samdan), "that he is my favourite among the clerics of the Descert, and another thing thou shalt say to him: ask, does he receive woman-

15 kind to his confession, and will he accept my soul-friendship?" The pedlar took this message. But when he told him that he was Samdan's favourite, he rose at once and raised both hands

as in a cross-vigil and gave thanks to 20 When the pedlar asked him God. next whether women took counsel of him, and whether he would accept Samdan's soul-friendship, he blushed down to his breast, and made three 25 genuflections, and fell silent for a long time. Then he said: "Tell her," said he, "that I will seek counsel from her." Then the pedlar told all these sayings to Samdan, and she said: "I trow," 30 said she, " something will come of that youth." Then she draws her brooch out of her mantle and drives it into her cheek till it stuck in the bone, and then there came out two filaments of milk : yet 35 not a single drop of blood came out. At that sight the pedlar began to weep and wail. Then she took the wound between two fingers and began to squeeze it for a long time, and not a drop was wrung 40 from it. Then at the last by reason of

- 7 Supply dollotar
- 4 Supply asbert

<sup>&</sup>lt;sup>1</sup> Read congair <sup>5</sup> Read buide

 <sup>&</sup>lt;sup>2</sup> Read conerbera
 <sup>6</sup> Read doicsa

<sup>&</sup>lt;sup>3</sup> Read is sruithiu

§ 62. Maccaildecha craibdecha id serc<sup>1</sup> lais daul doa hacaldaim<sup>2</sup> 7 do nertad irsi doib 7 i nemfecsiu inda gnuis 7 senoir it coimitecht 7 anacaldaim iarum for aulaid oc cros ind dorus lis no isind Б disirt imbíatt 7 ind senoir dano teiti latsa 7 senoir caildidi bis a comaitecht na maccaildidi do bith hi farrad 7 ni cian huaib imbíat. Andand donetarrat míaccobar nó míimradad tre faicsin no 10 ac acaldaim mbanscál ma atrocuil am menme nad cometesta dó ceith folam deit ní fil bríg laisiom hisind accobar sin. IS fochric immurgu ma gabthair tairis and and mbis a foindel inda 15 menmain commór fri mimradud a timtasad [43ª] for caulæ feib dorrontar 7 tuidecht<sup>3</sup> légind nó a scrutain fris 7 menme isind aurnaigti. Nicon aorsusa4 laisiom commas pende ara facendel 20 sin indda menman. Fobithin nícomór⁵ imbisom ifus eitir.

§ 63. Bithfer fíta na riaglae tra ceith dand erán 7 den seildind imbe .i. ind 25 lethbairgin 7 ind cethramtu *nó* anaild 7 the long squeezing out came a little tiny drop. It was a little drop of water, and there was a little yellow on the surface enough to change its colour. Then she put this little driblet on her nail, and she said: "So long," said she, "as there is this much juice in his body, let him bestow no friendship nor confidence upon womankind."

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§ 62. Devout voung nuns he thinks it [right] to go and converse with and to confirm their faith, but without looking on their faces, and taking an elder man in thy company: and it is right to converse with them standing on the slab by the cross in front of the hostel, or in the retreat where they live. And the elder who goes with thee, and the senior nun who lives in company with the young nuns, should be present and not far from you, where they are. When ill desires or ill thoughts overtake thee, through seeing women or in converse with them, if . . . . . that it is not to be indulged by thee even as an idle thought (?), then he considers that such desire is no great matter: it is meritorious, however, if a man gets clear of it. When the thoughts are constantly straying towards ill meditations, they must be checked and recalled as far as possible; and he should resort to reading or to examining himself against it, and keep his mind fixed on prayer. He does not consider it easy to fix any penance for such straying of the thoughts; for . . . . not much about it here at all.

§ 63. If a man constantly keeps to the pittance prescribed by the Rule, both as to the bread and the *selann* of

1	Corrupt : perhaps ní haurchail	<sup>2</sup> Read nacaldaim	<sup>3</sup> Supply do
ŧ	Read nicon aurusa or perhaps nicontin	arussa ( for niconfúar-sa)	5 Something lost here

aldind cid fogluasa ind doenacht ind accobar combí todiuscad accobir in membris bes beith fochetóir són lasan praind. Baóes beith inda ligiu eitir codlad 7 cen cotlatt. Bes immagaba ceit co matain níco mórbrig laisim and acht ni cometestar dond accobar ma dogabthar chetamus a fít is imfolang galir són 7 fíce secda brond A mesrugud do neuch tra buddesin la eolus ind fita 10 arnara<sup>1</sup> fochund galir mat robecc. Narap altram dualchi mad romór. Ní iarum notlortnigetar 7 nat furea galir. A timmarcad fo reir na ndáonnacht ar is ecsamail reim daonachta caich. IS sed file irriagail doimine abbatis romæ is ferr lais 7 is inildiu do anmin neich ind fit bec mín quam ind fit mór de tuari anmín Fobithin is ferr do fulang duine 7 da blath ambece mín 7 is lugai 20 dodúsci ind daonacht fri miaccobar quam ammór den gantuarai

§ 64. Andand as crad tra don chach frisambí immalde de aos [43<sup>b</sup>] sruith.
nemchomaitecht doib im caomelód praindi
25 nó a tórmach 7 temet ipsam castigas do traothad do tole 7 do accobair 7 ní airigetar sam ón. Anda leosom immurgu isarabstinait deitsiu. IS inildiu laisiom iarum nemchomitecht doibsiom cid crad
30 doib 7 coch be a sruithe indas ni bes epiltiu anme dit 7 indas nad pende a chinta Dogniat arale immurgo guchoibbutter (that is, the half loaf and the quarter or other quantity), and the [proper amount of] drink, even though human weakness may stir desire, so that

5 there is an excitation of desire in his members (perhaps it may happen immediately with meals, or it may happen in bed, whether he be asleep or awake, or perhaps he may escape it until morning)—he counts it no great matter,

provided there be no yielding to desire. If a man's allowance be suddenly diminished, that will cause sickness and dry internal piles. Everyone should 15 regulate his pittance for himself, knowing the proper amount, that it cause not sickness, if it be too little; neither nourish vice, if it be too much : as much then as suffices him, and does 20 not induce sickness. It should be

not induce sickness. It should be limited according to men's natures, for the course of nature differs in each man. This is what is laid down in the Rule of Doimine, Abbot of Rome; he holds it better and safer for a man's soul to use a small light pittance rather than a large pittance of coarse food: for the small light diet is better to sustain a man and make him healthy, and it excites human nature to ill desires less than the large diet of coarse food.

§ 64. When it is grievous for anyone in regard to such elderly people as live
25 with him not to indulge them with a change or increase of diet, while thou art chastising thyself to subdue thy desires and propensions, and they do not observe this—(they suppose,
30 however, that it is by way of abstinence on thy part)—he considers it safer in such a case not to indulge them, even though it be grievous to them, and

senæ do thuildiud indaldeth fadesin do tormuch pende føraib 7 ni coir son 77

§ 65. Praind dano do tomailt la marb hi tig ceth naob is a hurcul acht sailmchetal 7 aurnaigti occo. Cid ind fer graid dobeir sacrafic dond fir galir dlegair dó daul astig statim iarum ne presenti illo moritur. Ar diambe hi fiadnaisi ind bais istig nicotaldad do oifrenn do denam conidcoisrecad epscob 10 Tocaomnacair do diarmaid 7 do blathmac mac flaind fecht robói conid eiter a lamaib rothathamir cú rui quando mortuus est tarmartsom<sup>1</sup> oifrend do denam iarum cen a coisecrad conditoir- 15 mesc colcu díob uctaras ind leuitic 7 diarmait dano abb ía lais occo

§ 66. Feeht robai luid araile manoch do findio mac uiatach for sétt. Tecmoncuir banscal immaildi fris arsin teit<sup>2</sup> 7 20 postulauit ilda concubitum eius. Foceirtt lamae fair fadeoig commaranic caradrad irse [44<sup>a</sup>] Nicotaldsom iarum der dia gruud statim cotanic dochum findio 7 confesus est illi culpam suam Findio 25 dixit nicombia bríg isindi sin Demmun aridralistar sin olsesiom dot breithsiu úanna 7 dotfastad eiter tuaid 7 dotbreith a teg pendi corop imdergad deit fía cách Nípa cobair immurgo dosom sech ni raga 30 however aged they may be, rather than that to do anything that might be death to thy soul, or shouldest fail to do penance for thy soul's sins. Some, however, make false confessions about themselves, in order to increase the penance laid upon them; but this is not right.

§ 65. Now, to eat a meal with a dead man (though saintly) in the house is forbidden: but instead there are to be prayers and psalm-singing on such occasions. Even one in orders who brings the sacrament to a sick man is obliged to go out of the house at once thereafter, that the sick man die not in his presence; for if he be present in the house at the death, it would not be allowable for him to perform the sacrifice until a bishop should consecrate him. It happened once on a time to Diarmait and to Blathmac mac Flaind that it was in their hands that Curui expired. When he died, they were about to perform the sacrifice thereafter, without being reconsecrated, till Colchu hindered them from doing so. The authority is Leviticus; and Diarmait also, the Abbot of Iona, was with him on that occasion.

§ 66. Once upon a time a certain monk went on a journey to Findio mac Fiatach. A woman happened to meet him on the journey, *et postulavit illa concubitum eius*. She laid hands upon him at last, and there befell intercourse by tryst between them. Immediately thereafter he did not stay to wipe the tear from his cheek, till he came to Findio and confessed to him his fault. Findio said: "That shall not matter. A demon has contrived it," said he, "to carry thee off from us, and to set thee among the

1 Read tarmartatarsom

sa hi teg pende 7 nitberasam eiter tuaid Rogai1 do sacerafic 7 isintturtt chetna biæ tre cach oena Doluid ind satan chuici iarsin 7 atgladastar tria aslach tanaidi<sup>2</sup> 7 dixit ildi. Nipa mor a glanad deitsiu ind chomairle dobeir findio deit. IS sed is maith deit ercc co comgald co ruccæ breith fort dochoidsom ón dano 7 confesus est illi 7 dixit comgeld. IS fochen am do tichtu ní bía brig 10 desium 7 comgellus dixit eadem uerba quæ dixit findio. Andand doluid a bendchar sechtair. IS and gabuis port curuch coluim cildi 7 satanas suasit illi ut iret ad columbani niba hicc deitsiu tre findio 15 7 comgeld olseisiom ised is maith deid perge ad columbam. Dochoid ón dano 7 dorat a coibsena dosom 7 dixit ildi columba, sicut<sup>3</sup> crucifixsi christum per temed ipsum pecato fo' infindio quod non 20 credidisti quod dixit ildi per ipsum sanctam<sup>5</sup> tercio in comgello quarto in me adbirsa fritsa ol colum cilli cuice bliadna dec pendi fobithin na dimicni doratais for firbald crist .i. findio. FINIT do- 25 scribus sin domdoig 7 inddí sceol so 7 ni hainfis acht día necar doniam indnos

laity, and bring thee into a penitentiary, that thou mayst be publicly put to shame. It shall not avail him, however; thou shalt not go into a peni-

5 tentiary, neither shall he carry thee off among the laity. Thou shalt go to the sacrament, and shalt continue under the same rule through each fast." Satan came thereafter to him and accosted

10 him, tempting him a second time, and said to him: "The counsel Findio gives thee will be no great cleansing for thee. This is what is good for thee to do: go to Comgell, that he may pass judgment on

thee." He went accordingly and confessed to him, and Comgell said: "Welcome indeed is thy coming: this thing will not matter"; and Comgell said to him the same things as Findio had said. When he came along from Benchor, just then Colum Cille's curragh reached harbour, and Satan persuaded him to go "Thou shalt get no cure to Columba. through Findio and Comgell," said he; "this is what is good for thee to do, go to Columba." So he went and made his confession to him, and Columba said to him: "Thou hast crucified Christ once of thyself by sin; secondly, in the person of Findio, because thou didst not believe what he said by the Holy Spirit; thirdly, in the person of Comgell; fourthly, in I pronounce upon thee," said mine. Colum Cille, "fifteen years of penance because of the contempt thou hast shown for a true limb of Christ-namely, Findio." Finit. (I have written this on my own account, and these two tales; and it is not in ignorance, but to set them forth that we proceed in this way.)

§ 67. Etach berar do áos tuati cotaot<sup>6</sup>

§ 67. A garment that is brought from

<sup>&</sup>lt;sup>1</sup> Read Regae <sup>2</sup> Read tánaisi <sup>3</sup> quater C (see Notes) : read semel <sup>4</sup> secundo C <sup>5</sup> per spiritum sanctum C <sup>6</sup> cotetet C

demun coronaoenastar<sup>1</sup> 7 nídnanaid<sup>2</sup> a crothad nach a flescad acht a nidi. Araile ancarae robui hi cluaoin mac naois laisrien a ainm imnocht imdilmain cen ní for a cubus. he dano hi luibri galair. Nombered iarum cách ar uair dina mac cleirchib dochum a tigid leu. Ronucc araile mac clerech and aidci dochum a tigi dobert brat fa a taob. Conidtuil<sup>3</sup> laisren for a brut. Atchí 10 aislingi coildnidi 7 niconfacae óa gein gusan aidchi sin. Atraig iarum fecais for cáoi 7 maircctenaich fecais for figild iarum corogaib na tri cáoectæ fri figild Tolduid iarum taurtaim fair fora beolu. 15 Tonanic iarum ind taingil 7 dixit ildi. Na bád bronach tra olse quam<sup>4</sup> in ácc nocti sensisti iterum in uíta tua non 7 sensis.5 accus issed forúair indí sin Fobitin is brat lanamnæ ind brat forsa 20 roæ 7 ni roaonacht iarna beith lasand lanamain cotreicigur<sup>6</sup> demmun iarum úare nad roanacht. Ar nach brat berair do áos étraich conamteit7 demmun airet nat negar 7 cetera 25

§ 68. Ni molatharsom ind troscud is ferr lais ind fit mesraigti dogres niconfil eiter ind riagail i fueregtar<sup>8</sup> acht mad a cinta oircene Aon troscut hi riagail comgeild .i. ind cetain ria caise. 30 Trí troisciud immurco tantum la colum cilli in ando .i. aidchi notlace steill .i. post .xii. nataleis 7 ochtmad imbairgine<sup>9</sup> coluim cilli isuidiu 7 seilind 7 bochtan ais maith bat ead indas ind troiscti sin 7 35 the laity a demon accompanies until it has been washed; and it is no protection to shake or beat it, but only to wash it.

A certain anchorite lived in Clonmacnois, named Laisren, quite naked and free from sin, with nothing on his conscience. Now he was infirm with disease: so each of the clerical students in turn used to take him home with him. A certain student had taken him home one night, and put a cloak under him. Laisren slept upon his cloak. He sees a carnal vision, and he never saw one from his birth till that night. Then he rose up, and began to weep and lament. Then he began to perform a vigil, and recited the Three Fifties with his vigil. Then a trance fell upon him, as he lay on his face. Then an angel came to him and said to him : "Be not sorrowful," said he; "what thou hast felt this night thou shalt not feel again in thy life. And this is what caused the thing : because the cloak on which thou hast slept is the cloak of a wedded couple, and it has not been washed since it was used by them. So. because it has not been washed, a demon hath. . . . For any cloak that is taken from lustful people, a demon accompanies it so long as it is not washed," etc.

§ 68. He does not commend fasting: he prefers a regular measured pittance. There is no Rule where it is imposed, except on account of injury done. There is one fast in Comgall's Rule—namely, the Wednesday before Easter. However, Colum Cille recognized three fasts only in the year: the eve of Epiphany—that is, twelve days after Christmas, and the eighth part of Colum Cille's loaf at that

<sup>1</sup> coroenastar C	<sup>3</sup> ni anaich C	<sup>3</sup> conatil C	4 quod C	<sup>5</sup> senties C
<sup>5</sup> cotretiguir C	7 cotnimtét C	<sup>8</sup> fuirestar C	9 <i>Read</i> mbairgine	
R. I. A. PROC., V	UL. XXIX., SECT. C.			[22]

ind cetna cétaoin  $[45^a]$  de quadragissima 7 in cena cetain post pensticostin ochtmhadh in cechæ. INd aine immurgu in chesta dosforslaicde<sup>1</sup> colum eille for noebaib herenn fobithin atbathatar dend aine sin sruithi iar sircacht in chorgis **B**a erdath 7 ba lith mor iarum la colum cille ann dogress dona braithribh ass ningnama doib ann nobithe tremsi ocaurcilliud 7 oc legcude usce trit feil na nairemon leisom insin fobithin is ann forcentai anas.

§ 69. IS cutrumme tra hirriagail coluim eille fit sathairn 7 fit domnaich fobithin in chatudh robui forsint sabbait
15 i fetarlaic in opair tantum is and deilicid fri domnach Ata irriagailib ailibh dano cosmailius fitta i sabbota 7 in dominico in tun tra mbis isna riaglaib superponat nó superpositito do leith fitt 7 do leith 20 trosud is dir insin cena caræt immurgu in tan is troscud i. cena in nocte

§ 70. IS cumme dano forich in biat nó an offrend in oen ocus in sochaidhe ar ni luga cumung naernaighthi dosom cit lir quam si sibi soli assignetus amail nach moa soillsi na grene don oenfer for leith indas don sochaidhe

§ 71. IS mor leisim in mile cemenn nó eo amplius do aithidhigh in deissi i domnuch is<sup>2</sup> foracbadh in mile cemind fri torrome fir galair fri tabhairt comne do 7 do ocaib 7 tuathibh biti fo anmchairtes time, with a *seland* and a *bochtan* of good milk: that was the manner of that fast; and the first Wednesday of Lent, and the first Wednesday after Pentecost:

- 5 the eighth of a loaf to each fast. However, Colum Cille relaxed the fast of the Passion for the saints of Ireland, because old men died of that fast after the long privations of Lent. A great festivity
- 10 and merrymaking was regularly allowed by Colum Cille thereafter to the brethren: the growth of the crops was given to them then: three months were spent in tending and watering them. He called that the Feast of the Ploughmen, because it was then that the crops reached their full growth.

§ 69. In Colum Cille's Rule Saturday's ration is the same as Sunday's, on action is the honour paid to the Sabbath in the Old Testament. It is only in respect of work that it is distinguished from Sunday. In other Rules also there is a similarity of rations on the
20 Sabbath and on Sunday. When, however, there is in the Rules "superposatio," this is properly applicable to a half-ration and half-fast; "cena careat," however, is used when a fast is meant—that is, cena in nocte.

§ 70. It is all one whether one person or a number is present at the *Beati* or
25 the Mass; for there is no less efficacy in his prayer if there be many present than if it be appropriated to himself alone—just as the light of the sun is no greater for one man only than for a number.

§ 71. He makes much of going the 30 thousand paces, or more, to visit the tenantry on Sunday; and the thousand paces have been left as an ordinance for watching a sick man, and for

<sup>&</sup>lt;sup>1</sup> Read doforslaicthe la
5

dotiagat do airsemh offrind 7 do etsecht procepti 7 do rætaibh tricibh cene 7cetera :-

§ 72. [45<sup>b</sup>] IS hed rochuala la crundmael acht fo thri nico rotroisci mælruain o gabis tamlachti .i. for artrig mac fælmuire im chaingin robui de muintir tamlachti friss. Iarsin chetna troscud cetemus romemaid coss ind ríg indó. Iarsin trosc<sup>1</sup> tanaise rotuit in tenid 10 corroloise hé o mulluch co talmin. Iarsin tress troscud fogeib in rí bás.

§ 73. Bithbés<sup>2</sup> menadche is he a auctartas robui telchomrac mor i muidh lena de noebaib herind IS hed rotinol 15 ropo immned leo an aes pende do epiltin for usce 7 bargin3 lasna sruithi robatar remib som Rotheiscset<sup>4</sup> iarum imbi fri Dosnanic iarum int aingel 7 asbert dia. friu napa machtad amh libsi olsuide<sup>5</sup> 20 int usce 7 int aran indiu inn æs pende. Rofasaigthea na toirten<sup>6</sup> 7 clanda in talman cona fil nert na brig indib idiu fri fulang neich. Go 7 peccad 7 anfhir<sup>7</sup> na ndaine dorelacht<sup>8</sup> annert 7 a brig 25 asin talmin cona thoirthib. INtan rombatar in duine do reir dé Robui an nert coir i clandaib in talman nirbo messa int usce hisuide do fulung neich. quam lac hodie IS iarum atbert int 30 aingel friu ni de min do chummusc doib aranim combed menadach arna toitsitis an aes pende immallama<sup>9</sup> fobithin arna forfoelnangair<sup>10</sup> int uisce 7 int aran.

administering the communion to him, and to the young, and to the laity who are under spiritual direction who come to wait for the Mass, and to hear preaching, and for urgent matters besides, etc.

§ 72. This I have heard Crundmael say, that Maelruain never fasted but thrice since he settled at Tamlacht -namely, against Artri son of Faelmuire, about a business that arose between the monastery of Tallaght and him. After the first fasting the king's leg broke in two; after the second, the fire fell and burnt him from top to toe; after the third fasting the king died.

§73. This is the authority for the habitual use of gruel. There was a great gathering of the saints of Ireland in Mag Lena. This is what brought them together: they were grieved that penitents died on bread and water in the days of the elders who lived before them. Then they fasted against God on account of this. Then an angel came to them and said to them : "Wonder not," said he, "if the bread and the water cannot sustain the penitents to-day. The fruits and plants of the earth have been devastated; so that there is neither strength nor force in them to-day to support anyone. The falsehood and sin and injustice of men have robbed the earth with its fruits of their strength and force. When men were obcdient to God's will the plants of the earth retained their proper strength. At that time water was no worse for sustaining anyone than milk is to-day." Then the angel told them to mix some meal with

<sup>4</sup> Rotroiscsit P 1 Read troscud <sup>2</sup> bithbin P (see Notes) <sup>3</sup> P adds ocus roscoiblic iarum <sup>7</sup> anfhírindi P 9 dorelsat P <sup>5</sup> Supply cenid fael P <sup>9</sup> imalama P 6 tairti P 10 forfulngarair P read forlangair

 $[22^*]$ 

§74. Teor menadcha ann iarum. menadach uas usce 7 menadach eter da usci sech ni teit [46ª] sis arrec co dommain lestir ni theit súas huas usci aceus menadach indi usei. Rosaigi immurco dommain lestair berthus ind arbar sis. 'Aos ata etromæ cinaith 7 atroilded bliadain no anaild do pendait menadach huas usciu doib. Aós immurgu ata trumæ cinaid atroilded .TII. no v. andos menadach eiter da usei dóib. Aós morchinaid immureo atroildett .vu. anttos uel eo amplius ut fiunt episcopi uel sacerdotes qui cadunt in principali cremine uel homicidæ 7 15 reliqui. Menadach is uscu doib 7 cetera. Cleirech lasa marbtar cimmid ised is choir laisiom a pendit do amail cach nduinorenid

§ 75. **IS**sed aspered máolrúaoin oca 20 aurail do neuch fairsiom guidhi dé laisiom 7 tócbale soscéli fris. Gestisi día lindi olsesiom condalithisi<sup>2</sup> iarum ar naurnithe fründi. Cena taithmenam for nanmand. ar nách áon guides día 25 lind guidemne<sup>3</sup> día lasuidiu cid na taithmenam. ainm caich

§ 76. ISsed atbert mac óigi lis máir asrubairt fria alale iarmoracht dó dús cía bald ba dech dó nógébad di cleireccht. ISsed asrubart som is hé bald for nad cúalæ lochtt bós. Cid derscaigtech<sup>4</sup> nech olsesiom atberar bát their butter to make gruel, so that the penitents should not perish upon their hands (?), because the water and the bread did not suffice to support them.

§ 74. There were three kinds of gruel after that—gruel upon water, and gruel between two waters (while it does not sink right down to the bottom of

- 5 the vessel, it does not float above on top of the water), and gruel under water. However, [in this case] it reaches the bottom of the vessel; the grain carries it downwards. Those
- 10 whose sins are lighter, and who deserve a year or two of penance, get gruel upon water. Those, however, whose sins are graver, who deserve four or five years, get gruel between two waters.
  15 Those, however, who have committed great sins, and deserve seven years or more, as do bishops or priests who fall
  - into mortal sin, or homicides and soforth, get gruel under water, etc. A cleric by whom a captive is killed should, he considers, do penance like any other homicide.

§ 75. This is what Maelruain used to say when anyone enjoined on him to pray God for him, and to lift up the Gospels towards him. "Do ye pray God for us," said he; "and then ye share our prayers with us though we do not mention your names. For if anyone prays to God for us, we pray to God for him, though we do not mention each man's name."

§ 76. This is what Mac Oige of Lismore said in reply to a certain man who inquired of him which attribute of the elerical character it would be best for him to acquire. He replied: "That attribute with which he has never yet heard fault

<sup>1</sup> Read is <sup>2</sup> Read condálidsi <sup>3</sup> Read guidmini <sup>4</sup> Read deg-sercach (Plummer)

romór a degsere. Cid umal asberar bát roumal dano ind fer ísin. Cith áointech bat romor a abstinait 7 reliqui similiter. Niteualæ immurgù neuch asroepred bat rrofossad ind fer hisin arsé cipe dán ara coratar neuch láimh ised as dech dó foss occa 7 cetera

§ 77. Báoi alaile anchoire antuaid o sláne colcu. Coibnius dochuttæ, Rochachti iarum commór corroabstinit. Robaoi 10 iarum áirgi laisim [46b] o muindtir 7 taiscit on muindtir. Fodaledsom iarum do bochtaib commór. Robbo accobar laisiom iarum a facebail uile 7 daul commaolruaoin. Fobithin focerd a 15 chubus som ar tomailt torith na muindtiri ind narbo lor iodne ind caich imma cuired a toratt. Atbertatar iarum ind sruithi fria choicsiom ara tesed inda commaitecht som docum maolruin Iar-90 mofocht iarum maolruaoin dó cid forúair olcus a blatha 7 non confesus est Tolduid iarum ind choic co tairfid and fítt forsambidsom do máolruin 7 multum commouit illam **D**oronais fer 25 indgail1 fort am ol maolruin Addominso tra olse do reirsi de. Ni talaad<sup>2</sup> cetamus ol maolruain isind lucesa ata foagles choir and cruthsa olsesiom. Ind ldín file isund ol maolruaoin sech 30 dogniatt a mod cóir. Rocaithet a fít. Ni tallasu iarum etturra sech ni dingne gniomrada Ní rocaithfet<sup>3</sup> do fit. Slechtais iarum fo ogreir maolruaoin. IS si mo riarsa am olsesiom arnatta do 35 saogal ní do tórmuch forsind fitt teirc sin cen cop étech<sup>4</sup> 7 cen cop accobar lat And doberthar dano deit o<sup>6</sup> maolruaoin

found. If a man be distinguished [for charity]," said he, "it is said that his charity is too great; if humble, it is said again that that man is too humble; if
ascetic, that his abstinence is excessive, and so with the rest. I have never heard, however," said he, "of anyone of whom it was said that 'this man is too steady.' Whatever task a man has set his hand to, it is best for him to persevere in it," etc.

§77. There was a certain anchorite from Slane, in the north, named Colcu, a kinsman of Mochutu. He was much given to austerities and strict absti-Now, he had dairying and nence. store of victuals given him by the monastery. Then he used to make frequent distributions to the poor. Then he had a desire to leave all and to go to Maelruain, because he exercised his conscience about eating the produce of the monastery, as to whether each man who brought the produce was sufficiently Then the elders said to his pure. cook that he should go along with him to Maelruain. Then Maelruain asked him what caused his ill colour, but he would not confess. Then the cook came and disclosed the diet on which he lived to Maelruain, and he was greatly moved. "Truly thou hast wrought an unnatural crime upon thyself," said Maelruain. "Isubmit indeed," said he, "to thy will therein." "In the first place," said Maelruain, "thou wilt not fit in this place. It is under due arrangement (?) at present," said he. "Those who are here," said Maelruain, "while they do their proper share of work, are able to eat their rations. Thou, therefore, wilt not fit among them.

<sup>&</sup>lt;sup>1</sup> Read Dorónais fingail <sup>2</sup> Read talda (for tallai) <sup>3</sup> Read rocaithfe <sup>4</sup> Or étig (Plummer) <sup>5</sup> Read ol

10

do torad ind erlama cith anidan ind cách is idan sancto taisfentar for lár dotegtisiu ar is disliu det siu torutt na naérlam quam ildis. Ni aurcuil dano deit a tír ind erlama fort chubus do fodil a toraid do bochtaib.

§ 78. Ni cóir tra laisiom cen tabairt do neuch a coibsen for cech náoi dondhi danacoibsenither su cen comtecht<sup>1</sup> do in prandio mad immalde fris doteceme 7 non [47<sup>a</sup>] ilde curat de frepuid na coibsen hisin aralegasu fiadosom ind riaguil 7 ind pennatoir 7 conetis<sup>2</sup> dóib ne pereas tre connairclius neich aile.

§ 79. Nicongus laisiom dano do neuch 15 cid arfaoma anmchardine nó cobsen neich bess siniu nó bess sruithe indas **A**rusce rere de aiti nó sinserbrathair mani bé nech aile bes lór laiss i focraib dó do athcomare fris. Ni tend forngari 20 immurgo dlegar dosom forsuidiu<sup>3</sup> acht aralégda<sup>4</sup> inda libra ara mbelaib combo mou de ronduca athgnu.

Thou wilt neither do active work, nor be able to eat thy rations." Then he knelt down in submission to the absolute will of Maelruain. "This is my will truly," 5 said he; "so that thy life fail not, to make some increase in that scanty pittance, without leaving thee free to refuse it or desire it (?). But as to what shall be brought to thee out of 'the patron's fruits,'" said Maelruain, "though all who bring it be impure, it is pure for him who is holy. It shall be exhibited on the floor of thy house, for the patrons' fruit belongs rather to thee than to them. It is not forbidden thee to lay it upon thy conscience to distribute to the poor the fruits of the patron's land."

§ 78. He does not consider it right for anyone not to exact confession about everything from him to whom thou art confessor, without sparing him at meal-time if thou happen to be beside him, and he does not care about the healing effect of that confession; thou shouldst read the Rule and the Penitential aloud in his presence, and [do not] spare such persons, lest thou perish through indulgence to another.

§ 79. Now, he does not consider that it matters if anyone accepts the spiritual direction or receives the confession of a man that is older or more venerable than he is (for example, his tutor or an elder brother), if there be no one else at hand of sufficient authority for him to consult with. He should not, however, lay upon such persons strict injunctions; but let him read the books before them, so that he may gain the more knowledge (?).

<sup>&</sup>lt;sup>1</sup> Read dia coibsenigthersu, cen chomaitecht <sup>4</sup> Read araléga

<sup>&</sup>lt;sup>2</sup> Read ní cometis <sup>3</sup> Read forsuidib

5

§ 80. Bithbés troiscta dano ní forgein<sup>1</sup> lasna naobu <sup>2</sup>acht áon troscut indorsa.<sup>2</sup> Ni forgeni la comgald .i. aidchi cenlai a aithliu na cetaoine accus ni dentai immurgo aidei ind césta Tri troiscethe immurcu la colam cilde ind ando 7 leth fít ind cach ái díb 7 ba cumlechtach ind lethfitt hisin. Arre troiscethe la diarmait da fitt chert chutrume cid min cid anmin dondecme 7 inddala hí do tabirt do día 10 Araile do tomailt fadein 7 artáott troscud sin

[Here the Abbgitir Crábid, which we omit.]

§ 81. [51ª21] IS hed dano dohuce colccu ho eogun qui uiderit somnium cornale in dominica nocti daul do do laim 15 arabarach 7 a techta do denam isind domnuch ria ndul do laim .i. cáoccae nó cét slechtan cid ind domnuch ceth hi soldamain nicon dermanad laisiom a pendaid and non sic máoldithruib acht 20 aidchi lúain ind pendaidd ISsed dano bad doig la coilchín indhí notegtis isna huseiu. is do traothad 7 damnad hi<sup>3</sup> tole 7 ind accobur fogníd leó nó is tormuch saothair dano cena. 25

§ 82. Ní aurcail dano laisiom do neoch cid chodala a lórtid acht rop la forcomet na trade colleir eter lao 7 aidche. IS ferr laision dano do [51b] neoch arabertha<sup>4</sup> ní do maith do denam a ingell 7 30 comallnad iarum ISsed asber solam qui obseruat uentum non seminabit qui considerat nubes non metet

§ 80. Now, continual fasting was not practised by Comgall, and it is not practised by the saints at present, save one fast, namely the eve of Maundy Thursday after the Wednesday. On the eve of the Passion, however, no fast is to be observed.

Colum Cille, however, kept three fasts in the year, with a half-ration on each of them, and this half-ration was liberal. As an equivalent for fasting, Diarmait used to allow two exactly equal rations to be made, whether it happened to be coarse or light food, and one of these to be given to God; the other he was to eat himself; and this serves in place of a fast.

§ 81. This precept Colecu got from Eogan, that whoever had a carnal dream on a Saturday night should receive communion on the morrow, and should perform the due observances on the Sunday before receiving communion, that is to say, fifty or a hundred genuflections: even on a Sunday or a festival he was not allowed to forget This is not Maeldithhis penance. ruib's way, but he orders the penance on Sunday night.

It was Colccu's opinion that those who used to stand in water did so for the purpose of crushing and subduing their desires and longings: or else simply as an additional labour of piety.

§ 82. He does not forbid anyone to sleep his fill, provided that he diligently observe the Hours, both day and night. He thinks it better, moreover, for anyone who may intend doing any pious act, to make a vow and to fulfil it forthwith. Solomon says: Qui observat ventum non seminabit : qui considerat nubes non metet.

<sup>3</sup> Read na

<sup>&</sup>lt;sup>1</sup> Read forgéni

§ 83. **B**íadd p*ra*ntigi da*no* is*ed* aonach ndedenach indsin is coir do imbirt isna mbelaib iar p*ra*ind hi sessam 7 hi p*ra*indtig a cetal.

§ 84. Cleirech lasammarbthar cimmid ised is coir laisiom a pendidd do amail cach ndunoircnid

\$ 85. Forith dano ind soscele 7 cobrid inda hanmanna f*ri*sa tocabar am*ail* forith uíuos 7 fogni laisiom a tocbail frissna marbu Fecht robáci tecmongur celdag hi cluain mac nóis im cosnam na hapdaine. Suidigestar iarum adomnan deorad etarru. Indand imbáoi iarum adamnan deorad ind hí. rocraidsetsom ind taldsatsam a apdaine aire Fóidis iarum a muindtir dochum nadamnain do achúine friú 7 dixit illis ne pranderent 7 ne soluerent calciamenta usque quo alloquerentur adamanuss dixit ut comederent in illa nocti 7 comederunt 7 in crastina die non intrauerunt ad illum usque ad tertiam horam et tunc narrauerunt causam suam 7 adamnanus eliuauit manam suam cum euangelio de1 aibritiud atarann in tene muindtir 25 cluana mac nois Nicon fordamar suide nó ligi do fir díob congabsat an deorad iterum. Adbert iarum adamnan frisna techtaire tudecht dia tich co fuaratar a cele isind apdaine ara cind 7 legati interrogauerunt horam specialem in qua ille effectus est abbas 7 ba sí húarsom douargaib adamuan ind soscele andall 7 postea de tam celeri miraculo inter [52ª]rogatus est 7 ille respondit napad 35 machtad libsi olsesiom airde na cruichi tresind soscele is indeniu aibritid tresngata na huile dúile súas coricci riched. Is denitir sin rosaigh fudumne pene 7 rosaig turchail 7 funed ngrene 7 dessiu- 40 bar 7 tuadebur ndomain hisin doen aibritiud 7 forbrisi each doding

§ 83. Now as to the *Beati* of the refectory: it is proper for them to repeat (?) the last . . . with their lips standing after meals, and it should be sung in the refectory.

5 § 84. A cleric who kills a captive he considers bound to do penance like any other homicide.

§ 85. Now the Gospel helps and assists the souls of those towards10 whom it is lifted up, as it helps the living, and it is his practice to lift it up towards the dead.

Once upon a time there arose a contention in Cluain mac Nois over a 15 contest for the abbacy. Then Adamnan set a stranger among them [as abbot]. Then while Adamnan was in Iona, they persecuted the stranger, and deprived him of his abbacy. Then he sent his

20 monks to Adamnan to complain against them, and told them not to eat nor loose their shoes until they should have speech of him. Adamnan told them to eat on that night, and they did eat; and the next day they were not admitted to

25 his presence until the third hour and then they set forth their case to him, and Adamuan lifted up his hand holding the Gospel at the moment when the fire . . . the monks of Cluain mac

- 80 Nois. He did not suffer one of them to sit or lie down until they received the stranger back again. Then Adamnan told the messengers to go home, and on their arrival they found their comrade
  85 in possession of the abbacy. And the messengers asked the precise hour in which he was made abbot, and it was the hour that Adamnan lifted up
  - the Gospel yonder; and afterwards he
    was asked about so sudden a miracle, and he answered: "Wonder not," said he, "that the sign of the Cross by the

Read d'óen

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§ 86. Maoldithruibin quadragesimis in aqua 7 pane usque ad nouissimum tempus pro anima patris sui. Fobithin ba deournichte1 dogres in quadragesima. Robói araile laoch hi mudornaib cum uxore sua fo anmchairdes eochach ui thuathail hillanamnas dligid 7 cum decimis iis² post inimici eius iugulauerunt eum 7 omnes plebilis uidentes dixerunt quid profuit illi bona facere 7 statim 10 uenit eocha ad dublitir narrauit illi causam suam 7 duiblitir dixit leth nó trian a folith do fodail do bochtaib 7 cenmac de udpart a chuirp 7 a anmæ do dia 7 in pendit nopeinebad ind laoch 15 · itir fit 7 an figill 7 saothar co cend .uii. annorum a denam do a mace tar a cend. accus a setig dano do pennait tar a cend fadesin 7 dara cendsom ind ré cetnæ Doronad iarum indní sin huile co ndechaddar do laim dia secht mbliadna a mac 7 a seitig. Donarfad iarum in illa nocte do duiblitir post .uii. annos 7 badu..l a sochraiti 7 etach net- [52°] racht imbe. Dobert iarum bendachtain 25 for duiblitir ar ind fortacht dorradad dó 7 dixit illi in ac nocte dominus meisertus est mei et eduxit de inferno ad ragnum cælorum 7 dixit duiblitir. tu quis es ego miser de me cogitauit echo. Donarfid 30 iarum in una eademque3 do eochaid 7 filio 7 uxori 7 benedixit illos et eadem uerba dixit illis

power of the Gospel traverses quicker than a wink of the eye all the elements up to heaven. With like speed doth it reach the pit of torment; and it reaches the sunrise and the sunset and the southern and northern ends of the world in a single twinkling and vanquishes every obstacle."

§ 86. Maeldithruib lived on bread and water every Lent for the good of his father's soul, usque ad novissimum tempus: for his prayers were always occupied therewith in Lent.

There were a certain layman and his wife in Mugdoirn living under the spiritual guidance of Eocha ua Tuathail in lawful wedlock, and with ten sons. Afterwards his enemies murdered him, and all the lay folk, seeing this, said: "What did it avail him to live virtuously?" Eochu came at once to Dublitir and set forth his case to him : and Dublitir told him to distribute to the poor half or a third of the layman's substance, and that one of his sons should offer to God his body and soul, and should observe on his behalf the penance which he would 20 have performed, the pittance and vigil and labour, to the end of seven years; and that his wife also should do penance on her own behalf and on her husband's for the same period. Then all this was. done, and his son and wife came to communion that day seven years. Then he appeared on that night to Dublitir seven years after his death, and . . . was his comeliness and he had glistering raiment about him. Then he gave Dublitir a blessing for the help that had been given him, and said to him, "In this night the Lord hath taken

<sup>2</sup> Read docem filiis

<sup>&</sup>lt;sup>1</sup> Read ba de a urnichthe R.I.A. PROC., VOL. XXIX., SECT. C.

§ 87. **P**raind dano do tomailt la marb is coir andso 7 etach berar do æs.t. annsin nieon molatarsom ind troscud andos is coir ind

§ 88. IN dand donecmic imsitin hi 5 codlad do neoch 7 ni facaid deilb 7 nibi cumman lais ní do faicsin tresambed elned do canad<sup>1</sup> cethtra salmu 7 donicc<sup>2</sup> in aqua 7 nin derban dó dul do laim iarabarach Fobithin ni heillned dosom indnísin 10 acht is míchumne spiride fri télach neich din imarcraid lenda bís isind churp

§ 89. IS aurcail lais dano codlad do neuch oc praind. ISsed immurgu as 15 choir laisiom cudnód ind prainde arna bether ocu nach cein do<sup>3</sup> cach son immurgu.

§ 90. Treide nad *con*airiti tol dé.<sup>4</sup> maith ara *cum*misct*her* olc. maith 20 tinscantar 7 nad berar co forcenn. accus cobair foreissed madoberthe inruth nocobrafad<sup>5</sup> 7 doberar iarnasa<sup>6</sup> indruth nad cobradar. pity on me and has brought me out of hell to the kingdom of heaven." And Dublitir said: "Who art thou?" "I am a wretched man: Eochu has thought upon me." Afterwards he appeared on the self-same night to Eochu and to his son and wife and blessed them and said the same words to them.

§ 87. "Praind do tomailt la marb" ought to come here, and "Etach berar do aes túate" next. "Nico molatarsom in troscud ... annos" ought to come then.

5 § 88. When pollution happens to anyone in sleep, and he does not see a dream-image, and does not remember seeing anything which should cause him to be polluted, he sings four psalms and

washes in water; and it does not hinder his going to communion next day. For this is no pollution to him, but it is an evil recollection of the spirit, accompanying a discharge of some of the excess of liquid that is in the body.

§ 89. Now he forbids anyone to sleep at meals. This, however, is what he thinks right—to dispatch the meal so that no long while may be spent over it. That, however, is [not] incumbent on everyone.

§ 90. Three things which are not pleasing to God: good that is mixed with evil: good that is begun but not brought to an end: and help that comes too late, which would render aid if an attack should be made, and there is made an attack which it does not help [to resist].

<sup>1</sup> Read canaid <sup>5</sup> a gloss <sup>2</sup> Read donig <sup>3</sup> Supply ni before do <sup>6</sup> Should come after cobair

lo <sup>4</sup> Read nadchonaircet toil Dé

#### NOTES.

P. 127, 3. For the Beati (Ps. exix) followed by the Magnificat cf. 129, 8.

127, 8. fermaidni: for fermit-ni: this form of 1 pl. is found already in the Glosses, e.g. Wb 15d18, guidmit.

127, 10. The word *diol*, if sound, is perhaps the *dil* 'poetry' of which Meyer (*Contributions*) quotes a single example from a poem written in *bérla féine*; but more probably we should read *int ilach*. There is perhaps a reference here to the legend that Christ was born *do mulluch na h-Ingine*, S na R 7529.

127, 13. Cethe for cid hé. So 135, 24. ceth : similarly maith for mad, 144, 3.

127, 15. With this paragraph compare ZCP. iii. 29 § 16 (*Rule of Columba*: cf. Haddan and Stubbs' Councils ii. 1. 119) "men that gossip on trivial and worldly topics, or murmur at things they can neither help nor hinder, . . . these thou shouldst not receive, but let them have a blessing if they deserve it."

127, 16. ni fogni laisim. This phrase recurs very frequently in our text and also in the Rule of the Céli Dé, (where the form fosgni is also found). Fogni, ni fogna are similarly used in the Uraicept, with the sense 'serves (does not serve),' 'is used (is not used)': e.g. BB. 316 b 8 fogni do chách, so BB. 326 b 14: ni fognae a telgud noe BB. 331 a 6: so, too, in Sg. Priscian 203 a 17, 220 b 9, 10, etc. In our text we have regularly ni fogni for ni fogna, no doubt because fogni has become a formula and its original meaning is forgotten.

127, 18. fobenad: for the meaning cf. Laws v. 284, 5 foben inracus acobuir.

doairmescad: this form is against Thurneysen's analysis tairme-scc (Handbuch, § 843).

127, 19. Manip lór etc. This is obscure, perhaps corrupt. With reim iond aosa coimsi compare reim iond aosa i senchellaib 128, 15: reim áosa lanamnasa, 145, 24. If coimsi is for coimse, gen. of commus, then ács coimse may mean influential people, such as neighbouring chieftains. But perhaps we should read ács cuibse, 'people who came to confess': cuibse being gen. of cubus, which two lines further on means ' confession.' There seems to have been a confusion between cubus and cobais.

128, 12. For sen-tascide cf. Togail Trói index. The next words are corrupt.

128, 14. Helair is the "Elarius, anchorite and scribe of Loch Cré" whose death is recorded by the Four Masters, anno 802. See O'Donovan ad loc. and Plummer, Vit. Sanct. Hibern. ii. 26. Helair's island (mentioned below) is Inis Locha Cre, or Monahincha, near Roscrea. There was a settlement of 'Colidei' there: see Reeves, Culdees, p. 21.

128, 15. senchellaib. I do not understand this term: it is used again at 137, 5.

128, 21. torud ind erlamai: tithes due from the fine erlama or tribe to which the patron saint of the church belonged: Laws iii. 38, 72, 74. For the principle laid down cf. § 77.

128, 25. Mochua = Cronán of Roserea: cf. Mart. Oeng., April 28, and pp. 119, 121: Plummer, Vit. Sct. Hib. I. lix., II. 22.

128, 27. With the details in this paragraph cf. De Arreis, § 32 (Rev. Celt. xv. 497). daig cudnuda na salm, etc. Mr. Plummer suggests that Helair preferred not to begin the day with the Beati (Ps. cxix), but to recite it in its proper order: he first recited Pss. i to cxviii in an ordinary vigil and afterwards Pss. cxix to end (cond neoch noduslen) in a cross-vigil, i.e. lying prostrate with arms outspread. The clause fobithin iond forcetail is obscure : cf. note on 133, 9.

 $[23^*]$ 

129, 2. At this point a sign in the margin of the MS. refers to a line written at the top of the page, which is here printed in brackets: unfortunately it is partly illegible; the connexion is obscure; and it is difficult to fix the exact point where the clause is to be introduced.

129, 13. Duiblitir: no doubt the Abbot of Findglas who died May 15, 791: cf. Mart. Don. and Mart. Tall., May 13 and 15.

129, 22. Nicodoes. This seems to be t-pret. passive to -duaid. As to Maelruain's strictness cf. the tract de quibusdam episcopis, R.I.A. Ir. Mss. Series, 1870, p. 129.

129, 24. Deer or wild swine : their flesh did not count as meat, § 51.

129, 32. lind dermait Dé: cf. cach lind somesctha is descaid dermait Dé, Ir. Text. ii. 2, 75.

130, 5. Cainchomrac's death is recorded by the Four Masters anno 786.

130, 10. conatallad: past subj. of tuilim with perfective -ad.

The less caillech may be a hospital for beggarwomen, but more probably it is a hostel for nuns regularly attached to the monastery. Cf. 151, 5 oc cros ind dorus lis.

130, 16. hé seems to be an interjection; unless we read Cid hed so, ol Dublitir.

130, 18. Do riar-su ind. Here ind means (not 'in the matter,' which would be and, but) 'in return for it,' viz. 'for my sin.' Cf. § 9 troscud ind. Other examples of this usage are atherim or Mac Con na cáirig ind LL 291b22; is iat na rátha fritha ind LL. 375b50; tucad dó i n-éc a ingen LL. 375b7; no in mbiad aithrige isna colaib doronsat LBr. 152a21. So also YBL. 287a18; Silv. Gad. 137, 36; Wars of G.G. 32, 10.-W.J.P.

130, 25. seq. Sancte Michaol . . . Sancta Maria: cf. § 28, § 30. Celebra Iuda, Cantemus, Hymnum dicat, Unitas: see Bernard and Atkinson, Liber Hymnorum i. 18, 33, 36, 42. Ego uero orationem, Ps. lxix. 13. I can find no other trace of Auis aue, but the Franciscan paraphrase mentions here the versicle Auerte faciem (Ps. li. 9); and auis aue is probably a corruption of these words.

130, 28. 6 roscithet celebrad: the construction is unusual, but cf. 140, 13, o roscithet iarum ind gabail hisin. Roscithet is for roscoichet.

131, 3. Biad prainddigi: cf. § 83, and Reeves' Culdees 84, 1 (LBr. 9 b 1).

131, 8. aidohi luoin. Sunday is reckoned as beginning from vespers on Saturday evening, and so with the other days.

131, 11. *iar praind*. It would seem that on Sundays dinner was in the evening, after vespers (and therefore really on 'Monday night'); whereas on other days it came after none: see *Culdees* 88, 11; 89, 27; 90, 4 (LBr. 10 a 32; 10 b 16; 10 b 23). The evening meal on week-days is called *cena*: cf. § 69.

131, 19. Nech loingis riasind tráth: cf. LBr. 11 a 5 (Culdees 91, 13).

131, 25. Cornan. This is Cronan of Glen Aosa who is mentioned in Mart. Doneg. Feb. 26 (Plummer).

131, 28. Contra familiam = fri muintir : cf. Thes. Palæohib. ii. 179, 222 (note).

132, 1. tnúth may be used for a variety of passions as well as jealousy.

132, 5. A distinction seems to be made between ordinary penance and strict penance  $(d\hat{u}r-phennit)$ : cf. De Arreis, § 14 etc. (Rev. Celt. 15. 489).

132, 6. rochualai laisim: cf. Pass. and Hom. 6730 itchuala leo.

With this paragraph compare § 51 and LBr. 10 a 45 (*Culdees* 89, 1), where it is laid down that one who does not eat flesh on Easter Day may not eat it under any circumstances whatever until the Easter following. In order to avoid this prohibition, even those who usually avoid flesh meats take a little piece at Easter, so that in case there is a scarcity of other food (through the crops failing or being destroyed by marauders) they may be free to fall back on meat. The arbitrary nature of this prohibition and the extreme rigour with which it is enforced (cf. 146, 17) remind one of the pagan *gessi*.

132, 12. a senad uli: cf. Wb. 9e28.

132, 20.  $n\delta[s]merai$ : this seems to be a case of the aspiration of initial sm-, which is doubted by Thurneysen, Handbuch, § 118b.

132, 24. Cf. the Penitential of Theodore, ii. 12 (Haddan and Stubbs, iii. 199). In §50, *infra*, abstinence on Sunday nights also is enjoined.

132, 32. *ind libris Clementis*: the reference may be either to the Clementine Homilies xi. 30, xix. 22, or to the Clementine Recognitions vi. 10.

133, 1. *illocthiu* may be a corruption of *il-locud* (from *locaim* 'I flinch from '): or perhaps we should read *il-lochtaib cóir* and render 'in contravention of duty.'

133, 2. attmaither is perhaps for addaimther 'is conceded,' or possibly we should assume an admaithim 'I forgive, condone,' and write admaiter.

133, 9. ma theomaised forcetal ind arrad: cf. LBr. 11 b 39 (Culdees 94, 20) na tri cóicait do chedul cech dia mina thoirmesci forcetul.

133, 18. This section is found in almost the same words in LBr. 11a15 (Culdees 91, 26). déraich; prototonic form: one would expect doérig: cf. Stories from the Tain, index.

133, 24. Ní fil ní dogne dune etc. : cf. LBr 11a19 seq. (Culdees 91, 31; 92, 1).

Brandub mac Echach, king of Leinster, was killed in the battle of Slaibre, A.D. 601 (FM.), or 604 (AU.). He seems to have been a personage of note, to judge by the entries of the Annalists: see also the reference to him in FM. *a.* 906, and compare the fragmentary Annals (ed. O'Donovan, Irish Archaeological Society), *a.* 910. For the story as to the circumstances of his birth, see ZCP. ii. 134.

The story of the battle which Moedoc, aided by Columcille, fought against the demons for Brandub's soul will be found in Reeves' Adamnan, p. 205, *note*.

134, 1. isna tirib thair: Mr. Plummer remarks that this probably refers to Fursa's settlement in East Anglia: Bede HE. iii. 19.

134, 5. The dialogue is defective: Mr. Plummer suggests Cindas indeóna? ol sisi. Indeúin crábid ol sesem, 7 foss oc etlai etc. Cf. Ériu iii. 108 (Rule of Ailbe): T'indeuin do béimim i cepp. For the phrase foss oc etlai see Ériu i. 193, ZCP. iii. 449, Lism. Lives 4541. Stokes renders etla by 'penitence,' but this cannot well be the meaning, e.g. in Laws iii. 34, 36; it is rather 'self-abnegation,' 'holiness': cf. ZCP. iii. 448, § 1.

134, 12. inda sacairt doellad : cf. LBr. 10ay (Culdees 89, 6) in sacart doella a grada.

134, 18. [do]neoch gabthe: for this use of do neuch cf. Atkinson, Glossary to Pass. and Hom. s.v. nech. Or we may read nech gabthi 'whoever takes it' (such a resolution), assuming the absolute 3 sing. with suffixed pronoun to be used in relative function.

ariondgel7a, arindbó are pres. sbj. of gellaim, bonnaim with infixed -d-. For arind- see Thurneysen Handb., p. 247.

134, 21. *bithfur* 'continual preparation' as opposed to actual performance (Plummer). The point is that good intentions are more likely to be realized if they are publicly declared.

Mocolmóce ua Lítan = Colmán húa Liathain †725 (FM.): cf. Mart. Oeng., Mart. Doneg., July 25.

134, 27. derbgelsid < di-ro-b-gelsid (dogellim).

134, 32. asindgel7ai from adgellim (adgillim) with substitution of ess for ad: see Thurneysen, Handb. 252, 461.

135, 1. Feil sruith[e] etc.: cf. LBr. 10b2 (Culdees, 89, 9). Atcondairc-som: the person meant is probably Maeldithruib, who is named in the next sentence.

135, 11. Is lor la fairind etc.: cf. Culdees 89, 18 seq. (LBr. 10b8).

135, 17. *indróet*: one would expect *arróet*; I have not found *ind-emim* elsewhere: perhaps we should read *Is sed dorigni Helair ind*: [ar]roét &c. There were strict rules as to receiving monks who came from another monastery: see Wasserschleben, Kanonensammlung 150-1.

136, 3. fotroichleth-su from fociallur : cf. fonrochled Wb. 19c13.

136, 11. 'Summer-Lent,' i.e. the forty days after Pentecost. Jejunia tria ... XL ante Pascha, et XL ante Natalem Domini, et post Pentecosten XL dies et noctes (Haddan and Stubbs iii. 202); Vit. Sanct. Hib. I. cxx.

136, 31 de bith [f] úr ind rédæ sin: the usual meaning of fúr is 'preparing,' e.g. Togail Trói 1272 (Ir. Text ii. i. 40) frecor céill na scor 7 athnugud na múr 7 tórmach na rath 7 na fál 7 fúr cech réla: cf. Stokes, Metr. Gloss. 81, Archivi. 83. In the present passage it may be rendered 'contriving': but some forcing of the sense is needed both here and in the similar passage 134, 21. In 146, 28 bithbúr is no doubt a misspelling of bithfúr.

136, 35. *Ferdachrich*: no doubt the abbot of Dairinis who died in 742, according to the Four Masters, or in 746 according to the Annals of Ulster. His original name was Aed úa Aithmit. In some verses quoted in the Martyrology of Donegal, Aug. 15, he is called Maelruain's teacher.

Aed, ba he a ainm iar bfior ua Aithmit, ba maith a gniomh, Fiorbhráthair, iar mbuaidh co mbloidh, do Mhaolruain, diarb fo[r]cetlaid (sic leg.).

In § 61 Ferdachrich is mentioned as contemporary with Samdan, who died in 734 (FM.).

136, 33. conescomriter from asrenim, with perfective com.

137, 1. With this paragraph compare Culdees 93, 11 (LBr. 11b6). Confessions were usually heard on Sunday (cf. Culdees 87, at foot = LBr. 10a23); and it would seem that penances, including flagellation, were performed that evening. The consequence was, apparently, that the irreligious laity looked on this as a kind of work done on Sunday, and made it a precedent for Sabbath-breaking.

137, 2. fiach naidei luoin = fiach aibne na hoidehe luain LBr. 11b7 (Culdees 93, 12) Fiach aibne 'debt of strap 'i.e. 'flagellation': see Meyer in Rev. Celt. xv. 485. In our text, the phrase is varied: 138, 23, ni tabar fiach aibne : 143, 28-29 iar nimbirt aibne . . . iar tabirt feich: cf. 142, 10 cet moailli (mbuilli) de abaind. In Culdees 86, 15 [= LBr. 9bz] fiach nailme is evidently a scribal error for fiach naibne.

is becc rand seems to be an idiom : literally 'is a small share.'

137, 18. cuaird comgi Michil. For cuairt 'searching,' 'looking for,' see Meyer, Contributions, and cf. gan chuairt cobra BB 401a24. Mr. Plummer would regard cuairtchoimge as a compound, literally 'circuit-protection.'

137, 20. *icennale*. This is written, at the end of a line, *icen na* with *le* above the line. The right reading seems to be *in céin naili*, meaning 'alternately': but this phrase is usually preceded by *cach* '*la céin* (cf. Ml 19b3, 39d12). The words seem to have been misplaced, and should come after *immun maire matin*.

Is head doleici: cf. LBr. 10b29 (Culders 90, 11).

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138, 5. Cetheorae crosfigell (read crosfigle): one for each tráth (cf. note on 141, 4): there was a fifth at nocturns (line 24). He began by reciting the Beati (Ps. cxix) and the Hymnum dicat in 'cross-vigil,' that is, lying prostrate with his arms spread out in the form of a cross: then he sang the first hundred Psalms: then he performed the second cross-vigil, reciting the Beati a second time, and also the hymn Cantemus: then came Psalms ei to cxxxix (Domine probasti) followed by a third cross-vigil, with the Beati as before and also a hymn, which was on alternate days the Hymn to Mary or the Hymn to Michael: then the remainder of the Psalms were sung, and after them he performed the fourth cross-vigil, reciting this time thirty paternosters. This last form of cross-vigil is mentioned again 144, 36.

138, 23. The reference to exemption from flagellation is out of place here: it is introduced because relaxation in regard to cross-vigils is granted at the same periods.

138, 25. Two Christmases i.e., Christmas Day and Epiphany (notlaic steill). Two Easters, i.e. Easter Day and Low Sunday (the Sunday next after Easter).

139, 7. Ní dilgatar: the Franciscan paraphrase has ni maitter iad.

140, 3. Cach [la] gabal, etc. : cf. LBr. 10a37 (Culdees, 88, 17).

140, 6. is dia forciull som : read perhaps is de daforgill-som (cf. 16 infra); this sentence would then begin the next paragraph.

140, 8. Niconéirsed . . . niconsesed : for this use of the secondary future cf. Táin Bó Cúalnge (Eriu) 333 seq : ní tergad . . . dogénad : and infra 142, 17 nogébad a salmu.

140, 13. O roscithet ind gabáil: one would expect ó roscáich, but cf. note on 130, 28.

141, 4. The period between *matin* and *fescur* is divided into four *trátha*, and a hundred genuflections are made in each of these.

141, 29. tresind dochradsa for tresa ndochrudso (dochruth, 'indecorous').

142, 1. Gille nó timtirid: cf. LBr. 10b32 (Culdees, 90, 16).

142, 2. arnachoarda seems corrupt.

142, 3. Manataigter, for mani-t-ágathar.

142, 7. arnachadfercaigther-su . . . manatfercaichther : the verb is reflexive : cf. mad notfergaither LBr. 10b32.

142, 27. iar tabairt a fuail cf. LBr 10b37 (Culdees 90, 20).

143, 4. Clemens mac Nuadat is probably the same as Clemens of Tir da Glas, † 797 FM., or 801 (AU.).

143, 6. inddand dondecmised, for intan dondnecmised.

143, 13. Ni aurtet ní: Meyer, Contributions, gives 'arteit, it proceeds, passes': but this interpretation does not fit the passages quoted. The true meaning seems to be 'takes the place of, answers for, compensates'; thus in Laws iv. 176, 26, when a man has killed a bee that stung him, artet a cinaid 'the killing compensates for the liability incurred by its offence,' Laws iv. 178, 16 artet sochaide cinaid noenfir 'the many answer for the liability incurred by one' (so Atkinson). In our text 161, 11 we have artaott troscud sin 'this takes the place of a fast.'

143, 21. Bliadain glantai cf. 136, 6.

Na tri xl aidchi: that is, the three Lents; see on 136, 11.

143, 24. ma tecme: so LBr 9b40 (Culdees 86, 2) cingit chorma didiu intan donecmaic.
144, 1. Aithrus may be for aithris, 'telling' (i.e. telling one's state of mind): or perhaps for aires 'meeting, interview.' In either case the genitive ind anmcharat is somewhat awkward.

144, 26. Diarmait was abbot of Iona from 815 to 831 (Reeves' Adamnan 388); so 'bishop Carthach' cannot here be the saint usually known under that name, Mochutu of Rathen and Lismore, who died in 636. Perhaps the person meant is the Carthach, abbot of Tir Da Glas, who died in 851 (Four Masters): he may have been both abbot and bishop.

144, 28. Ní bé erchailiud lat, etc.: a warning against ascetic vows of excessive rigour: compare the story told in § 34 and the tone of §§ 68, 77, 80, 82.

144, 35. 'Between nocturns and tierce:' cf. Culdees, 90, 13 (LBr. 10b30).

145, 3. fri geld báis, cf. LBr. 9 b 34 (Culdees, 85, 24), minabe gell de anmannaib and the modern geall le 'almost': gell re beith marb, Death Tales 42, 2.

145, 14. cin troiscid: a breach of rules punishable by fasting; but one would expect troiscthe.

146, 8. Cf. 129, 24 and LBr. 9b29 (Culdees, 85, 18).

146, 13. Mani chaithea feoil 7 saill in pascha: cf. note on § 12.

146, 28. bithbúr : see note on bithúr, 136, 31.

146, 29. Beo-marbad. The correction beógad 7 marbad is easy, and accords with cach 'la céin: if we keep the manuscript reading, we must understand it as meaning 'all but killing,' just as beó-gonta means 'wounded but still living,' beó-chned 'a wound that is not fatal.'

146, 32. *inda timchol* may mean 'apart from them,' 'without their knowledge': for this use of *timchell* cf. Pass. and Hom. Glossary; Thes. Pal.-Hib. i. 597, note d. But perhaps it is to be taken with *timthirid* 'the servant who waited upon them.'

146, 33. seland always implies some little indulgence in the way of food: cf. 135, 6; 151, 25; O'Dav., 1484.

The object of adding extra water and boiling for a longer time is apparently to make the mess more digestible and nourishing.

147, 2. *tiug-lagin*. I have not met the word elsewhere; but the meaning must evidently be 'porridge' or something very similar.

147, 15. Antan tra dontic, etc. There is something wrong with this sentence; some words seem to have been lost.

147, 25. ni argara itid diob: cf. cumma aranggairtís gortai 7 íttaid díb na hubla LU 23a16.

147, 28. mani pendea a reir: cf. LBr. 10b38 (Culdees 90, 25) inti nád penni do reir anmcharut.

148, 2. fothrue should perhaps be fothrucad, but cf. co foile 7 co fothraic LU 58a14.

148, 6. ni accamar praind indi[b] fri die. On Sundays the prandium seems to have been postponed until after vespers: see note on 131, 11.

148, 13. rombeir: the infixed -n- denotes that the verb is dependent on some implied idea such as 'be sure that.'

148, 19. neich forbé lortid do muindtir de. We should perhaps write do muintir Dé, translating: 'anything that remains to the family of God (the works) after they are satisfied. But cf. 128, 7 a forbí for lortaid na muindtire.

148, 20. maith leisim bess: here maith is for mad, as in 144, 3: leisim apparently refers to lex aos, a phrase which I take to mean the 'idle rich' (lese-des); unless it rather denotes those who lead a profane life, neglecting the labours of piety (sdethar). It was evidently a disputed point whether contributions should be accepted from such persons: cf. 128, 16; 159, 15.

148, 22. This paragraph is somewhat obscure. The first sentence would naturally

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mean that after a full meal stirrings of concupiscence are apt to be felt (cf. §§ 59, 63). But then what is the meaning of rejecting (adcor = athchor) or subtracting from the meal, if it is already eaten? Does adcor mean 'casting the responsibility' upon the Lord? digbail neich den praind presumably denotes reduction of diet for a certain period after such an experience. brue is apparently dative of broe 'sorrow,' here rather 'vexation, annovance.'

148. 26. Doselbi: a present subjunctive used quasi-imperatively 'you may keep': cf. Táin Bó C. (Eriu) 1553 doselba do chotach didiu. I have not found the compound elsewhere, except as a variant to Félire, Epilogue 4 dosealba do bliadain.

148, 29. an eola [s] sin. The word eolas means knowledge gained by experience: see Ml. 19d18, 57c11. Here it rather means 'experiment, trial.'

149, 4. The suggested emendation *foibthi* is understood as participle of *fobenaim*, as foirbthe of forbenaim, but the meaning assigned is doubtful.

149, 10. Another story is told of a sister of Molaise, LL 285b, but her name is not given.

149, 15. fit mesraigti: cf. 155, 27; so in the Pœnitentiale Vinniai, panis et aqua per mensuram (Wasserschleben, Bussordn. 109 sq,).

149, 18. Bui siom oc huamim. This was a common occupation in monasteries: it is prescribed in the Rule of St. Columkille (Haddan & Stubbs ii, 120: so too in the Rule of Ailbe, Uaget, negat in bráthair (Ériu iii, 100).

150, 1. As to Samdan abbess of Cluain Bronaich, see Plummer, Vit. Sct. Hib. 1, lxxxvii, 11, 253.

150, 23. conimthisi I take to be for co n-imthius-sa fut. of \*imtechim (cf. adteach). 150, 28. conidairsir from arsissiur.

151, 1. As to the relation of devout women to monasteries see Loofs, Antiq. Brit. et Scot. Eccl., pp. 81 seq.; Gougaud, Chrét. Celt. 93. A canon laid down by the Synod of Patrick, Auxilius, and Iserninus is worth quoting (Haddan and Stubbs ii, 328) :--"Monachus et virgo, unus abhinc et alia abaliunde in uno hospitio non commaneant, nec in uno curru a villa in villam discurrant nec assidue invicem confabulationem exerceant."

151, 14. Is fochric: so Wb. 10b1, 14, of those who prefer the life of celibacy.

151, 15. a foindel, etc.: the a seems unnecessary. It is doubtful whether one should read here and in line 21 ina menmain 'in his mind' or inna menman 'of the thoughts.'

151, 21. Nicomór, etc.: after ní a verb is needed meaning perhaps 'I inquired.'

152, 13. nat furea galir for nad fóirea galar: cf. 3 B. 23, 19b, Nech praindes co fuiri galar ndó.

152, 16. Doimine abbatis Romæ. I know nothing of this man, nor have I met the name Doimine elsewhere. It is possible that we should read *ir-riagaild Eimine* (there is no division in the MS., and the spelling *riagaild* might be supported by figild, 128, 31). There was an Emine who died at Rome; see LL. 313b25. He can hardly be identified, however, with the author of Cáin Emine Báin, who was buried at Ross mac Treoin (Plummer, VSH i, 21; Ériu iv, 40, note 2).

152, 18. ind fit bec min, etc. : cf. LBr. 10by (Culdees, 91, 5).

153, 1. do thuildiud is probably a doublet of do tormuch and should be omitted, unless we are to construe dogniat . . . do thuildiud: cf. dorinne sé é féin do nighe (Dinneen).

153, 3. Praind dano, etc.: cf. LBr. 11a11 (Culdees 91, 21). As to the pollution caused by the presence of a dead body, cf. Todd Lectures, v, 89 (Life of St. Martin) arna roelnitís roise in nóib ó básaib na ndóine nécraibdech in a fhiadnaise.

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153, 11. Diarmaid: the Abbot of Iona already mentioned, § 47. It was during his tenure that Blathmac mac Flaind was murdered in Iona by Norse pirates: see Four Masters, 823. Who Curúi was I cannot say: he may have been the 'chief of Cinél Loegairi' who died in 792 (FM.). Blathmac was celebrated in verse by Walafridus Strabo: see Reeves' Adamnan, 315, 388-9, with the references there given, and *Poetæ medii ævi Carolov.* ii. 297, ed. Dümmler and Traube.

153, 15. conditoirmese diob : cf. Pass. and Hom. 575 ni rotoirmescad dibso.

153, 16. ind leuitic. See Leviticus xxi. 11; xxii. 4.

153, 17. For this use of occo denoting a set of circumstances, cf. Thes. Palæoh. ii. 252 *Huisque prius in calicem* 7 *issed canar occo*, and the instances given by Fraser in ZCP. VIII. 56.

153, 18. The latter part of this story (from 154, 5 *et dixit illi*) and the next have been edited by Bergin (Ériu, ii. 222) from Stowe C. i. 2: some of the principal variants are given in our critical notes (marked C).

153, 19. Findio mac Uiatach: probably Findén of Mag Bile, who belonged to Dál Fiatach (LL. 349e10; BB. 219a39).

153, 29. *tech pende*: Bergin reads *tech péne*, but a special house for those undergoing penance is expressly prescribed in the Canons of the Synod of Aix-la-Chapelle: Hefele, Concilien, iv, 24.

154, 2. isintturtt for isind urd.

155, 27. *niconfil ind riagail*, etc. Fasting is of course regularly prescribed as a penance: the meaning here is perhaps that it is not enjoined as an habitual discipline.

155, 28. fueregtar for fuirigther, from fo-rigim: the variant fuirestar might be referred either to forigim or to foricim.

155, 29. A Rule ascribed to Comgall will be found in Ériu i. 192 seq. : but it contains no reference to fasts.

155, 33. *bairgine Coluim Cilli*: presumably a loaf of a particular size and make used by St. Columba: cf. *arán Mochue*, 128, 25.

156, 1. Page 45 of the MS. is written in a different hand from the rest; and it is noticeable that aspiration of medials and of m is much more frequent here, and that the only cases of d. pl. of adjectives in -ib occur in this page, 156, 17 and 157, 2, also the late forms *rotuit*, *rotinol*, 157, 10, 15.

156, 7. erdath for airddach: see Meyer, Contributions. It would seem that St. Columba lent his countenance to some festival of pagan origin connected with the growth of the crops. Or perhaps his Feast of the Ploughmen is an imitation of the Jewish feast of the first-fruits: see Levit, xxiii. 10.

156, 9. nobithe: passive imperf. of the substantive verb.

156, 13. *ir-riagail Colum Cille*. There is no reference to this subject in the *Regula Columbæ* printed by Haddan and Stubbs ii. 119.

156, 19. superposat . . . superpositio . . . cena careat. These formulæ are used, e.g. in the Penitentials of Gildas and Cummean (Wasserschleben Bussordn. 107, 466, 489). Superpositio is properly the continuation of the Friday fast into the Saturday: it was sometimes practised as a form of self-discipline, sometimes enjoined as a penance: Duchesne, Christian Worship (translation), 231, 285.

156, 23. forich : read forice, 'finds.'

156, 29. *in mile cemenn*. Mr. Plummer suggests that there may be some reference to a limit of distance imposed on Sunday walks, a 'Subbath day's journey,' but perhaps it is rather an obligation to make excursions on Sundays with some pious object.

156, 31. in mile cemind fri torrome fir galair: cf. céim torroma lobair lis, in a poem attributed to Adamnan, ACL. iii. 215.

157, 4. I cannot identify either Crundmael or Artri.

157, 13. Bithbés menadehe, etc. Another copy of this story is found in R.I.A. 23 P 3, and has been printed in Anecdota from Irish MSS. i. 75 (see also ACL. ii. 136). Some variants are given in the critical notes (marked P). The latter part of the tale is, however, corrupted in this copy. The word which we have expanded as bithbés is written in our text bithb-, in 23 P 3 bithbin. Meyer regards it as a man's name, quoted as authority for the story. But this makes it difficult to explain the words is e a auctartas: one would rather expect is é as auctarthas don soél-so sis. The word bithbés is found (as Mr. Plummer points out to me) in Keating's History (ed. Dinneen iii. 82, 4).

157, 22. Rofasaigthea na toirten . . . Gó 7 peccad, etc. The idea that the fruitfulness of the earth was affected by the virtues and vices of its rulers is common in Irish literature: see, for instance, the Dindsenchas of Carman, RC. xv. 314; Tripartite Life, ii. 507, note; and compare Leviticus xxvi. 4.

158, 17. Clerech lasa marbtar, etc. This sentence is repeated in § 84.

158, 28. *Mae 'Oige*: †746 (FM) or 752 (AU): see a curious note on him in Mart. Oeng., p. 256, where he is called abbot of Less mór Mochutu, i.e. Lismore in Waterford.

158, 30. *cia bald ba dech*. At 154, 25 and elsewhere *ball* is used in the sense of 'a member' of the Church: here it seems to mean rather 'constituent' or 'attribute' of the religious character.

159, 1. degserc is merely a miswriting of deserc; and derscaigtech is a corruption of degsercach = desercach (Plummer). The paraphrase has deirceach.

159, 9. Rochachti, etc. Cf. LBr. 11a35 (Culdees 92, 14) Fer didiu nacachta cu mor, "A man who disciplines himself severely."

159, 15. focerd a chubus som ar tomailt torith. For the idiom cp. Ériu ii. 92 focheird mo menma airi, LU. 130a 14 focheird a menmain airi, and Wb. 11b21 arna rala for cubus airi. These instances show that in the passage last quoted for is not, as Stokes and Strachan suggest, the preposition, but the possessive pronoun.

arna tta i.e. arna tae pr. subj. of -tuit with gemination after arna.

159, 37. cen co is not found in the Glosses (Strachan, Stories from Táin, 15, note).
160, 5. fort chubus: cf. LBr 12a37 (Culdees 96, 17) fer graid gaibes eclais for a chubas.

160, 9. dana coibsenithersu: the suggested emendation assumes the existence of a deponent coibsenigim. But the whole sentence is very awkward, with the transition from the third person to the second.

160, 14. ne pereas: if the confessor neglects his duties, he becomes liable for the sins of his penitents: cf. LBr. 10 b 8 (Culdees 89, 17) dosteit a chin fair.

160, 15. Nicon gus, if sound, seems to be used like nicon mór brig, 152, 6. In LBr. 10b45 (*Culdees* 90, 33) it is laid down that a younger man may receive confessions from an elder.

161, 1. Bithbés: the MS. has bithb<sup>-</sup>: see note on 157, 13.

161, 5. Tri troiscothe: cf. 155, 31.

161, 8. Arre troisethe, etc.: cf. LBr. 11a42 (Culdees 92, 23, where the last clause should read "this serves in place of a fast").

161, 14. This Colccu is probably Colcu úa Duinechda, †789, author of the Scúap

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Crdbaid, copies of which exist in Brussels, 5100-4 fol. 12, and 2324-40 fol. 69 (Plummer). Eogan may be Eogan mac Colmáin, †769 (FM.), or Eogan of Lismore, †771 (FM.).

161, 16. a techta do denam : cf. antaun mbis a cridhe ina techta ZCP. iii. 451, 14, and ni cumaing foruacrae firinnde inna techta ZCP. iii. 450, 24; cf. Thes. Pal.-Hib. i. 582, note d.

162, 1. Biadd prantigi: cf. 131, 3 and LBr. 9b1 (Culdees, 84, 1). aonach is corrupt: some word meaning 'verse' or the like is required.

162, 8. ind soscele . . . frisa tocabar : cf. 158, 22 tocbale soscéli.

162, 13. deorad. In the Laws the term deorad Dé apparently signifies a person who has renounced his place in the tribal organization in order to dedicate himself to the service of God, and has thereby forfeited the claim which his tribal connexions might have given him to the succession to an abbacy (Laws iii, 74). Skene (Celtic Scotland, ii, 70) regards the term as simply equivalent to 'anchorite.' In the present instance deorad means perhaps simply a monk from another monastery.

162, 25. *atarann*: Mr. Plummer would read *a taraind* (tairndim) 'when the fire struck down.'

163, 6. Eochu ua Tuathail, anchorite, bishop and abbot of Lugmad (Louth) †820 (FM.).

163, 8. If the archetype had cum .x. fis, this would easily be corrupted to cum .x. siis, and hence the reading of our MS.

164, 17. [ni] do chách són: cf. LL. 74b34 ni do chach la Meidb in lind dailter for Fer mBaeth. The meaning here may be that it is not good for everyone to hurry over meals.

164, 22. Treide nadcon airiti, etc.: cf. LBr. 71 marg. inf. a tri on-airecur tol dé, etc.: this suggests the emendation offered. Cf. also LBr. 225 marg. inf. Fuil tri ní do nach buidech mac Dé bii. We have to do with a triad of things which fail to keep up to their first promise. The third seems to be cobair iar n-assu 'help that comes too late': cf. Táin Bó Cualnge (ed. Windisch) 3942 giarb i in chobair iar n-assu. The rest of the last sentence is then explanatory, and nocobrafad is a gloss on foreissed (from foriuth). Arrange accordingly: accus cobair iarnasa, foreissed (nocobrafad) ma doberthe inruth, 7 doberar indruth nad cobradar.

#### GLOSSARY.

abraitiud a wink of the eye 162, 25, 37, 42; Contr. adgellaim I promise rel. cum pron. infix. asindgel7ai 134, 32: adgillim Contr. adlongaim I drink : pr. sbj. 3 pl. adlúsat 147, 24 admaithim ? I excuse 133, 2 adrali has caused 149, 8 aille méise praise for the table, grace after meals 131, 9; aille, praise, Wi aintech given to fasting 159, 2 airchaill prohibition Contr.; ni haurchail 143, 18; 145, 15 airddach festivity Contr. ; erdath 156, 7 aires tryst Contr.; caratrad irse 153, 22 aithglanad repurification 136, 7 aithrus telling (one's sins) ? 144, I; aithris, Contr. alt kind Contr.; pl. altai 140, 28 ammarthan ill-luck 130, 13: i.e. am-sorthan, cf. am-sén (or else am-marthain) anteirt prime 138, 7; 145, 25; Thes. Pal.-Hib. i.. 3 arberim I intend Contr. 3 s. pr. sbj. rel. arabera (sic leg.) 161, 29 aridralistar has contrived it 153, 27: cf. Thes. Pal. ii. 318, note k arre an equivalent 161, 8: Contr. arrec immediately, absolutely 158, 3; Thes. Pal. ii., 162, note d. arsissiur I stick fast Contr. ; pret. conid-airsir 150, 28 verbal noun air[i]sem 157, I artét compensates, takes the place of 143, 13; 161, 11: Laws aruscc rere for example 160, 18: Suppl. Thes. Pal. 25 asendad at last 135, 21, 25; 150, 34; Contr. asrenaim I pay : with com- infixed, conescomriter, 136, 33 atarann? 162, 25 athgnu for aithgne knowledge? 160, 23 atrocuil ? 151, 11 aulaid stone slab 151, 5: Wi aurcilled ? 156, 9: cf. airichell ' preparing for, expecting,' Contr. ball attribute, characteristic 158, 30

bannán a little drop 150, 34 beo-marbad killing alive, half-killing 146, 20 (dub. 1.) bíait 1. The Beati (Psalm cxix) 127, 3 et passim 2. biait praintige, a form of grace used after meals 131, 3; 162, 1 bith-fer a constant observer? 151, 24 bith-fur continual preparation 134, 21; bithur 136, 31; bithbúr, 146, 28 \*bonnaim I declare : pr. sbj. cum pron. infix. arindbó 134, 18: cf. adbonnaim, Contr. braisech kale 132, 20 : Contr. broc grief Contr. dat. bruc 148, 26 buidetu yellowness 150, 36 caodet they eat 132, 7: for caithet (?) cathbarr crown 127, 13 céimm stile 130, 8; Cáin Ad : LL 286613 celebrad celebration of canonical hours 129, 7 etc.: see Plummer VSH 1, cxv note 14 cellach contention 162, 11; Contr. céta what art thou? 134, 3; ciata, Contr. enoc lump (of butter) 147, 9 coibsenigim I hear confessions Contr. pr. ind. dep. d[i]a coibseni[g]ther-su (sic leg.) 160, 9; verbal noun coibsenugud 149, 5 coich of whatever kind 152, 31; Contr. coimsi, aosa coimsi? 128, I colláa, begone ! 130, 12: Contr. condalim I share in 158, 23; Contr. conmescaim I mix with Contr. ara cummiscther 164, 20 conmidiur I give orders Contr., pres. 149, 14; pret. 141, 24; fut. conmesar 129, 30 corp lai the middle of the day? 129, 6 cotaot (v. l. cotetet) accompanies? 154, 28: conamteit (v. l. cotnimtét) 155, 24 cotreicigur? 155, 22: (v. l. cotretiguir) orád distress 152, 23, 30; Contr. cride-scél a darling wish 136, 20: cridiscel la Faind Ir. Text i., 208, 32; Contr. crochet flitch Contr. : d. pl. croch [t]aib 128, 13 cross-figil cross-vigil 129, I etc. Wi (figell) cruthaim I shape Contr. fut. rocru[th]fem 'we shall be able to devise' 130, 22

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- cúairt searching Contr. cuaird comgi Muiri 137, 19: cf. cúairt cobra BB 401a24 cudnód hastening 164, 16; Contr. cudnud keeping Contr. : daig cudnuda na salm 128, 31 cumlechtach abundant 161, 7; Contr. cuthech a snare Contr. : d. pl. cuidachaib 131, 16 dag-menme hilarity, jollity 143, 5: cf. LU 73b39 corop maith a menma. déis tenantry MacNeill, Population Groups 62: g. s. in deissi (read na déisse) 156, 30; pl. deissi, Triads. deorad a stranger, outlaw 162, 13; Contr.: cf. Laws, deorad Dé dessebar the southern region 162, 40; Contr. deu[d]lái the end of the day 129, 5; diu láoi 138, 29; Contr. diching? 142, 29 dígde asking pardon 141, 25, 29; Contr. díol ? 127, 10 doairlim I approach 142, 14; do-air-ell-Ascoli : nímthairle Thes. Pal. ii. 352 doairmescaim I perplex 127, 18; I hinder 153, 15; tairmescaim Tog. Tr. docuirethar it befalls, it falls upon 135, I: cf. Stories from Tain, index doenacht natural temperament 152, 14, 15, 21 doérgim I make bare, I abandon, Stories from Táin; déraich 133, 21: verbal noun, dérge 133, 19 \*doetarrethim I overtake: pres. ind. donetarrat 151, 9; past subj. danetarred 143, 4 doforgillim I arrange, appoint? 140, 17 : hence perhaps -torclaither O'Dav. 1587, meaning 'is ascertained, is testified ' dogellaim I pledge 134, 27 (or do-ro-gellaim ?) doicsaim I pull; dotiesa (for doiesa) 150, 27; ticsaim Wi doim 'poor' 144, 24: SnR, ZCP vi. 265, st. 26doléicim I discharge, perform 137, 24 doselbaim I keep? 148, 26. -dúad I ate, Wi: pret. pass. nicodoes 129, 22 dul do láim to receive the sacrament 161, 17: 163, 21; 164, 9; Rev. Celt. ix. 24 erlam patron saint, Wi., Laws; torud ind erlamai 128, 21; 160, 1; tír ind erlama 160, 5 escai 128, 2? ess vessel 143, 19: Rev. Celt. xii, 117? O'Cl.
- etla self-abnegation, holiness 134, 6: SnR, Ir. Text iii. index
- feccaim for I set about 150, 30, 33; 155, 13: cf. Ériu ii. 226
- fíach aibne lit. debt of strap, the penance of flagellation 138, 23. Rev. Celt. xv, 485:
  Ériu iii, 102: so fiach naidei lúoin 137, 3.
- fice piles 152, 9, pl. of fie = lat. ficus: Vendryes, Hib. Voc.; Ann. Ul. 807
- flescad beating with rods 155, 2
- fobenaim I attack, annoy: fobenad 127, 18, Fianaigecht, index; participle (?) foibdi 149, 4 'excited'
- fociallur caveo ; pf. pass fotroichleth-su 136, 3 fochíallaim, foichlim Wi
- \*fo-fo-ess-crinim I wither: 3 s. pres. ind. fofeiscren 149, 8, 9; verbal noun feiscre (fescred) Triads
- fogni serves, is used 143, 27, etc.: ní fogní 132, 21, etc.; ní fodgní 140, 25; fodgníod 140 22; fogeni 145, 7; forógeni, 143, 2 (see note on 127, 16)
- fofúabraim I undertake t-pret. forrórpart (for foropart) 130, 16 fóbairim, Wi; fofúabair, Stories from Táin
- forbíu (1) I exceed 128, 7; 148, 19; (2) I light upon 130, 13; Táin 551 (Ériu); Rev. Celt. xiii, 471
- forcell evidence, indication 140, 6 (dub. l.); forgell Wi, Laws
- forcleith concealment 135, 20
- forcomaim I guard Tec. Corm.: dep. forcomedar 129, 35
- foropair extra labour 133, 14: Mart. Oeng.
- forrach a perch, a measuring-rod Wi, g.s. na forchae 133. 14 (or perhaps from farcha, 'a mallet,' P. & H., Laws, Mag Rath 162; but Dinneen gives this word as masculine).
- foss continuance, perseverance 134, 6; 144, 28 Wi
- fostad confirming in orders (?) 128, 19; from fossad, steadfast, Wi.TBC index; but cf. Contr. adsuidim

fothruc washing 148, 2 perhaps for fothrucad; but cf. Stories from Táin, index

frepad cure, healing 160, 11, Wi

friscomarcim I ask, Wi; ceni freemaire
135, 16 verbal noun fremarc 134, 23

gabail a division of the psalter 139, 11

- gann rough, coarse gan-tuarai 152, 22; Thes. Pal. ii, xxi; stout, thick O'R.; Saxan ngalbech ngann Metr. Ds. ii, 36
- gell promise, pledge, Wi: fri geld bais 'at point of death,' 145, 3
- gléim (1) I decide, Wi, (2) I am fixed, completed; coroglea dó a foropoir 133, 16: go roglé dó uile, 'till it was all done,' Mart. Oeng. 92, z; co roglé dam, 'till my mind was made up,' Ir. Text i. 98, 16
- gleten finishing 140, 29: cf. gléim
- iar nassu too late 164, 23 Contr. s.v. asse
- immarchide fitting 127, 9 Zeuss
- immberim I pour water 142, 15; I wield, I
  ply, etc. Wi (imbrim)
- imbert chanting? muttering? 162, 2 (imberim) imchomarc greeting Wi 150 2
- immdílmain wholly free (from sin) 155, 4: dílmain Contr.
- imsitiu pollution verbal noun of \*imb-esssemim 164, 5: fothrucad hi nimsitin LBr 11 a 39
- immtechim (?) I entreat fut. 1 s. co n-imthisi 150, 23
- indemaim (?) I accept : -t pret. indroét 135, 17
- ingell vow 146, 18; 161, 30 Laws

ingnam produce, crops: g. s. ingnama 156, 9: cf. ingnum O'Dav. 1138 indgnam, Laws

- less caillech hostel for nuns 130, 10, 20
- lex-áos for lesc-áes or lax-áes? idle (or irreligious) people 148, 18
- lictiguth permission, authorization 136, 4: from Lat. licitum: cf. licet, Ériu i, 208 locthiu 133, 1 corrupt
- longaim I eat Wi, I drink O'Dav. 1163, cf. 1197: pr. subj. -ralú 145, 2; impf. subj. -lúsad 143, 1; -lustis 129, 21
- lortnaigim I satisfy verb. dep. notlortnigethar
  152, 13
- lórtu sufficiency 128, 7; 148, 19; 161, 27 Asc.
- maircethenach lamentation 155, 13
- mí-accobar evil desire 152, 21
- mí-imrádad evil thoughts 151, 16.
- mod measure Wi; of food 149, 14; of labour 159, 31
- muim a possession (?) 141, 11: O'R.
- náilim (naillim?) I put on oath? ronáil fair 150, 3: cf. noill Laws

neméle 127, 6 complaint Wi

- ord *rule*, *regulation* Wi: ord bertha 137, 11; isintt urtt chetna 154, 2
- pars a particle 132, 7; of sacramental bread, ZCP iii. 36 note; of time, Mag Rath 108, 332.
- rand share: in phrase, is beec rand 137, 4. réimm course of duties prescribed, cursus 128, I, 15; 145, 24 Wi
- roebaidecht excessive drinking 147, 25
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rúsce firkin 128, 13 Wi

- sain-serc favourite 150, 10, 15
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- scuchim I cease: Wi: present-perfect roscithet
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- seland any addition to the ordinary diet 135, 6, selind nimbe; 146, 33; 151, 25; 155, 34: g. s. seillne 145, 21
- sen-chill old church 128, 15; 137, 5
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- súire freedom from restrictions, exemption from duties 132, 34, 145, 31
- tairridi ? dia tairridi 138, 32 aidchi tairridi 138, 35 the day after, the night after; perhaps dia táirre di (tárr, 'hinder part')
- tairthim a swoon, trance 155, 15 (taurtaim): cf. Wi, Táin B. C.; Mart. Oeng.
- teeh pende house of penance 153, 29; 154, 1
- techte fitting, proper 147, 24 Wi?
- télach, discharge, effusion 164, 11 Dinds. 104; Anecd. i, 1
- ting-lagin mess of pottage? 146, 33; 147, 2, 6.
- tnúth lust 132, 1 ' envy, indignation, longing ' U'R., Dinneen
- tóebatu *trust* 150, 41 cf. mairce dibeir toebadeo de Rev. Celt. xxi, 318 (read tóebatid)
- tolnur (5) I please pres. ind. ní mór tolnathar 134, 19, perhaps for tolathar, cf. Hymn. 1, 35 rontolomar; LL. 171a3 ratholathar
- tromde troublesome 130, 11: Stories from Táin tuádebar the northern region 162, 41

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## VI.

# THE FIRST PRINTING OF THE NEW TESTAMENT IN ENGLISH AT DUBLIN.

#### -By E. R. McC. DIX.

#### Read APRIL 10. Published JULY 12, 1911.

WHETHER the so-called "Authorized Version" of the Bible, or of the New Testament, was printed in Ireland before 1714, when Rhames's edition of the Bible appeared, has been long the subject of dispute arising from an allegation that the Bible, or New Testament, was printed in Belfast prior to that year; but this allegation is now generally rejected for lack of satisfactory evidence to support it, though the point is not absolutely and finally settled even yet.

Evidence, however, is now forthcoming to show that the New Testament was actually set up in type and printed off in sheets and some copies, in that state. sold in Dublin in the year 1698.

The Guild of St. Luke, one of the ancient Dublin Guilds, comprised the Painter-Stainers, Cutlers, and Stationers of the City. Their original Minute and Record Books are extant in the custody of the Master Painters of Ireland; and Mr. Charles Keatinge, about ten years ago, read a paper on the Guild before the Royal Society of Antiquaries of Ireland, which paper appears in the Society's Journal, vol. xxx, pp. 136 et seq. (1900). At p. 139 Mr. Keatinge quotes from a Minute of a meeting of the Guild [held on 7th November, 1698, not 1699] in which a charge of lately printing (for James Malone & Partners) an edition of the New Testament, containing very many errors, is made against Bryan Wilson and Cornelius Carter (the printers of it), and the Stationers (Members of the Guild) were given leave to meet and advise what course or method was fit to be taken to suppress or detect the same, and that the Clerk do draw any Petition or address as should be thought fit or advisable. I have also recently been kindly afforded an inspection of the original Minute Book, and took a copy of the Minute in question so far as it bears on the matter; the same appears at Appendix A, and is fuller than that given in Mr. Keatinge's paper.

The particulars afforded by this Minute are very meagre and insufficient alone, and also represent only one side, or version, of the alleged illegality of publishing a New Testament full of errors. It may be stated here that

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Eliphal Dobson, Jacob Milner, and Robert Thornton, three of the members at the meeting, were Booksellers and Stationers.

Lately, however, while checking over the MS. Catalogue or Index to the original MSS. in Marsh's Library, Mr. J. R. Scott, B.A., the new Assistant Librarian there, noticed an original paper, in contemporary writing, dealing with this very matter, and at once drew my attention to it, and through the kindness of the Rev. Dr. White, the Librarian, I have been permitted to have a copy of the "Paper" made, to submit to the Academy.

The "Paper" is a Petition or Statement drawn up for, and presumably presented to, the Privy Council, though it may never have reached them; and, while confirming in the clearest manner the actual printing of the New Testament, it also gives a wholly different version of the whole matter, and throws light on Dublin printing at the time that is of much interest. There is no date to the paper itself; but internal references, coupled with the Minute of the Guild meeting, fix the date sufficiently.

Though I annex a full copy of the paper as an appendix (B), I will here detail its substance with such references and additional information as seem necessary.

The paper is headed and endorsed —

"The State of the case of Thos. Somervell Merchant."

Somervell describes himself as a "Merchant"; but as his "Goods" were in part "Schoolbooks," he may fairly be given as a "Bookseller," and perhaps "Publisher." He says he was a Freeman also. He states he imported from London quantities of Schoolbooks; but, owing to the heavy tax laid on paper and printing in 1696, such importation became unprofitable; and he joined with Thomas Simpson, Merchant, and James Malon[e], Bookseller, to have such books printed here, and sold them much cheaper than the imported ones, besides giving local employment, and keeping money in the country.

At the end of 1697 he had a quantity of fine Genoa paper which fell to half its value; and to retrieve the loss he proposed to print on it a New Testament, and agreed with Cornelius Carter, a Dublin printer, to print 400 copies, and gave him a copy of a London-printed Testament bought from a "Protestant" bookseller. Carter proceeded with the work, and, when nearly finished, Somervell offered to Simpson and Malon[e] to take the book in partnership at what it cost him, and they agreed. (Malone had been Stationer to James II. when that Monarch was reigning in Dublin, and was a Roman Catholic.)

Several of the other Dublin booksellers, however, finding Somervell's project was almost perfected, bought twelve of the Testaments in sheets, and proceeded to note any defects in them. They found some undoubtedly, though Somervell

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gives only one, and says it occurred in the London edition. It was sufficient, however, apparently, to enable the objecting booksellers to make a complaint to the Lords Justices and Council on the subject, and all the Testaments were seized (in sheets, Somervell said, as, presumably, not bound), and were retained by the Clerk of the Council. Somervell also and his two co-partners were taken into custody.

Somervell then states that these booksellers were trying to have the books condemned, which, if effected, would occasion him much loss, etc. He offered good security to amend any errors in the Testaments, not to sell them till approved of by some divine chosen by the Council, and to sell them 40 per cent. less than imported. He protested that he would not print any Roman Catholic book, though the hostile booksellers charged him therewith, the better to obstruct his good intention to try and bring printing to perfection in Ireland, and to sell books cheaper than before.

As a further instance of the booksellers' persistent malice against him, Somervell states that they had obtained an order from the Lords Justices to stop in the Customs some type imported from Holland for John Brocas (a Dublin printer of that time), solely because such type was consigned to him (Somervell) and James King, and the latter was not "permitted to an entry" till the pleasure of the Lords Justices was known.

The incident is one of interest in all its details—the effort to promote and improve local printing, the source whence types were obtained, the names of the booksellers and the printers, and the jealous action of portion of the trade to injure a fellow-tradesman under cover of religious zeal of a party character; but it is of interest mainly to establish the fact that the English New Testament (Authorized Version) was actually printed here in 1698, though suppressed before being publicly sold.

The early records of the Irish Privy Council, etc., having been destroyed by fire in 1711, it is impossible to ascertain what was done eventually with the seized New Testament; but as no copy is extant or recorded, it must be assumed that the booksellers were successful, and that Somervell's petition was rejected and all the sheets of the New Testament destroyed. DIX-First Printing of the New Testament in English at Dublin. 183

### APPENDIX A.

Extract from Minutes.

Com. Civil Dublin.

Monday Novr 7th 1698 Being a Hall day of ye Guild of St Luke ye Evangelist Dublin

Present

Joseph Toplis Master, Robert Caddell & Eliphal Dobson Wardens

Aaron Crossley Hen Coleman Jacob Milner Luther Slater Roger Evans Geo Dowdall John Bentley John Ellis Robert Thornton

Ordered, &c.

Upon a motion made that ye title & preface of Cockers Arithmetic was printed & putt to Hodders Arithmetic & thby those were Deceived yt bought ym for Cockers Arintmetic, On exam<sup>n</sup> of ye matter, Mr Patr Campbell & Mr Jacob Milner Acknowled ye error & confessed that a very few or not above 20 were disposed of or sold so altered & promised that what Titles were Printed shd be destryed & for ye future no book shd be sold with a contrary title or preface.

John Dykes &c. fined &c.

"Upon informacion that ye New Testament was lately printed by Bryan Wilson & Cornel' Carter for James Malone & partners with very many Errors &c. throughout ye impression Ordered that ye Stationers members of this Guild, have Leave to meet & Advise wt Course or Method is fitt to be taken to suppress or Detect ye same And that ye Clark do Draw any peticon or Address as shall be thought Fitt or Advisable.

J. Toplis Master

R. Caddell & E. Dobson, Wardens.

W. Winter clk.

21.

#### APPENDIX B.

#### The State of the Case of

## THOMAS SOMERV $\overline{E}$ LL Mercht.

That the said Thomas Somervell is a Merchant and Freeman of the City of Dublin and amongst other goods deales in Schooll Bookes haveing in his time Imported from London to this city severall great Quantityes of ye s<sup>d</sup> Commodity—

That about ye year 96 the Parlaimt of England haveing Laid Near 30 per Cent on paper and Printing the s<sup>d</sup> Somervell found it would not turn to account to Import any such Bookes from thence and therefore joyned in Company with Tho<sup>s</sup>. Simpson Merch<sup>t</sup>. and James Malon Bookseller to have School bookes printed here which they sold 40. p. Cent Cheaper than such sort of bookes would be Imported from England and by that meanes also e Imployed severall poor people and kept Considerable sumes of Money in the Contrey.

That at the *Conclusion of ye peace*<sup>1</sup> Somervell had a Considerable quantity of fine Genoa paper which fell above halfe the price here that to retrive his Losse thought it Expedient to print a Testament on the said paper (a booke much wanted in the Countrey) & to  $y^t$  end did agree with Cornelius Carter a printer and freeman of Dublin to print 400 Testaments and Somervell bought a Testament of London Print from a Protestant Bookseller and gave it to Carter for a Coppy.

That when Carter had Near finished y<sup>e</sup> Testaments Somervell Accquainted Simpson and Malon that if they pleased they might take the said booke in ptnershipp at the price they Cost him to w<sup>ch</sup> they Agreed.

That Severall Booksellers of Dublin finding that Somervell was like to bring the Worke to pfection w<sup>ch</sup> they never could and Envying Somervell for y<sup>e</sup> same Bought a doz<sup>n</sup> of said Testaments in Sheets to see if they could finde any faults in them and finding some the Most Materiall whereof was in the  $12^{th}$  Chapter of St Mathews Gospell & y<sup>e</sup> 10<sup>th</sup> Verse wher y<sup>e</sup> words (that they might Accuse him) were left out both in y<sup>e</sup> Copy and y<sup>t</sup> printed here on which they gave Information to their Exx<sup>ncies</sup> the Ls Justices & Counsell and thereuponn y<sup>e</sup> s<sup>d</sup> bookes were all Seized in Sheets and are now Remaining with ye Clark of ye Counsell and Simpson Somervell & Malon were taken into Custody of y<sup>e</sup> Messingers.

<sup>1</sup> Nov., 1697.

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That the  $s^d$  booksellers and printers do Indeavour to get  $y^e s^d$  bookes Condemned  $w^{ch}$  if Effected will tend much to the prejudice and Losse of Somervell.

That Somervell will give good security to Amend all Faults & Ommissions in ye sd Testaments & when Finished will not Expose any untill Veuied and approved by some reverend Divine that the Counsell shall thinke fitt and will Sell them 40 p. cent. Cheaper than they could be Imported and also Somervell Never Intended nor never will print or cause to be printed any Popish bookes though the booksellers would Asperse Somervell therewith ye better to Obstruct Somervells good Intention in Endeavouring to bring printing to pfection in this Kingdom whereby bookes will be much Cheaper sold than formerly. And in Manifestation of y<sup>e</sup> Booksellers Continued Malice to Somervell they have lately peured An Order from ye L<sup>ds</sup> Justices for Stopping some printing Letters Lately Imported from Holland for Account of John Brocas a freeman of Dublin & a Protestant for no Other Reason but y<sup>t</sup> y<sup>e</sup> said Letters are Consigned to Somervell in Company with James King of Dublin Merch<sup>t</sup>, and y<sup>e</sup> said Letters are now stopt in the Custome house and King Somervells Partner not permitted to an Entry till their Exx<sup>cys</sup> Pleasure be known in the Matter Although Brocas will give Very good security Never to print a popish Book w<sup>ch</sup> the Booksellers scandalously asperse him w<sup>th</sup>.

[Marsh's Library,---V. 3. 1. 27, No. LXXXVIII.]

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## VII.

## TYPES OF THE RING-FORTS REMAINING IN EASTERN CLARE (KILLALOE, ITS ROYAL FORTS, AND THEIR HISTORY).

#### BY THOMAS JOHNSON WESTROPP, M.A.

Read JUNE 26, 1911. Published AUGUST 12, 1911.

In two previous papers<sup>1</sup> we have more than once had occasion to study forts to which the evidence inclined in favour of the great age of the structures. There can be little doubt that the "great Clare gold find" (which came to light near the foot of the hill girt with the triple ramparts of the great fort, or rather town, of Moghane) was the plunder of the chief fort of eastern Co. Clare. If so (and the remains give every mark of vast age, in the decay and collapse of the walls, and in ring-forts of a type attributed to the early days of our era having been also built across their lines), the stronghold may date back to the sixth or seventh century before Christ. The isolated finds, such as the bronze socketed celts and other implements found in a fort at Raheens and elsewhere, prove very little, but may favour the origin of certain lesser forts being also of the Bronze Age. The connexion of a first-century chief with the name of Magh Adhair, in the legends reaching us from the later tenth century, give a not incredible date to the place and mound specially connected with his name, but the subject calls for scientific excavation.

In this section I have to follow up the history of a far later group of structures, but as simple and primitive in type as the forts of Tara or Rathcroghan. Hitherto, the best evidence we found for a ring-fort of the comparatively late period was for that of Tulla, about 610. Now we must come down more than 200 years to reach what seems the earliest assignable date for any of the Killaloe forts.

The interest of this present paper is historical rather than structural, for the forts were the chief seats of the kings of that great Dalcassian line who set their mark everywhere on the history of the West for a thousand years. They and the history of their owners commence after the gloom and silence of the seventh and eighth centuries; for, though it may be owing to the wars with the Norse in the ninth century that the history of the preceding period is so obscure, that time is the well-head of many a stream of events that is still

<sup>&</sup>lt;sup>1</sup> Proc. xxvii. (c), p. 217 and p. 371.

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affecting the Ireland of to-day. Documentary evidence for forts later than these is rare-mention of a fort near Magh Adhair named Lismacain, from a Macan who fell in the raid of King Flan to the inauguration place there in 877;<sup>1</sup> the stone fort of King Chonchobhar Ua Briain about 1100; the Norman castle of Huamerith,<sup>2</sup> on the Shannon, in 1199, possibly made near Cappagh and Sixmilebridge, where a place called Baile an Mhuta, the townland of the mote, was still known in 1558,<sup>3</sup> but is now forgotten; and the Norman castle at Killaloe some ten or twelve years later. No trace is known to exist at any of these; but the square or oblong platforms at Bunratty<sup>4</sup> and Culleen,<sup>5</sup> so different from the normal earthworks of the district, may have been made by the followers of Robert de Musegros, in Tradree, about 1250. The latest fort of all, the "rath of beauteous circles," dug between 1230 and 1250, at Clonroad, has left no trace. Evidently late is the oblong earthwork of the "Earl's House." Whether, and, if so, which of the numerous little ring-forts scattered over eastern Clare may be late, I have no means of knowing. The Cathreim Thoirdhealbhaigh abounds in mention of residence in forts, duns, cathairs, and "uamhs" from 1280 to 1317; the "1390" rental names "MacNamara and his servants in the rath"; O'Huidrin, before 1420, tells of the family of Muinter Duibhraic dwelling in Dun Brain in O'Gonnello. The peel towers of Aharinagh, Ballyganner, Cahercloggaun, Cahermurphy, and others show forts used as residences during the later fifteenth century. Certain Elizabethan documents name (apparently) inhabited forts, while the O'Davoren deeds of 1605 and 1675 show how late that learned family of lawyers dwelt in the ring-wall of Caher MacNaughten. That the forts were inhabited down to very late times by the gentry is certain; several were occupied by the peasantry far down the last century, and two (Cahir-Balleeny and Craghballyconoal) in Burren to the present day; small ring-walls, indeed, were built and ringmounds thrown up from a slight fosse to make a cattle-pen or a fence for a

<sup>4</sup> If this be (as I am inclined to think) the base of one of the wooden towers that surrounded the stone castle in 1290, see Pipe Rolls, Ireland, Edw. I. <sup>5</sup> Supra, xxvii., pp. 230-232.

 $[26^*]$ 

<sup>&</sup>lt;sup>1</sup> Mr. R. Twigge, F.S.A., kindly gave me this reference from the Book of Ui Maine, a very helpful fourteenth-century MS., rich in extracts from earlier sources. It occurs on *f*86*b*1.

<sup>&</sup>lt;sup>2</sup> Hu Amerith—Hui Aimrit (Aimbrit).—There was another ancient sept of the name (descendants of Barren) in Ciarrhaighe Luachra, a branch of which may have crossed the Shannon.

My former conjecture (R. S. Ant. Ir., vol. xxiii., p. 189) that Huamerith is Buanereth or Bunratty is certainly wrong. Huamerith is the "Y Emrid" of Thomas de Clare's Inquisition, 1287, the "Ui Aimreth" and "Ui Ainmire" of Irish documents. From the account of O'Brien's march from Limerick to Tulla through Ui Amrid in 1318 (Cathreim Thoirdhealbhaigh), it commenced not far to the west of Crutloe, and extended past Ballymulcashel to Cullaun Lake, i.e., the parishes of Clonlea, Kilfinaghta, and Kilfintinan, down to the Shannon. The upper part is "Tuath na hamban" in the "1390" rental.

<sup>&</sup>lt;sup>3</sup> Domhnall Og Mac Cearnaigh had a pledge on the half-quarter of Baile an mhúta—apparently adjoining Leckan (Carrownalegan) and Cappagh, south-west from Sixmilebridge, near the railway station. The date is given, 1450, incorrectly in Proc. R. I. Acad., vii. (1857-61), p. 15.

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plantation, even within my recollection, so caution is always necessary unless the massive character or size of the fort marks it as of early origin. Clare (like Kerry) is singularly devoid of large earthworks or, indeed, tumuli. The existing forts were probably all courts or cattle-pens, few sepulchral, none probably "castles" or "forts" in a military sense, as for holding down an imperfectly subdued country<sup>1</sup> or keeping out invaders. They were merely fenced protection during the endless raids of our history.<sup>2</sup>

#### THE DAL GCAIS.

An important question may be faced here, for the history of the Killaloe forts makes it very relevant to this survey. How far is the received belief about the early importance of the Dalcassian Chiefs true to history? The silence of all our Annals (even those of Innisfallen) as to this subsequently great house before the Danish wars (about 812) is most striking.<sup>3</sup> The great difficulty, or break, of their chiefs' pedigree at Corc is equally marked; so is the lack of recognition of the Dal gCais as a power in Clare. About 840, the Ui Cormaic of Central Clare, when cruelly pressed by the great tribe of Corcavaskin along the Atlantic, turned for help to Felim (Feidlimid), the Eoghanacht King of Cashel,<sup>4</sup> not to Lachtna or Lorcan of the Dal gCais. Only gradually, and that in no "pre-Danish" record, do we find the assertion of the double succession of the Dal gCais and Eoghanachts. No examples can be produced, even from Dalcassian ex parte statements, save Aed Caemh, about 560, and Lorcan in the ninth century, and, as to these, there was an Eoghanacht, Aed of Cashel, contemporary with the Dalcassian "Aed of Cragliath," while the most reliable king-lists give no King Aed of Cashel within three or four generations of the mid-sixth century. The "Lorcan son of Conligan," who was actually King of Cashel, is clearly not Lorcan son of Lachtna; the latter is only King of Thomond in the best attested records, but the later O'Briens alleged him to have ruled at Cashel.<sup>5</sup> The evident weakness

<sup>4</sup> Eugene O'Curry's "Manners and Customs of the Irish," vol. iii, p. 262.

<sup>5</sup> So O'Dubhagain: see Keating, History (ed. Dinneen, Irish Texts), vol. iii., p. 197. Keating (p. 199) emphatically states that Cormac's will was not carried out.

<sup>&</sup>lt;sup>1</sup> This use was not unknown, however; cf. Cath ruis na Rig (Todd Lecture, Series 6), p. 9, "The warriors' hands are occupied with making dunadhs and dindgnas in the territories of strangers."—Poem of the Norse period: "the warriors" were Irish.

<sup>&</sup>lt;sup>2</sup> Professor MacNeill points out, however, that the raids have a weighty significance as denoting (1) claims to tribute, (2) repudiation of such claim, (3) attempted enforcement, (4) a means of testing he prowess of young aspirants to the chiefship; "the first raid of a young lord" being proverbial.

<sup>&</sup>lt;sup>3</sup> The entries relating to Thomond in the Annals of Ulster record Corcovaskin, 704; Corcumroe, from 743; Tomgraney, 739; but the Princes of the Dalgcais are not named till the time of Cenedid. Annals of Inisfallen give Kings of Cashel from 585, and records of Cliach from 697, Hua Fidginte from 720, Corca Duibhne from 771, the Dalgcais only from 918 (*recte* 938); but incidentally mention Lorcan as father of Cinedid.

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of the Dal gCais at the raid of Fedlimid of Cashel about 840 is well marked.<sup>1</sup> He possibly recognized Lachtna as their chief. It is certain that Cormac MacCuileanan, King of Cashel, at the very close of the ninth century, was the first to see the growing importance of the tribe.<sup>2</sup> Even half a century later, when the decadence of the Eoghanachts, after the death of Cormac at the disastrous defeat of Cashel by Leinster at Bealamoon (907), and the capture of King Ceallachan Caisil (941), had paved the way for other competitors,<sup>3</sup> and Cenedid of the DalgCais had been tanist of Cashel (even if he had not claimed the kingship, and then consented to forego it, as is stated in a rather doubtful record),<sup>4</sup> Mathgamhan's seizure of the kingship of Cashel was resented, not as a wanton reinforcement of an effete right, but as rank usurpation, as gross as that of his brother Brian, when the latter usurped the High Kingship of Ireland a little later. Mathgamhan paid with his life for his intrusion on Cashel, which largely excused in Eoghanacht eyes<sup>5</sup> the treachery of Maelmuadh and Donnabhan in 976. The reign of Brian shows a feverish desire to assert vested rights to the throne of Cashel from prehistoric half (or wholly) fabulous princes, Eogan and Ailill Olom. The real right was that of the Lamh Laidir, the strong hand, still borne by the descendants of Brian in crest and motto. The fresh, able, physically strong and long-lived princes and warriors of Craigliath ("Highlands above Lowlands," as so usual) tempered in the fire of the two centuries of struggle with the Norse for very existence-rose upon the ruin of the men in the rich plains of the Golden Vale and the Eoghanacht of Cashel. Then, when at length their claim could not be gainsaid, their opponents saved their own credit by accepting the myths so flattering to the conquerors.

Professor Mac Neill, to whom I owe much help from the records and many suggestive hints, had, with greater material and knowledge, arrived independently at similar conclusions to mine. Most striking of his discoveries is that of the identity of the "In Deis Tuaiscirt" with the Dal gCais. He notes:—"That Dál Cais was anciently known also as 'In Déis Tuaiscirt,' is proved by a number of texts." The Book of Leinster, 319c5, 'Cormac Cass, a quo Dál Caiss .i. In Déis ' (that is, In Deis). In the Book of Ballymote, 171b39, "Is i cland Ebir fo Erinn .i. Dail Cais, agus Dail Cein, agus Dealbhna,

<sup>&</sup>lt;sup>1</sup> Book of Munster, MSS. R. I. Acad., 23 E 26.

<sup>&</sup>lt;sup>2</sup>He even in his "will" recommended that Lorcan son of Lachtna should succeed him (Keating's "History of Ireland"), vol. iii., p. 199.

<sup>&</sup>lt;sup>3</sup> However, Ceallachan defeated Cennedigh mac Lorcain at Maghduine in 943 ("Chronicon Scotorum"), and survived him for three years, dying 953.

<sup>&</sup>lt;sup>4</sup> Cathreim Cellachain Caisil (ed. Bugge, 1905), p. 59, note, p. 122. Keating's History, vol. iii, p. 223.

<sup>&</sup>lt;sup>5</sup> The Annals of Inisfallen do not conceal the violation of the pledge (957, i.e. 976).

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agus Desi in Tuaiscirt" ("The descendants of Eber throughout Erin are," &c.). The scribe repeats a former error by separating Dál Cais and the Northern Déis into two peoples. Probably he failed first to recognize their identity, and then added "Dál Cais" to supply the supposed omission, for in the Book of Lecan, p. 455, in a paragraph commencing "Se maic Milead," the list is given without the word Dál Cais-"Eber, now from him descended the Eoghanacht of Munster and the Northern Déis." In another passage (174b10), "This is the covenant of Dál Cais among themselves, i.e. the Northern Déis and the Southern Déis." Déis means a vassal community; Déisius equals rent; Aire Desa, chief of vassals. The Dési of the Annals were, perhaps, ancient (pre-Celtic) vassal communities under Celtic lords. I am convinced that the genealogical connexion between Dál Cais and the Eoghanacht of Munster is fictitious, or rather symbolical, expressing the fact that the Dál Cais was a free state, like the Eoghanacht states of Munster, not being tributary to Cashel. This identification explains some entries in the Annals of Ulster, where Dál Cais is not mentioned before 1053. A.D. 712, "The battle of Carn Feradáig, ubi cecidit Cormac mac Maenaig, King of Munster [in battle], with the Northern Déis." 743, "Overthrow of Corcu Mu Druad by the Déis." 835, "Carnage in battle [inflicted] on the Northern Déis by the Pagans [Norse]." 896, "Flann mac Lonain, descendant of Guaire [was] slain by the Déis of Munster." 940, "Muirchertach [of the Leather Cloaks] ravaged the Déis." The dates are corrected by adding one year.

It is very probable that the local Annals and documents of the Bruree monarchs perished in the unexpected, irresistible swoop of the Norsemen on the plains of Limerick after A.D. 800.

This identification, to some extent, breaks the silence that most of our Annals keep with regard to the powerful and warlike tribe of the Dal gCais before 800.

I have only to add that I venture to give these papers with long collections of field notes to the Academy, from the belief that the culpable negligence of our local authorities, and their refusal to vest and preserve our ancient monuments, are already leading to the wholesale destruction of invaluable lesser antiquities. What avails it if an abbey or occasional castle or church be preserved if hundreds of forts, tumuli, dolmens, and pillars are swept away to the detriment not only of Irish but of European archaeology?

<sup>&</sup>lt;sup>1</sup> The Annals of Inisfallen only mention (under 882) his mortal wound. The "Chronicon Scotorum" (under 896) tells of his death by the Ui Cuirrbuidhe, viz., by the Ui Fothaidh of Loch Dacaech in the Deisi of Mumhain. Care must, however, be taken that the later "Deisi Mumhain" or Desmond entries be kept distinct from those of the northern Deis. The Deisbeg tribes in eastern Limerick about 1200 must also be distinguished from other Deis.

#### KILLALOE.

The three forts of Grianan-Lachtna, Bealboruma, and Kincora lay close to Killaloe. That place must have been a settlement from very early times, being a comparatively strong and secluded position, and an important pass, a glen hemmed in by great heathery domes and walls of mountains from 900 to 1,700 feet high (their flanks once thickly wooded), above rich plains and slopes, and a fish-abounding river. At the second fort was a most important pass between the two parts of the old Kingdom of Thomond, the ford of Boruma. From it lay a highway for ships and boats up far between Connacht and Leinster into Leitrim and Sligo. A great natural fortress, a long spur of drift clay, commanded the ford, and on its extremity, probably for ages before any entrenchment was dug, dwelt a colony of the Stone age. Traces of a remote civilization met those who, to us, are the ancient inhabitants. Cragliath was the holy hill of the great war goddess, the tutelar spirit of the Dal gCais, Aibhinn, "the lovely one," akin to if not the actual war goddess of the Gauls, "Catabodva." Fert Fintan, on the eastern hills, was so ancient that the monks could only symbolize their belief by regarding its hero as antediluvian. Nevertheless, the historic Killaloe was made in the seventh century by two clerics of the ruling line; and its secular history only begins when the Norse had trampled under foot the royal line and residences of the old capital at Bruree, early in the ninth century.

THE EARLY KINGS.—In dealing with the beginnings,<sup>2</sup> I am painfully aware of my own great, perhaps hurtful, limitations, so nothing is written here dogmatically, but with the utmost reserve. Criticism has only now commenced

<sup>&</sup>lt;sup>1</sup> For her and other Clare banshees, see "Folk Lore," vol. xxi, p. 186. The Gaulish component may be, however, "bodva," victorious, rather than "badbh." For the war goddesses, see Cormac's Glossary (Irish Glossaries, ed. Whitley Stokes, 1862), xxxv., pp. 8, 31. For her replacing the Sybil in the Irish "Dies Irae," see MSS. R. I. Acad., 23M27.

<sup>&</sup>lt;sup>2</sup> For helpful material in the collections of the R. I. Acad., see Hodges & Smith's Catalogue--23E26, Firbolg territories; 2868, Boruma; No. 153, Baile Boroimhe and its festive arrangements, 23E26, p. 35, Cormac mac Cuileanan's poem on Conall Eachluath, son of Lugad Meann, ante 900; p. 41, poem on Lachtna and Felim of Cashel; p. 42, King Flann's defeat at Magh Adhair; p. 43, the bard Flann's panegyric on King Lorcan and Essida, ante 891; p. 47, same on Lorcan's defeat of the men of Connacht; p. 49, anonymous poem (contemporary) on Cenedid son of Lorcan; p 50, panegyric on same, "Cenn Coradh where happens to be"; p. 51, poem by the Coarb of Patrick on Mathgamhan, son of Cenedig, when he took the shield of O'Rorke of Breffni; p. 36, poem by St. Brenan of Birrha on Aed Caemh of Cragliath, ante 570; MS. 23F16, Shane O'Dugan's poem on the Kings of Cashel from 380 to 1367 (ante 1372); one of 1020 by Donchad, son of Brian, vaunting his father's fame. Dr. O'Brien, Bishop of Cloyne, "Essay on Tanistry." Vallancey's "Collectanea," vol. i, p. 456, from the Mac Bruodin's manuscripts. The early "Wars of the Gaedhill with the Gaill," Rolls Series. a history of Kings Mahon and Brian, 970-1014. The Tract on the Dal gCais has been first published in the North Munster Archæol. Soc., vol. i, by Mr. Robert Twigge, F.S.A. "The explication of the race of Cormac Cass." I cite it as "Dal gCais," with the pages of the translation.

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bringing together the early sources of this history, and has gone far enough to make the comfortable omniscience of earlier antiquaries impossible without as yet replacing very much on a surer basis. It is very probable (as Professor Mac Neill has noted, and as I long ventured to assert) that we have little original matter relating to the history of Co. Clare earlier than the ninth century. Our detailed knowledge possibly begins with the collections of the poet, Flann mac Lonain, in the latter half of that period.

I venture to suggest that when the Irish learned classes endeavoured to recover what was left after the fearful ravages of the Norse and Danes, they found probably lists of kings, fragmentary genealogies, and certain old accounts of heroes of outstanding importance, which sagas (early forerunners of the "Wars of the Gaedhil" and the "Triumphs of the Torlough") gave only patches of light in the gloom of the earlier centuries. The tribal genealogists endeavoured to connect the pedigrees of the chiefs with these, partly by genuine descents, partly by, wrongly or rightly, embodying early lists, partly it may be by unfounded guesswork.<sup>1</sup> Tribes, recognized as of equal standing and rights, or conscious of ancestral ties, gave a further clue, and their rulers were traced to common ancestors. Therefore, while believing that some (perhaps much) truth lies in what has come down to us, I do not commit myself or my readers to any belief in the full correctness of the alleged pedigrees.

It is clear that with the great collapse of the Roman Empire and the westward movements of its destroyers, there was a strong development of energy and restlessness in Ireland in the fourth century. Claudian sang of "the Scot" who made the sea foam "with hostile oars" in his raid on Britain;<sup>2</sup> and there can be but little doubt that the nameless Irish invader was the terrible Ardrigh Niall, "of the nine hostages," under whom St. Patrick was brought a slave to Ireland. In north-west Connacht another great monarch, Fiachra, had arisen.<sup>3</sup> His mother, in endeavouring to secure the sovereignity for her sons, poisoned her brother, Crimthann, the High King, in 377, drinking of the same cup to disarm his suspicion. She died; he was carried towardsMunster, to die on the hillside above Limerick; but her crime failed of its object.<sup>4</sup> Crimthann had a foster-son, Conall Eachluath, whose father, a Munster king, Lugaid Meann,<sup>5</sup> had ravaged the present Co. Clare, and reduced the central

<sup>&</sup>lt;sup>1</sup> Similar welding, by unproved assertion, of modern descents to the English visitation pedigrees were common in the eighteenth and early nineteenth centuries.

<sup>&</sup>lt;sup>2</sup> Ode to Stilicho.

 $<sup>^3</sup>$  O'Donovan has brought much material together in "The Tribes and Customs of Hy Fiachrach." Crimthann's race and "high kingship" is doubtful; both rest on somewhat uncertain legends.

<sup>&</sup>lt;sup>4</sup> Book of Ballymote, translated by Mr. Standish Hayes O'Grady in Silva Gadelica (vol. i, p. 413, text); vol. ii, p. 378, also "Wars of the Gaedhil," p. 67.

<sup>&</sup>lt;sup>5</sup> Mr. Knox suggests that Lugaid and Conall may have been princes of non-Dalcassian tribes,
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plain as far as the hills of Corca Modruad. This possibly led the young prince to claim the district as an eric for Crimthann's death. On this, and the " strong hand," the Dal gCais kings, reputed descendants of Conall, are all said to have based their title to the conquered land. Fiachra could not rest; again and again he penetrated into Munster, till he fell in a great victory in Kenry, Co. Limerick, in the latter half of the century.<sup>1</sup> St. Patrick met a son of this warrior; and the early Christian priests may have heard, from aged veterans, of him, Lugaid, and Conall, full accounts of the war, of which, not improbably, authentic history secured at least an outline, for Conall lived at the very close of the century. Lugaid Meann<sup>2</sup> was reputed descendant of a very great mythic King of Munster, Aillill Olomm, who reigned at Bruree, in the rich eastern plain of Co. Limerick. He crossed the border of Connacht (which lay then at Cahernarry, and the Shannon), and fought the conventional "seven battles," ending at Lughid, or Ath na Luchaid (now "Lockwood"), on the border of Co. Galway. So awful must have been the reverse that one of those primitive geasa (in the "Book of Rights") enjoined the King of Connacht for all time, "in a speckled cloak let him not go to the heath of Lughid in Thomond." It was, however, only Eanna,<sup>4</sup> his grandson, son of Conall, who colonized the new acquisition, "Lugaid-red-hand's cruel sword-land," possibly in the early fifth century, and the great tribes of Corca modruadh and Corcabhaiscinn, in the west of Clare, at most only paid a tribute. So far the tradition is clear, widespread, and credible. This cannot be said of the crowded generations between 400 and 440. In them we find a misty series of eponymi. Cass, Cassin, and Blod, from whom the tribes of Dal gCais, Ui gCaisin, and Ui mBloid, were said to have sprung; and the even more doubtful Aengus Cen-aitin (furze, or fire, head), and Aengus Cenn Nathrach ("serpent head"<sup>5</sup>), from whom the O'Quin and the O'Dea families boasted descent. It is possible that there was only one legendary, Aengus, whose variant epithets were

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such as the Ui Catbar, but the character of their conquest as a gain from Connacht seems unmistakable.

<sup>&</sup>lt;sup>1</sup> Some say "in 358"; the dates are of course very doubtful, the period fairly certain. See Keating's "History of Ireland," and Mr. P. J. Lynch in Journal, North Munster Archæol. Soc., vol. i, p. 168. Lugaid's acquisition was "from Carn Fhearadaig to Luchad, and from Ath na Boraimhe to Leim an Chon (Cuchullin's Leup, Loop Head)." For Carn Fhearadaigh being Cahernarry, Co. Limerick, see the 1540 Rental of the Burkes.

<sup>&</sup>lt;sup>2</sup> Son of Aengus Tireach ("Wars," pp. 53 and 67), not to be confused with the Ulidian prince Lugad Meann, son of Aengus, who slew Eochy Gunnat in *curca* 267 ("Silva Gadelica," ii, pp. 102, 519).

<sup>&</sup>lt;sup>3</sup> "Leabhar na gCeart" (Book of Rights), ed. O'Donovan, p. 5, and Cuan Ua Leochan's poem (ante 1024), p. 21.

<sup>&</sup>lt;sup>4</sup> Tribal ancestor of the Hui Enna and Hui Erc Osraidi, "Book of Lecan," p. 406. For the first, see "Wars," p. 82, n. 8.

<sup>&</sup>lt;sup>5</sup> "With poison" is added in one late copy.

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taken from the great ridge of "Cenn Nathrach," or Keentlae (ceann tsliabh)1 over Inchiquin Lake.

If the Tripartite Life of St. Patrick be correct in that particular, the saint visited and baptized Cairthinn, "the fair," and his infant son, Eochu of "the red mark," at the fort of Singland near the later city of Limerick,<sup>2</sup> where in the townland of Singland an ancient church and round tower, long levelled, bore, and a modern graveyard still bears, the saint's name. Eochu's son, Breasal, or Brecan,<sup>3</sup> founded existing churches in central and north-western Clare and Aran, about 480, sharing the great Isle of Aran with St. Enda. His brother Conall did not reign, but his son Aedh Caemh (548 to 561) is said to have dwelt at Cragliath at Killaloe, and to have been made King of. Cashel. A complimentary poem by St. Brenan of Birrha<sup>\*</sup> supports the first statement: "Both are my friends-Aed of Craig Liath of numerous offspring. and Aedh of Corc's Cashel of the companies." It was to the interest of the Dal gCais to show that some of their separate line had reigned at Cashel,<sup>5</sup> but Mathgamhan in the tenth century is the first undoubted case after the Christian kings of the fifth century, and the kingship of Lorcan is a mere assertion.6

With Aedh, the kingship even of Thomond appears to have passed from his line; next to him succeeded Forannan of the Ui gCaisin (brother-in-law of Guaire Aidhne, a powerful prince), 610-20, the opponent of St. Mochulla :7 he dwelt at Tulla. The kingship returned to the line of Cass in Dioma, of Bruree; the last attempt of Connacht to recover the present Co. Clare was

\* See Dal gCais, p. 237. The genuineness of the verse is doubtful, but it does not seem to support the accession of Aedh Caemh. Probably later Dalcassian politicians (yearning for evidence of the alternate succession to Cashel) wilfully confused Aedh of Cashel with Aedh of Cragliath.

<sup>3</sup> The early Christian Kings of Cashel ("Book of Ballymote," 596 44) are : Aengus, s. of Nad Fraich fell at Ceil Osnad, c. 490 : Eochu. his s., fell at Sliab Eblinne (A.U. 533); Cremthann, his s., 20 years: Cairbre Crom, s. of Eochu, 30 years; Fergus, s. of Cremthann, 12 years; Feidlimid, s. of Cairbre, 15 years; Finghin, s. of Aed, s. of Cremthann, s. of Fedlimid, s. of Aengus, Fingen Cohld. Fille Florn 20-20-14 personauters, of Angaid s. of Cairbre. s. of Core, the father of Nad Fraich), 10 years; Maenach, s. of Fingen, 15 years.

<sup>6</sup> Sons respectively of Lachtna and of Coniigan. The latter was king of Cashel, on strength of which the former was asserted to be king. Cennedigh was tanist of Munster. There is no evidence of weight for earlier claims of the Craglea line.

7 "Vita S. Mochullei Episcopi" (written 1141). "Analecta Bollandiana," xvii, p. 135, Guaire appears in the Annals from 626, at a battle at Corn Feradhaigh, where the Connacht men were

<sup>1</sup> See "Book of Rights," pp. 89, 93, among the forts (port) of the King of Munster, or rather claimed by him. Nathrach is probably a man's name, not a "serpent," though legend revelled in such monsters. See "Folk Lore," xxi, pp. 477-480. <sup>2</sup> "Tripartite Life of St. Patrick" (ed. Whitley Stokes, Rolls Series), vol. i, p. 207.

The accessories are mythical, the main facts probable.

<sup>&</sup>lt;sup>2</sup> "Book of Lecan," p. 214, "Brecan of Aran, a righteous true-judging saint, he and Conal Caemh, of much guile, were the two sons of Eochu Bailldearg." Brecan was at first named Breasal. His tombstone, "Sci Brecani," was found buried deeply in his traditional grave at the end of his church in Aranmore.

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frustrated by his victory at Knocklong. The Dalcassians allege that he claimed the kingship of Cashel from Failbhe Flann, in 634, but without success. Contemporary with him was Toirdhealbhagh<sup>1</sup> (Torlogh), father of St. Flannan of Killaloe, who is said to have been "king" in the life of that saint,<sup>2</sup> the only descendant of Aedh even called king till the ninth century. He may have been actually chief of the obscure little tribe of Ui Thoirdheabhaigh, near Killaloe, which bore his name.

The Bruree line<sup>3</sup> had a long succession in the kingship of Thomond. The above-named Dioma, 627, son of Ronan son of Aengus son of Cairthen finn; Ferdomnach (who gave Inis Sibthonn, on which island part of Limerick city now stands, to St. Mainchin), Aindlid, and Dubhdiun, the three sons of Dioma. Cernach grandson of Aindlid, after 700; Torpa, his son, *circa* 750; Donall and Finachta, sons of Eachtighern, grandson of Ferdomnach, 770 till after 800. Then about 810, the Norse fleets landed their mail-clad swarms on the plains of the Luimneach, the plain of Bruree was overrun, and the house of Dioma vanishes from history.<sup>4</sup>

The house of Aedh Caemh stepped to the front; in their natural stronghold, which the "sea-borne fleets" could not reach, thanks to the rapids of Limerick and Doonass, they escaped the first rush of the Norse and set their backs against the wooded hills, determined to fight to the last. The pedigree that has come down to us is evidently at least incomplete. St. Flannan and his brother Mathgamhan (Mahon), sons of Torlough, lived about the middle of the seventh century, Corc,<sup>5</sup> Mahon's alleged grandson, about 910. Anluan, the intervening name, thus covers the whole eighth century. Probably two generations dropped out here as in other pedigrees.<sup>6</sup> To the late tenthcentury writers Corc, son of Anluan, was the beginning of history, save for the tale of Lugad Meann. "Corc, the man who first routed the foreigners," says Brian: "He had fought eight battles in defence of Mumhan (Thomond)";

<sup>1 &</sup>quot;Wars," p. 59, give his descent from Eochu Bailldearg as Conall, Aedh, Cathal, Tordhelbhach.

<sup>&</sup>lt;sup>2</sup> "Vita St. Flannani" (compiled from earlier "Gesta" in 1164), "Acta SS. Hibernia ex codice Salmaticensi," 1881 (ed. Caroli de Smedt et Josephi de Bacher), and a popular edition by Rev. S. Malone in 1902. The "Lives" notoriously exaggerate the position of the parents and relatives of the various saints.

<sup>&</sup>lt;sup>3</sup> Dal gCais, p. 160.

<sup>&</sup>lt;sup>4</sup> Some compilers make their successor Reabachain (son of Mhothla), Abbot of Tomgraney. He really succeeded Lachtna, and died 918 (say the Ann. Inisfallen), really 935. Ballyvalley, near Killaloe, is probably named from his father's family, Baile Ui Mhothla, 1390; Ballyvolly, 1655; Ballyvolly, 1675, in the Surveys.

<sup>&</sup>lt;sup>5</sup> "Wars of the Gaedhil," p. 66 n., and chapter xi. n., p. 59. An anonymous poet cited by "DalgCais," p. 163, mentions Anluan as one of the four sons of Mathgamhan. The age and authority of the poem are unknown, so it carries no weight. Whichever is correct, the line must break at Anluan.

<sup>&</sup>lt;sup>6</sup> Some confusion may have arisen between the later "Core, son of Anluan, son of Cennedigh," whose grandson died 1025 (Chronicon Scotorum).

he probably led the men of Thomond in their naval victory over the Norse, fought on Lough Derg, in 812.<sup>1</sup> His son Lachtna,<sup>2</sup> a strong and prudent man, was evidently chief when Fedlimidh, King of Cashel, paid his half-hostile visit to Killaloe before 847, but is nowhere called "king." His son, Lorcan, was actual King of Thomond; "Lorc of the Lamp" is described as a brave, wise, and successful prince. Dr. Todd, calculating at thirty years to the generation, fixes his birth in 880, but three years before that he was evidently a man of mature years, and forced the invading king Flann Sunagh, "the Ard righ," to come to terms after the skirmish of Magh Adhair. His son Kennedy Cennetigh<sup>6</sup>, King of Thomond, was a man of the same type; he fell fighting the foreigners in 951. These princes were evidently a long-lived and vigorous race in every respect, and were honourable, self-sacrificing, and patriotic.

HISTORY OF THE FORTS .-- The "Book of Munster" gives us the first full history of any important event in the life of the Dalcassian chiefs. Premising that the race was free from tribute,<sup>5</sup> and had maintained its independence for thirty reigns of the Kings of Cashel, it tells how Felim (Felimidh), King of Cashel, demanded submission and was refused. The tribe was willing to fight, but desired the friendship of the provincial king. They had won their lands (which had never belonged to Munster) by their own swords, and had resisted King Crimthann mac Fidhe, of the race of Fiachra, so they were free from all claims of tribute, hostages or levies from Cashel. The heralds brought this message to Felim, who at once prepared to invade the Dalcassian territory. A brave man of the Dal gCais, Lachtna son of Corc son of Anluan, tried to persuade the "council" to let him confer with the enemy first; but they all sprang to their feet, drew their weapons, and determined to fight. Lachtna took one attendant and went down to Lough Derg as if to shoot a wild goose, for the place in which the "council" conferred lay on the side of Cragliath, between it and the Borhomha. He then went on to see the invader and arrived at a pillar-stone, named Liag na Neasain, where Felim had camped. The clerics were ringing and chiming bells, for the Mass was being celebrated, so Lachtna waited till after the service, and then asked

<sup>&</sup>lt;sup>1</sup> See "Wars," p. 21, possibly the same battle.

<sup>&</sup>lt;sup>2</sup> See "Book of Munster" (Ms. R. I. Acad., 23 E 26, p. 39), a late copy of ninth-century documents. Also Journal R. S. Ant. Ir., xxuii., p. 192.

<sup>&</sup>lt;sup>3</sup> For Cennedig mac Lorcain, see "Cathreim Cellachain Caisil" (ed. A. Bügge, 1905), sections 5, 10, &c., and Annals of Clonmacnoise, p. 169. He was made tanist of Munster, a mark of the growing importance of his house. In section 26, Cath. C.C., the Irish meet to expel the Norse "from their cathairs and duns." Also in "Wars of the Gaedhil."

 $<sup>^4\,{\</sup>rm Loc.\,cit.,\,p.\,39.{--}I}$  have to thank the late Professor O'Looney for the translation which I condense.

<sup>&</sup>lt;sup>5</sup>This is recognized by a poem of King Cormac mac Cuileanan, *ante* 802. and the "Book of Rights," pp. 43, 62, 69, 71, 81, 87, 250, and 561, giving all the rights of the tribe groups, also Wars of the Gaedhil, p. 55.

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The latter, after some conference, was satisfied to be brought to Felim. with the good intentions of Lachtna, and said he would take his word instead of hostages; the Dalcassian set out to his tribe, promising to return even if no one else joined him. Scarcely had he left when one of the king's sages said: "Do you know what this Liag (the pillar) told me? Finn mac Cumhail once prophesied at it that a fair man from Cragliath should come on a friendly visit thither and betray Erin to foreigners." Felim was afraid and sent a messenger after Lachtna, who at once returned; touched by his good faith, the king gave him his robes and horse, blessing him and his progeny. When he returned to his tribe and told them all, they determined to send an embassy to the king, honourable terms were made, and the now friendly visitor was hospitably entertained. A poem (attributed to Felim) runs, somewhat as follows: "Lachtna son of Core, may his children reign over the children of others! May the Great King of Laws give him corn, honey, and fat hogs! May he excel the tribes in robes and splendour, in might and valour, and his progeny be like him !"

It is clear that the fort of the meeting, between the summit of Craglea and the Boruma, is the Grianan of Lachtna; his kingship may have originated in some investiture by (or agreement with) Felim. The "Tract on the Dalgcais," followed by all later writers, asserts that another Lachtna,<sup>1</sup> son of Kennedy, made the Grianan, about 950, but the earlier mention of its existence, and the very common usage of "build" for "rebuild," besides its emphatic connexion with the earlier Lachtna, justify the view that it was named from the latter, and dates from before 847, the year of Felim's death, and that the late king at most repaired it.

The fort at Boruma probably first appears in the Annals in 877, when Flann Sunagh, the Ard righ, "ravaged Munster from Borhaime to Corcagh.<sup>2</sup> It was probably owing to his defeat at Magh Adhair<sup>3</sup> that he did not also ravage the part north of the Shannon so pointedly excluded in the record.

Kincora, Ceann Coradh, the head of the weir, first (I think) appears in the poem of Cormacan Eiceas on "the Circuit of Ireland,"<sup>4</sup> by Murcheartach of the Leather Coats, King of Aileach in 941. That prince spent "a night at

<sup>&</sup>lt;sup>1</sup> "Book of Lecan," quoted in "Dalg Cais," pp. 164, 239. This Lachtna only reigned for three years after his father ; he left no issue.

<sup>&</sup>lt;sup>2</sup> "Annals Four Masters." If "Ath na Borhaime" of Lugaid Meann's conquests be from the "Psalter of Cashel," *ante* 902, it is only a record of the ford, not of the fort. The Psalter was probably used extensively in the tract "Dal gCais," see p. 167: "Huc usque de psalterio Caisil scriptum est."

<sup>&</sup>lt;sup>3</sup> Poems of Flan mac Lonain, died 891, "chief poet of Erin." He was present, and highly praises Lorcan and Essida of Ui gCaisin. Published in "Story of a Sept" (Dr. N. C. MacNamara), p. 82, also p. 72. The poet negotiated with them on behalf of the Ardrigh, and exchanged horses. See also "Wars," p. 67.

<sup>&</sup>lt;sup>4</sup> Ed. O'Donovan, Irish Archaeol. Soc., p. 43.

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the strong Cenncoradh," "a night at Flannan's Cel da lua." He "laid aside his anxiety" after crossing the Shannon, and went at his leisure round the Cratloe hills, resting a night on the plain of Magh Adhair, but he took no hostages, and whatever may have been his relations with Cenedid, he did not add him to his collection of captive princes. I do not think his capture of Cellachan argues either weakness or slackness in the Eoghanachts, but merely that no one expected such a raid in the depth of winter. The de Clares' wars in the late thirteenth and early fourteenth century are full of such surprises. Muircheartach's attempt to take hostages shows that he regarded Thomond as an "overkingdom,"

BRIAN BORU AND THE FORTS .- Brian Boroimhe took a leading place among the recorded fort-builders of Ireland, and seems also to have resided at the Grianan, as he certainly did at the other two forts of Killaloe. During the reign of his brother Mahon (Mathgamhan) he won a hard victory over the Norse, at or near the Grianan. Asked by Mahon, when they met, where his soldiers were, he sadly replied—" I have left them on Cragliath<sup>1</sup> in the breach where shields were cleft. Birrn-it was difficult to cut off the man-fell there with his people." This was before 976. During the terrible guerilla warfare, which ultimately raised the wave of courage that swept away the power of the Danes, Brian "used to set up huts instead of longports<sup>2</sup> in the woods, solitudes, deserts, and caves of Ui Blait," in the mountains behind Craglea. He had no time for fort-making till after 1000, when all his foes were subdued and his strong rule established in comparative peace. He "restored" churches and towers, made bridges, causeways, and roads, and strengthened the royal forts (righ port) of Munster. These were Cashel, Cenn-Abhrat, the "Islands" (crannogs and fortified islets) of Loch Cend and Loch Gair (Gur, Co. Limerick); the forts of Dun Eochair Maige (Bruree), Dun Claith (probably Aine Cliach, or Knockaney), Dun Crot (Dungrot in Aherlow); the "Islands of Loch Saiglend and Inis-an-ghaill-dubh; Rosach fort, and, chief of all, Cenn Coradh and Borumha."3

It was needful. "Never was there a dun, a dangan, or a diongna, but

<sup>&</sup>lt;sup>1</sup> "Wars of the Gaedhil," p. 63; one recalls Harold Haarfagr's battle ("Heimskringla," ed. Morris and Magnusson, p. 99). "The King for ever wrathful had battle high on the heathland."

<sup>&</sup>lt;sup>2</sup> "Wars," pp. 51-61. Keating's "History of Ireland" (ed Dinneen, Irish Texts Soc.), vol. iii, lib. ii, sec. iv. "Long means a house; hence a village where people dwell is called *longport*." In Annals of Ulster, 840 and 850, the Dubh-Gall stronghold at Linn Duachail, and the Finn Gall one at Dublin, are each called *longport*. There were at least two "Long-port" names in S.-W. Clare—Derryanlongfort, probably near Trough, held by Donough MacNamara in 1633, and Athlunkard near Limerick.

<sup>&</sup>lt;sup>2</sup> "Wars," p. 141. Ann. of Ulster, 1012, gives the list of *dangans* as Cathair Cinn Coradh, Inis Gaill dubh, and Inis Locha Sainglenn. Keating adds to the list in the "Wars" Dun Iasg and Duntriliag. One Ms. (see "Wars," 140 n 3) says, "By him were fortified duns and dangans, rioghports and celebrated islands."

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it was taken by that howling, furious, loathsome crew, and plundered, neither was there concealment underground in Erin" that was not discovered by them. The fact that the forts and monasteries were often palisaded and crowded with wooden houses greatly facilitated their destruction. Although (save in the case of certain Scotch forts) our Annals do not record sieges, the storming and burning of forts was very common, and made its mark on our legends, history, and fictions of many periods. To give a very few examples from history:-In 622 "Fire seized Rath Guali; save ye a little from it; vehemently the wicked have lighted fire in the rath": in 680, "Burning of the kings in Dun Cethirn (the "Giant's Sconce"),<sup>2</sup> sorrowful to look at their stony graves, to see your dogs, your greyhounds, and your women in the possession of your foes." 925. "Destruction of Dun Sobhairche (Dunseverick, Antrim) by the foreigners." Burnings of the forts (duns) of Dun Echtach (Duneight, Co. Down), by Flathbertach Ua Neill, 1010; 1081, &c., of Cenn Coradh, which we give below; 1088, of Dun Aiched (in Co. Limerick); 1101, of Aileach (Grianan, Donegal), and in 1165, the lake fort of Inislachain (Co. Antrim); the above are pre-Norman. In the medieval lives of the saints such episodes also occur; we recall the destruction of Dun mechair (Co. Clare) in the early sixth century in the life of St. Senan and the burning "Castle" near Ardmore (Co. Waterford) in the previous century in the Life of St. Declan. In the "Sagas" we may quote from the "Wars of the Gaedhil" -" Thou didst plunder their *dun* at the time; thou didst surround it with a wall of fire."<sup>3</sup> In the romances—we may select from the "Cath Ruis na Rig" -" she (Queen Medbh) left not in our province (Ulster) mur (rampart) or stead without ravage, nor *dun* in which they boasted not, nor *mur* without fiercely burning it"; and in the same tale the "murrads, dangans, duns, and dromthelchas (entrenched ridges) are burned." In the late romance, "Cath Finntraga," three duns in Co. Kerry, with their inhabitants and domestic animals, are burned.

"BORUMA"—Borama means "reckoning of cattle," i.e., for tribute. The position of the lower end of Lough Derg, with a convenient ford from the present Co. Tipperary, was very suitable for such a purpose, while the number of stone weapons secured here and at the ford of Killaloe, a little below it, shows the importance of the pass in very early times. The fort may

<sup>3</sup> "Wars," p. 81.

<sup>&</sup>lt;sup>1</sup> "Wars," pp. 41, 115. In 836 the Norse plundered the *duns*, churches, and houses of Magh Lifé and Magh Bregh, from the Boyne to the Liffey. A band, fitly called "the Sons of Death," ravaged Louth and Meath from a lake fort in Cavan. This was destroyed by the Irish in 846 (Ann. of Ulster). Professor Zimmer dated the conversion to Christianity of the "Danes" of Limerick about 943 (Celtic Church in Britain and Ireland, ed. Kuno Meyer, 1902, p. 95); but the prosperity of Mungret Abbey, close to Limerick, after the first raids of the invaders, shows their toleration, even when pagan.

<sup>&</sup>lt;sup>2</sup> "Ancient Forts of Ireland," section 87, p. 116.

have had early predecessors on its site to protect this unpopular task. Whether "Borama" was the ford, or the actual rath above it, depends on the general bearing of the passage and in what connexion the word occurs. It is often absolutely doubtful. The fort is very probably meant, in the dirge of King Mahon, in 976, "the fiery king of Boromha," and it is nearly certain that Brian took his epithet from it, and not from the mythical reimposition of the Leinster cattle tribute. This I ventured to suggest in 1892, and it has been confirmed by Professor Kuno Meyer<sup>2</sup> and others. The ford probably took its name from a cattle tribute imposed by the Dal gCais and their descendants, the O'Briens, down to the reign of Elizabeth. Enforcing the "Boromha" on Corcomroe, cost King Conor O'Brien his life at Siudaine, in 1267; the Corcamodruadh "undertook to deal mutinously with Conor, omitting to send him his royal cess"; "they withheld it because they had not been raided,"<sup>3</sup> a very significant light on the precarious nature of these tributes. The "Book of Rights" gives that of the Dalcassians from Corcomroe as "1,000 oxen, 100 sheep, 100 sows, and 1,000 cloaks not white."<sup>4</sup> So late as 1585, Sir John Perrot's composition with the Clare chiefs stipulates that after the death of Donall, the MacNamara Reagh, all rights, duties, and customs extorted by the clan are to cease; while on that chieftain's death it was found by an Inquisition<sup>5</sup> (taken at Galway by Sir Richard Bingham) that the MacNamaras paid a boruma to the O'Briens. "The Earl of Thomond and his ancestors took up yearly rent charges .... also a compulsory rent called a borome on the death of each "MacNamara" (chief) of certain cows, or 13 pence per cow." Also the "O'Brien," "what time he wolde go of a forrey, could claim a footman for each quarter (of land) .... with food for two days, after which the said Earl had to support them." Indeed so late as 1712, Henry, the last of the old direct line of the Earls, imposed dues of hogs, sheep, and capons, with the support of soldiers, on the lessees of his estates.6

HISTORY from 1014. The Norse call Kincora, "Kancaraborg," "Kantaraborg," and "Kunniatinborg," Connacht town, in the Sagas, and tell how "Brian, the best-natured of kings, had his court in Connacht."<sup>7</sup> In its hall took place

<sup>1 &</sup>quot;Wars," from a poem by "Mathgamhan's blind bard." Keating calls it "Ceann Choradh na Bhoraime," History, vol. iii, sect. xxv, p. 263. This tribe is called "Dal Cais Borumha" in "Wars," p. 53. <sup>2</sup> "Eriu," vol. v, p. 7; cf. Roy. Soc. Ant. Ir. xxii, p. 403*n*. The belief rests on a poem

doubtfully attributed to Brian's bard, Mac Liac.

<sup>&</sup>lt;sup>3</sup> "Cathreim Thoirdhealbhaigh," 1267.

<sup>&</sup>lt;sup>4</sup> Ed. O'Donovan, pp. 64, 65.

<sup>&</sup>lt;sup>5</sup> Exchequer Inquisition, July 27th, 1585, Public Record Office, Dublin.

<sup>&</sup>lt;sup>6</sup> I have even had to redeem portions of this "boroma" in recent sales of lands in Clare.

<sup>&</sup>lt;sup>7</sup> Niala Saga ("Burnt Nial," ed. Sir G. Dasent, 1900), p. 319, chapter cliii,

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that fatal quarrel at chess, between Murchad (Brian's son and intended successor, the "Margad" of the Saga), and Maelmordha, King of Leinster, which proved to be the "wrath" of the Irish Epic, that ended in the great battle of Clontarf in 1014. Two years later the Connacht men, no longer in restraint, made a raid to "Kinkora, and King Bryan his Manor House was broken down." The place was again rebuilt. In 1062, Aedh O'Conor (Ua Chonchobhair), King of Connacht, after cutting down the *Bili* or venerated tree of Magh Adhair (which had replaced that cut down in 982 by the Ardrigh Maelsechlainn), advanced to Kincora. He stormed and levelled the fort, broke down the weir, destroyed and choked the well, and (to add insult to injury) cooked and ate the two "sacred" salmon kept there.<sup>1</sup> Three years later the fort was attacked in a civil war, and many of its inmates slain. In 1074 its bridge was rebuilt at Killaloe. Ruadri O'Conor, King of Connacht, twice invaded Thomond, destroying Kincora each time, in 1081 and 1084.<sup>2</sup>

His sickly and much-harassed enemy, Murchad (Muircheartach) O'Brien, the titular Ardrigh, was, however, a man of "unconquerable will and study of revenge." He doggedly set to work to repair his own palace in 1086, and having as far as possible set his home affairs right, he undertook a curious vendetta. The King of Aileach had not only destroyed Kincora, but had carried off enough timber to roof his palace, the famous Grianan, in Inishowen. Murchad, when his buildings were completed, marched across Connacht to Co. Donegal, overthrew the Grianan of Aileach, and bade every soldier bring a stone from it for the rampart of the king's port in Limerick. The king with his advanced views had removed his capital to the Norse city of Limerick, girt by the river and its stone walls. The foreign inhabitants had given the O'Briens little trouble since its reduction after Mahon's and Brian's victory at Sulchoid, and probably had been planted in the "cantred of the Ostmen," which we find near its walls a century later. The cathedral of St. Mary is supposed to stand on the site of the fort, but I rather suppose the latter commanded the approach near St. Munchin's Church (where Prince John built the castle and bridge), for King Donald, the founder, continued to dwell in Limerick after the foundation of the cathedral, and therefore could

<sup>&</sup>lt;sup>1</sup> "Ann. Ulster," 1061, "Chronicon Scotorum" (1059), and "Annals of Tighernach." This keeping of sacred fish in wells is not unknown even yet in Ireland. A case in 1833, at a monastery in Constantinople, is noted by Curzon ("Monasteries of the Levant," introduction). The Chron. Scot. says, "He burned all Cill Dalua, and demolished the Cathair of Cenn Coradh, and ate the two salmon that were in the well of Cenn Coradh, and the well was afterwards closed up by him."

<sup>&</sup>lt;sup>2</sup> Chron. Scotor. They plandered Emly, Lough Gur fort, Drumin Ui Clerchin, Bruree, and Limerick, and destroyed Cenn Corad. The Ann. Ulster say, "The Conmaioni went into Thomond, so that they burned *duns* and churches." The Annals of Ulster in 1086 tell of "the communion of Tairrdelbach Ua Briain, King of Ireland": he "died at Cenn Coradh, after partaking of the body of Christ, and of His blood," July 14th, aged seventy-seven.

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hardly have given up his fort site to the clergy. Some have even tried to identify the northern stones in the walls of the cathedral. This insult was long remembered, and in the closing years of the sixteenth century O'Donnel was believed to have invaded Thomond "in revenge for Aileach." In 1082, Murchad entertained Magnus, King of Norway, at Kincora during the winter.<sup>1</sup> The house was burned by lightning, and the king's store of wine, ale, and mead destroyed; in 1107 it was again rebuilt, but its princely owner, worn out by troublous times and a wasting illness, retired to the monastery of Lismore, where he died, March 13th, 1118, his energy and courage surviving his strength. Besides his regal and soldier-like qualities, he encouraged art; and the belief that the ornate doorway in Killaloe is his monument is at least symbolically true, as the door dates from his period, and resembles one built by his friend and correspondent, King Henry Beauclerc,<sup>2</sup> at Caen. At the death of "the Golden Jewel of the West," the nominal High-kingship passed from the O'Briens;<sup>3</sup> its holder, Torlough O'Connor, of Connacht, at once marched to Killaloe, burned the place, and destroyed the forts; he completely levelled Kincora, throwing the stones and timber into the stream, and dismantled the fort of "Boromha." No mention is made of the Grianan of Lachtna; it probably was disused after Brian's time, and its decay preserved it from more hostile destroyers. The two other forts were never restored.

Three generations had passed, a Gothic cathedral had arisen, and Prince John had held Court at Killaloe. The Norman forces were well rooted in Munster, and, probably as part of their policy to win Thomond, they attempted to make "a castle at the Borowe" in 1207.<sup>4</sup> They failed; but a few years later they made one at Killaloe, perhaps on the site of the remains of Kincora, to command the bridge. It was probably an earthwork, with palisades and bretasches, or wooden towers; no trace remains. Henry de Loundres, Archbishop of Dublin, in January, 1222, was ordered to hold it, and appointed Thomas FitzAnthony to be its guardian. It is last heard of in August, 1231, when the castle of Kildelou, in the general neglect and weakness of English rule under Henry III, was given to Donat, the Archdeacon and Bishop-elect, who was bound not to give it to the King's enemies.<sup>6</sup> Evidently there was no castle or garrison there during the wars of the O'Briens and de Clares in 1284 to 1287, and later on in 1315 to 1318.

<sup>&</sup>lt;sup>1</sup> Torfæus, "History of the Kings of Norway," vol. iii, lib. vii, caps. v and ix.

<sup>&</sup>lt;sup>2</sup> See Letter of Lanfranc, Archbishop of Canterbury, in Ussher's "Sylloge," vol. iv (1847 ed.), p. 29, to "the glorious Muriardach, King of Ireland," and Chron. Scotor., 1112. The Ann. Four Masters give the King's death in 1118.

<sup>&</sup>lt;sup>3</sup> The Ann. of Ulster only note "Cenn Coradh razed by Connacht"; the Chronicon Scotorum, "Demolition of Borumha, and burning of Cenn Coradh, and plunder of Tuadh Mumhain, by Torlogh O'Conor, son of Ruadhri." <sup>4</sup> Annals of Clonmacnoise.

<sup>&</sup>lt;sup>5</sup> Calendar of Documents relating to Ireland (ed. Sweetman), under dates.

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Probably in the fifteenth century two peel towers were built at the bridge. Mr. White, of Kincora, tells me he saw the removal of the remains of one, standing in the river, at the Clare end of the greatweir. The other stood on the Tipperary shore, near the bridge.<sup>1</sup> In Cromwellian times the bridge was guarded, and gates set upon it. It was apparently unprotected when Sarsfield sallied from Limerick in 1690, and crossed by it on the raid that destroyed King William's guns at Ballyneety in 1690.

PREVIOUS DESCRIPTIONS.—Six hundred years had nearly passed since the destruction of Kincora and Boruma before any description of the Killaloe forts, however brief, appears to have been written. Even that one gives us nothing about Kincora, which the writer confused with Boruma. At this point-for no relic is known to exist of the lost palace of Brian, celebrated in the touching elegy of the great King's bard and friend, Murceartach MacLiac<sup>2</sup>—I may briefly note its probable site. The "weir," at whose " head" it stood, was most probably the great one above the bridge, where the old castle stood. There is a high bluff, on the platform of which the modern town for the most part stands, round the Roman Catholic church. The latter was probably not far from the site of the fort, but the long occupation has obliterated the Norman castle and any traces left of the fort and well, which obviously occupied a commanding position near to and above the bridge. For instance, when the offended King of Leinster, with his courtiers, rushed from Kincora, he led his horse over the narrow wooden bridge,<sup>3</sup> and was mounting at the farther end when Brian's ill-fated page, sent with a message of peace, overtook him. That it was a large house is implied by the 160 heroes, Irish and Danes, captured in it by Ruadri Ua Chonchoblair, King of Connacht, in 1091.

Keating (as we saw) confused the two residences as "Ceann Choradh na Boroimhe," and at the close of the same century, Hugh Brigdall, about 1693, repeats the confusion in the following words<sup>4</sup> :—"The ancient palace and habitation of the O'Briens, called Teachcincore, no great remarks (*sic*), there are only some heaps of stones fallen; it was built just where the river Shannon grows small." Brigdale's account of Clare shows but little interest in the ancient buildings and none in the numerous earthworks; but it is more than probable that in his day, as in ours, no vestige of the real Kincora was to be seen.

<sup>&</sup>lt;sup>1</sup> A bronze ring pin and stone implements were found near this end of the bridge.

<sup>&</sup>lt;sup>2</sup> "Where, oh Ceann Choradh, is Brian?" It is well known in the versified translation of Mangan, "Where, oh Kincora, is Brian the Great? And where is the beauty that once was thine?" <sup>3</sup> The Chronicon Scotorum, in 1119, mentions "the plank bridge of Cill Dalua."

<sup>&</sup>lt;sup>4</sup> Account of Clare in "The Commonplace Book relating to Ireland," 1693 to Jan., 1695. (MSS., Trinity College, Dublin, I., 1, 2, p. 225.)

A French traveller, De Latocnave,<sup>1</sup> late in the eighteenth century, next noticed the site. It is interesting to see how he gives the correct view as to the probable nature of the "palace," while in the last quarter of a century, if not now, several of the clergy and other "antiquaries" speculated as to the romanesque doors of the cathedrals of Killaloe and Limerick being "the doorways of the O'Briens' magnificent palaces." He writes that he saw "one of these round forts, so common in Ireland, near Killaloe. They call it O'Bryan's Palace: tradition tells us how O'Bryan Bohrom, who defeated the Danes at Clontarf and perished in that battle, made it his residence. It is fairly well situated for defence at the place where the river issues from the lake. The fort is not so large as several which I have seen, but the parapets seem higher and the ditches deeper. I am unable to imagine what kind of palace . . . they could build in such an enclosure unless they were wooden barracks or tents."

John Windele was led to visit the place in August, 1838; a certain Mr. Willes had "found in the circular rath of Kincora, three miles from Killaloe, a stone, the angle of which has a few Ogham letters. X.I.h. and III on a flat surface 2 inches long." Windele says that the fort was the parlour and kitchen of Brian, and gives a sketch of the mound and fosse. Kincora lay where the steamboat station "now" is. There were two long galleries across the flat; the servants passed the plates up one to Balboru and returned them down the other. There was also a wooden bridge. The rath was earthen, circular, with one rampart and a ditch, partly filled up; the exterior circumference 312 paces, the ramparts 20 feet high; inside it was 8 or 9 feet high and 36 paces, 118 feet, across. His other notes are of small value; he seems to regard the early oratory on Friar's Island as "a castelet of the same size and date" as the castle at the bridge; he renders the name Killaloe as "the temple of the two altars," which he supposes to be a fane dedicated to Rhea, whence Lough Ree, the Hindoo Dourga, whence Lough Derge !2 Then after this belated display of "Vallanceyan erudition," he returns to the fort, which he now describes as 780 feet to 650 feet round, 80 feet across the vallum, and 10 feet high, which disagrees with his former notes and the facts.

Lastly, O'Donovan, in the "Ordnance Survey Letter" of 1839,3 says of Kincora, "Not a trace of the walls . . . . no field works are visible." He had written in the same letters in 1834; "The ruins of Kincora are not totally levelled . . . . its walls were circular and built of large stones, without cement." This evidently was derived from some correspondent who held the common

<sup>&</sup>lt;sup>1</sup> " Promenade dans l'Irlande " (1797), p. 153. <sup>2</sup> MSS. R. I. Acad., 12. c. 3, pp. 614, 627, 635, and 688.

<sup>&</sup>lt;sup>3</sup> Co. Londonderry (1834), p. 26. Co. Clare, vol. ii., pp. 346-7.

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local belief that Balboru and Kincora were the same. O'Donovan adds that Bishop Carr (1716-39) reduced the height of the fort by 10 feet, and planted it with trees. This is quite inaccurate; the ramparts are nearly intact, and the filling and planting were done, nearly a century after the Bishop's installation, by Mr. Parker, uncle of the present owner of the site. I may add that O'Donovan (like myself on my earlier visits) quite failed to understand the remains of the Grianan of Lachtna, which he notes as 72 feet N. and S. by 38 feet wide.

### THE REMAINS IN 1910.

GRIANAN LACHTNA (Ordnance Survey Map, 37).—Ascending Craglea by a steep old lane (down which, even in summer, a stream flows from the well of the Banshee Aibhill, Tobereevul), we reach an earthwork, above a series of bluffs or terraces, on a lofty shoulder of the hill. It is strangely marked on the old maps as a "site," though much remains, including the nearly entire outer ring. It possibly is the "sidh (fairy fort) of Crag Liath," named in the Annals of Lough Cé, in 1014. It has a beautiful and wide outlook across the lower reach of Lough Derg to Thountinna, and across the Shannon, over the woods of Ballyvalley and Killaloe, to the beautiful dome of Slieve Kimalta, "The Keeper," and the Silvermine Hills. It is locally called "Greenaun." The epithet is now forgotten.

The fort was probably non-defensive. I formerly supposed that it had an outer fosse, for the upper edge of the field at it is slightly hollowed; but I now merely think it had an outer mound. The field slopes past the fort southward, and falls more abruptly to the east. The garth is a little lower than the field to the north, and terraced up for about 4 ft. over it to the south. The whole ring measures externally about 150 ft. north and south, by 126 ft. east and west, and 127 ft. diagonally; south-east and north-west the earthwork is 9 ft. to 12 ft. thick, and 4 ft. to 5 ft. 6 in. high. In summer it seems far higher from the tall bracken and the foxgloves raising their purple spires on its summit. The sides of the western half are steep and fairly preserved; but it is much injured by the modern fence to the east, and partly levelled to the north-east. Inside is a level space, an oval ring with no apparent hutsites, of very varying breadth, 27 ft. to the north; 17 ft. south-east; 24 ft. south ; 27 ft. south-west, and 15 ft. to the east and west.

Inside is a shapeless heap of stones; much has been removed since 1892. It was then 80 ft. north and south by 50 ft. across, roughly oblong, as shown on the map, and at least 2 ft. or 3 ft. higher.

The removal of the debris has, however, disclosed the actual plan, not, as it once appeared, an oblong platform, but a ring-wall well marked to the south. It was from 6 ft. to 7 ft. (6 ft. 10 in.) thick, with two well-built faces, and no

filling. This we may regard as a late form, occurring, as it does, only in the slighter stone-forts and in annexes, notably those of the lesser ring-walls in the Burren. The more marked mound measures 62 ft. to 63 ft. across, practically circular in plan, but it may have extended northward to the setstones, making it 80 ft. long. This, standing in an oval enclosure, makes the breadth of the surrounding garth so variant. There are large blocks of the local dark-grey slate round its edge, but the masonry of the preserved portions is of smaller stones, well-fitted, not showing the regular courses of the limestone-built cathairs. There are no traces of inner walls; the outer fence has an earthen core, but was faced with rather small masonry, probably till recent times; now only patches remain. Much of the facing of the eastern segment embodied in the field-fence may be comparatively modern. Two tall old hawthorns to the south-west grow on the ring, and give the only landmark to locate the Grianan in distant views. Below it lies a field called "Parc an each," or horse-park, where Brian Boru (according to local tradition) kept his steeds.

The palace was evidently a large timber house, circular, and girt by a drystone wall, with an outer court, in which probably a ring of wooden huts lined the outer wall.

The Banshee's residence is a bold crag, Craganeevul, jutting from the hillside, on the western side of Craglea. Aibhinn, or Aibhill, was the tutelary spirit of the Princes of the Dal gCais. Brian, when refusing to escape from the enemy in 1014, told his imploring attendant, "Oh God ! thou boy, retreat becomes us not, and I myself know that I shall not depart alive, for Aibhell, of Craglea, came to me last night, and she told me that I should be killed to-day." Ages of belief probably lay behind the monarch's fatalism. She may (like the Gaulish Catabodva) have been "Bodbh of Battle," when the fierce Lugaid invaded Clare over six centuries before.<sup>1</sup> She is still believed in at present, nine centuries after Brian, and was a commonplace in death-poetry, even usurping the Sybil's place, in unexpected partnership with King David, in an Irish version of the "Dies Irae."<sup>2</sup> Her well is still extant, as fresh and abundant as ever; but the new Ordnance Survey Maps only mark it as a "site."

(9) BEALBORUMA (O.S. 45).—Bealboruma, or "Ballyboroo," as some call it, rises near the end of a long drift spur, relic of the great glaciers of early Clare. which once doubtless dammed back the Shannon into its former river-bed, past Scariff and Lough Breeda, southward. The ridge is of very artificial appearance, seizing on which fact popular story told how King Brian was

<sup>1</sup> Folk Lore, vol. xxi., p. 186, gives the references. <sup>2</sup> MSS. Roy. Ir. Acad., 23. M. 47.

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making it to hold up the water and flood out his enemies in Connacht. It is interesting to find Brian's energy, his firm suzerainty over Connacht, and his somewhat questionable sovereignty remembered at his ancient residence, even in so mythical a form. As we noted, stone implements were found on the spur, marking it as an early settlement,<sup>1</sup> probably for ages before the fort was dug. Mr. Robert Parker still retains one of the stone celts. The above legend, found by Mr. and Mrs. S. C. Hall<sup>2</sup> in 1840, subsisted down to 1906, and probably to the present time. Brigdall, Latocnaye and Windele show how firmly the great monarch's name attached to the fort for the last two centuries.



Forts near Killaloe, Co. Clare.

I have been told that "bronze swords" were dredged up in removing the Boruma ford. A bronze pin-ring was certainly recovered from the ford at Killaloe Bridge.

Popular legend regards the fort as Brian's parlour. This is also asserted in an ancient poem attributed to his bard, Mac Liac. If this be genuine, we can even form a clear picture of the arrangements of the hall. The cooking, of course, was done on the floor, as we see in documents from the strange account

<sup>&</sup>lt;sup>1</sup>A number of stone celts found at the ford of Killaloe are preserved in the National Museum with a flint arrow-head found at the Tipperary shore, and a bronze ring-pin. Many of the stone implements were of the adze type for transverse work, and probably were used for making cances, for which the place (above the rapids, and at the end of a long unimpeded waterway, with forests close at hand) was a suitable factory.

<sup>&</sup>lt;sup>2</sup> "South of Ireland," vol. iii., p. 420.

and sketch of the great hall of Tara<sup>1</sup> down to the coarse view in Derrick's "Wood Kerne" in the reign of Elizabeth. Presuming that the doorway faced the only entrance of the ring-mound, there was a sort of dais to the west of the room. On it Brian sat, with the seats of the Kings of Ulster and Connacht to his left and right. At the door-post on the north sat the King of Leinster; beside him, near the door, Donchad, Brian's eventual successor, the "Duncan" of the Sagas. To the left of the last was the throne of Maelseachlain (the High King,<sup>2</sup> deposed by Brian), the "legitimatist monarch." At a second table sat Murchad, the eldest son, with his back to his father, between the Kings of Tirconnell and Meath. Tadgh, his brother, the "Takt" of the Sagas, sat at the south end between the Princes of Ui Maine and Ui Fiachrach Aidhne. The lower tables filled the rest of the hall, the officers and guests having their appointed places and portions. Behind the Princes stood the "esquires," furbishing their masters' shields and arms, boasting, and even striking each other at times.<sup>3</sup> Etiquette was very strict in other respects, for men were passionate and alert for slights, real or imaginary; and, though no such galaxy of chiefs may ever have surrounded Brian at one time, the seats were doubtless always ready to forestall some of the risks of misunderstandings.

There were numerous gold-mounted cups (Brian's was taken to the north by Torlough O'Brien as late as 1152; the great king's sword was recovered from Dermot, King of Leinster, in 1068).<sup>4</sup> The food consisted of beef, mutton, fresh pork, game and fish, with oat-cakes, cheese, curds, cresses, onions and (in their season) fruit, nuts, and honey.<sup>5</sup> For drink there was plenty of wine, ale, mead, and fermented bilberry juice. The wine was procured from the Danes of Limerick, who paid it in tribute.

Bealboruma Fort is so completely concealed by a fine mass of beech and fir trees that no photograph or even sketch gives any idea of its appearance. There are only faint traces of an outer ring; the fosse is usually 9 feet wide at the bottom and 4 feet to 6 feet deep, and is much filled up, probably with the outer ring. It is 20 feet to 25 feet wide at the field-level, and 18 feet wide at the north entrance.

The ring-mound, revetted by drystone facing for about 6 feet up, is steep and well preserved for most of the circuit, being 75 feet thick at the base to

<sup>&</sup>lt;sup>1</sup> Petrie, "Tara Hill" (Trans. R. I. Acad., xviii.), pp. 196-211, National MSS. of Ireland, vol. iii., plate LIII. The early illustrations are in the twelfth-century "Book of Glendalough," the other in the "Yellow Book of Lecan."

<sup>&</sup>lt;sup>2</sup> At his death the Chronicon Scotorum (1020, i.e., 1022) records that he owned 300 forts (port).

<sup>&</sup>lt;sup>3</sup> The original account is translated by Eugene O'Curry in "Manners and Customs of the Irish," vol ii., lecture vi., p. 120.

<sup>&</sup>lt;sup>4</sup> Ann. Inisfallen.

<sup>&</sup>lt;sup>5</sup>Compare the description of the hall with the royal food supplies in the Book of Rights and other early books.

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the south; 66 feet to the east; 51 feet to the west; and 36 feet at the entrance, but wherever uninjured along the top it is uniformly 9 feet wide. It rises 22 feet over the fosse, and 10 feet to 14 feet over the garth. The latter is slightly hollowed, and is about 4 feet higher than the field outside. I have noted this saucer-like garth in the fort to the east of Liscockaboe near Bodyke, but it is very unusual. There are no visible foundations or pits; a few blocks of stone lie around; there were heaps of stones in 1695-7. The garth is 102 feet in diameter north and south, by 87 feet east and west. The whole space measured over the fosse is 250 feet either way. The circuit is 650 feet, 625 feet round the foot of the bank, and about 380 feet round the top. The traces of the outer ring to the east and south are 25 feet to 27 feet wide; the hill-slope falls away from them to the low fields at the river. The plan and sections give all other needful information. The stones at the modern entrance and steps are cut with modern initials, crosses, and scorings; some of these were evidently reported to Windele as ogmic inscriptions. There are no traces of other forts or hut-rings on the plateau, but probably a "town" of wattled and wooden houses was crowded there.

The outlook is very pleasing, up the lake, past Thountinna and Craglea, the great pink and brown hills, with their green and wooded lower slopes on every side, while down the Shannon we look to 'the flashing weirs at the houses and low cathedral tower of Killaloe.

As I have noted, no trace or true tradition of the site of Kincora remains; the modern house has usurped its place in the "traditions" of drivers, fishermen, and tourists.

### THE LEINSTERMEN'S GRAVES, COOLBAUN.

Though lying in Tipperary, certain remains are locally and traditionally so closely bound up with the Clare forts that I may note them here, for they were equally in the ancient Thomond and the diocese, that preserves its former limits. Driving up the hills towards Thountinna, we pass a very interesting double fort, Lisnagry, fort of the herds. It has two circular enclosures 6 feet to 8 feet high, the northern, earthen with stone facing; the southern, mainly a dry-stone ring-wall within a fosse 3 feet or 4 feet deep and 12 feet wide, shaped like a figure **8** in plan. The combination of an earth and stone fort recalls Creevaghmore and the Earl's house described below. The whole is about 230 feet long, or 350 feet over all, the larger fort being roughly 150 feet north and south and 127 feet east and west, and it is in Curraghville townland.<sup>1</sup>

<sup>&</sup>lt;sup>1</sup> Perhaps it was connected with the bili or venerated tree of the townland name. R.I.A. PROC., VOL. XXIX., SECT. C. [29]

The "Leinstermen's Graves" were described to me in 1892 as "a fine circle of stones."<sup>1</sup> This is most deceptive. They stand on a high heathery shoulder of Thountinna with a splendid view over most of Lough Derg, Iniscaltra with its round tower and churches and the hills on the border of Galway. In this lonely spot (hovered over by countless hawks hanging on the wind) is a line of small slate slabs 42 feet long, the largest "pillar" being only 3 feet 6 inches high, by 2 feet 6 inches square, the others usually under 3 feet high. There is a low mount 17 feet to the north of the "chief pillar." A sort of fenced avenue runs into the slightly enclosed space between it and the alignment.

Farther to the N.-E., beside the road, at the very summit of the pass, is the great natural rock called Lachtreelyon (*leact righ Laighean*) and Knockaunreelyon,—the tomb-stone or mound of the King of Leinster. When a quarry was opened in Townlough and some cottages built, I am told that "they dug behind the Knockaun and found big bones." My uncle's gamekeeper at Townlough also told me some five years since that "a big heap of stones behind the rock was removed the time the bones were found." In 1892, Mr. Robert White, of Kincora, gave me a more definite account. His grandfather had told him that, when the mound was quarried into, a large skeleton and several rusted iron weapons were found. The latter were "kept as curiosities" by a Mr. Molloy, but I could not learn their ultimate fate; they were probably "thrown out" (as such objects usually are in Co. Clare) as rubbish.

The legends were probably little corrupted in 1892.<sup>2</sup> "The King of Leinster was to marry King Brian's daughter, and was coming to fetch her. Her wicked mother did not like the prince, and tried to get Brian to stop him," but he would not. Then "she hid soldiers on the hill, and there was a big fight. Most of the Leinstermen were killed and the king badly hurt; so he ordered his men to bring him to the top of the road where he could see Leinster and hold him up till he died, and bury him facing it; and they did." In 1906 all was manifestly recast and interpolated from books. "The King of Leinster was bringing a *maypole* to Brian, who was from home, and his (Brian's) bad queen came and called the king a sneak for paying taxes, and he went away. Brian came back, and she said the Leinsterman would not pay him; so he got in a great passion, and asked *how* he had gone. Brian had a cellar under the river from Ballyboroo to Rine Innish, and he took the short cut through it and overtook them (the Leinstermen) and killed the best men; he

<sup>&</sup>lt;sup>1</sup> Journal Roy. Soc. Antt. Ir., vol. xxiii., p. 194.

<sup>&</sup>lt;sup>2</sup> It is very possible that they only brought in King Brian in later days, as, in its main outline, the legend can hardly refer to his reign. The fact of a cairn burial, too, surely puts it behind the eleventh century.

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came to abuse their king, who told him all. Then Brian was very sorry, and he carried the young man up on the hill where he could see Leinster, and set by him till he died, and he buried him there." There were two divergent endings as to Brian's meeting with his fiendish wife. "He ran and broke her head," and "she ran away to the Danes when he offered to beat her." The colouring from the "Wars of the Gaedhil" overlays the original picture.

Firt Fintain was a famous monument "above Tul tuinne, over Lough Dergderc," according to the Book of Leinster and other sources. Ton tuinne was on the wave-beaten foot of the hill, whence the name spread to the peak above it. A wild legend was told how Fintan' slept unharmed there under the waters of the great Deluge. The Lacht may be really this monument, so noteworthy, yet of such a forgotten past, that later writers could only express their belief by dating it " before the Flood."

Below this on the island at Derry Castle, Conchobhar Ua Briain, King of Thomond, in the early twelfth century, built or owned a stone ring-wall or cathair, whence he was named "na Cathrach." Some suppose it to have been at Caher Island, on the Clare shore of the lake; but a deed<sup>2</sup> in giving a list of the lands of Murchartach O'Brien of Ara, Protestant Bishop of Killaloe (1570-1613), mentions "the castle of Cathair Conchubhair," unmistakably in Co. Tipperary, where also a map of the same period shows, about 1590, Lough Derg, Castlan Logh McEbrine, and Carcrowghore O'Brian on this shore. No trace of the stone fort survived the building of the castle. It was evidently a "stone crannog" like Cahersavaun in the Burren and other lake-forts; the name Caherconnor is locally remembered. It is unfortunate that it and Clonroad do not survive as late dated examples of their ancient and far-spread type of defences. The Tipperary shore has numerous small earthen rings. I only record the larger and more remarkable complex fort of Roolagh. It lies in a field to the north of the old road past Templeachalla Church, and is very like Lisnagry, above named, and the fort of Drumbaun, near Quin. It consists of two ring-forts within one fosse, and measures over all nearly 200 feet E. and W. and 350 N. and S. The larger enclosure is to the north, and is somewhat pear-shaped, 160 feet long by about 115 feet across. The type is found at Tara in the conjoined Teach Cormaic and Forradh; whether this marks it as used for ceremonial or even for worship our knowledge is too rudimentary even to suggest.

<sup>&</sup>lt;sup>1</sup> The famous antediluvian bard, Fintan, slept, says ancient writers, on that mountain so soundly that the waters of the Flood did not drown him. He used subsequently to awake at intervals, telling the history of the past, and gathering up that of the later generations, being accredited as the main transmitter of the remote tale of Ireland. He also used to collect legends from other reliable authorities, such as "The Old Eagle of Achill." Book of Leinster, 4; Stowe MS., R.I.A., D. 2.2. 56b, and Book of Lecan, 543.

<sup>&</sup>lt;sup>2</sup>T.C.D. M.S, H. I. 7. See also Hardiman Map, No. 68, temp. Elizabeth, in same collection.

The other forts near Killaloe, between the hills and the Shannon, are of but little interest: simple rings, about 100 feet across inside, and nearly circular, with usually a fosse and sometimes an outer ring; the stonework is nearly always destroyed. Three remain in Ballyvally and six in Creeveroe; the last is an interesting and suggestive name, occurring as it does near the royal raths of Killaloe; it recalls the Creeveroe near Emania, which itself recalls the great "order" of the Red Branch (*Creabh ruad*), so famous in our early epic poetry.

The length at which we were obliged to study the early history leaves me no option but to reserve for a final paper the accounts of the forts near Clonlara, Kilkishen, Quin, and Clooney, requisite for the completion of the study of the forts of eastern Clare, and of more structural importance (though devoid of history) than the "royal forts" of Killaloe.

#### ADDENDA AND CORRIGENDA.

Vol. xxvii., p. 232, third paragraph, for "23 feet" read "23 inches".

- p. 377, Carrowgar is oval, 111 by 96 feet, the wall 12 to 15 feet thick, with good small facing, and rarely over 4 feet high; no house sites or features remain.
- p. 380, line 11, move reference to Plate XVII. to end of following paragraph, the fort illustrated being the northern (and lower) cathair of Creevaghbeg.
- p. 386. I have since found continuous traces of an outer ring from the terraced scarp and "plot" round the southern, eastern, and northern slopes at Tulla church. A description and plan appear in Journal Roy. Soc. Antt. Ir., vol. xli, pp. 17, 18.
- p. 386, note 3, read "Bollandiana".
- p. 389, line 17, for "west" read "east" of Lisduff.
- p. 397, Ballydonohan Caher was first dismantled by Mr. Ed. O'Callaghan, of the Maryfort family, when building a house near Bodyke. Mr. Denis Balton tells me that there were five covered cells when he first remembers the fort, two leading under the wall, one at the east end of the inner enclosure, one at the S. W. angle, and another to the south, near the entrance.

Vol. xxviii., p. 2, third line from end, for "princess" read "princes".

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### VIII.

# A CALENDAR OF THE REGISTER OF ARCHBISHOP SWETEMAN.

### BY REV. H. J. LAWLOR, D.D. (

Read JUNE 26. Published SEPTEMBER 18, 1911.

### INTRODUCTION.

In the Public Library of Armagh is preserved a series of manuscript volumes unique among early Irish records. They are the Registers of the medieval Archbishops of Armagh, and, with some gaps, cover a period of two centuries, from about 1350 to 1550 A.D. They are the source of all the information we possess concerning the ordinary official life of a pre-Reformation Irish bishop, and they throw much light on the condition of the Church in Ulster in the centuries to which they belong. The volumes are seven in number, and their contents are as follows :—

Volume I, Registers of Milo Sweteman and Nicholas Fleming, together with some leaves of registers of earlier and later Primates.

Volume II, Register of John Swayne.

Volume III, Register of John Prene.

Volume IV, Register of John Mey.

Volume V, Register of Octavian de Palatio.

Volume VI, Register of George Cromer.

Volume VII, Register of George Dowdall.

All these are originals, with the exception of the last, which is an early copy of a lost original.

Of three of these volumes (vols. II, III, VI) transcripts were made by an excellent scribe in the eighteenth century, and are still preserved in the Armagh Library. The late Dr. Reeves, while he held the office of librarian, completed the set of transcripts, copying with his own hand vols. I, IV, V, VII. The volumes prepared by Dr. Reeves are probably superior, both in accuracy and as specimens of calligraphy, to their fellows in the series of fair copies.

It is obvious that copies of such beautiful workmanship could not have been made direct from originals which are often difficult to read, and yet oftener sadly mutilated. We may therefore infer that rough copies of the

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same volumes, in Dr. Reeves's hand, deposited by him in the Library of Trinity College, were made as a first step in the execution of his design. With them are placed transcripts of the Registers of Swayne, Prene, and Cromer, written by an amanuensis under Dr. Reeves's direction, and drawn, not from the originals, but from the eighteenth-century copies. In these the documents are not in all cases arranged in their original order, and the text is not free from clerical errors.

Thus the Library of Trinity College owes to the labour and the generosity of Dr. Reeves a copy of the entire series of the Armagh Registers.<sup>1</sup> It may be added that it possesses a second copy of the Register of Dowdall,<sup>2</sup> made apparently in the eighteenth century by the scribe to whom we are indebted for a copy of the Register of John Alan, Archbishop of Dublin.<sup>3</sup>

The first volume of the Armagh Registers opens with two unnumbered leaves of vellum, the first of which contains Acts of Archbishop David Mageraghty (1335-1346), and the second certain proceedings of the commissary of the Chapter of Armagh, during the vacancy of the see caused by the death of his successor, Archbishop Richard Fitz Ralph (1346-1360). Upon these follows a table of contents, written on paper about the year 1600; and then three leaves of vellum, containing Acts of the latter part of the archiepiscopate of Milo Sweteman (1361-1380). These are stray leaves from a volume, or volumes, now lost. The first of them bears the number 147. After them come 52 leaves, numbered in a later hand 1-29, and 31-53. The number 30 does not appear, either through loss of a leaf or through clerical error. These leaves are of paper, with the exception of ff. 32, 33, 51, 52, 53, which are of vellum. They are followed by a fresh table of contents, and leaves numbered 1-68, and described by Ussher in a note written on a fly-leaf as the Register of Nicholas Fleming. With these, which obviously at one time formed a volume apart, we have now no concern.

The earlier part of the present volume is generally known as the Register of Milo Sweteman, and the designation, if not quite accurate, is convenient. It is evident that at some period the portion of it which consists of consecutively numbered leaves formed a separate volume. But a cursory examination proves that it is a mere fragment of Sweteman's Register. We have in it 36 documents which may be assigned with certainty or high probability to the year 1365; 47 which may be placed in 1366, and 47 also in 1367. But the years 1362–1364 are represented by only 8 documents; 1368–1370 by 17 each; and the period 1371–1380 by no more than 26. Moreover, it is clear that several of the later documents have come down to us through the accident

<sup>2</sup> MS. 588 (N.2.11). <sup>3</sup> MS. 554 (F.1.8).

<sup>&</sup>lt;sup>1</sup> The series, in thirteen volumes, is numbered 557 in Dr. Abbott's Catalogue of MSS.

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that they were copied in the blank spaces left in an earlier book. Thus we have something like a complete record of only three out of the nineteen years of Sweteman's primacy.

And even in the part of the Register which relates to those years a good many leaves have been lost. In most cases in which a document commenced on one leaf and concluded on the next; either the beginning or the end has been lost. Thus, confining ourselves to the years 1365-1367, we find reason to suspect the loss of the leaf which followed each of the following :—ff. 13, 24, 27, 37, 42, 48, 50.<sup>1</sup> Leaves seem also to be missing before ff. 22, 23, 25, 39.<sup>2</sup>

Again, there are sometimes cross-references to documents which no longer appear. Such are the references to "f. xi supra" on f.  $19^{v}$ ; to f. vii on f.  $42^{v}$ , and to the 15th following leaf on f.  $45.^{3}$ 

Thus, it appears that for the three years, 1365–1367, alone, at least 12 or 13 leaves—which would have contained matter equal in amount to one-quarter of all that remains—have disappeared.

If further proof is needed of the fragmentary character of the Register as we have it, it is at hand. Some of the leaves bear older numbers. Thus f. 2 is marked 26(?); f. 28 has what appears to be a number—probably  $11^4$ —and f. 29 has the number 116. If these numbers mark the position of the leaves in an older book, it must have been much more than twice as large as the fragments of it that are left.

But if the remaining leaves of Sweteman's Register bear but a small proportion to those which once existed, it can no less easily be shown that the original Register was not a single volume at all. It is *à priori* improbable that the vellum leaves (32, 33, 51, 52, 53) belonged originally to the same book as the paper leaves with which they are now bound. And the suspicion that they came from a different volume is confirmed when we measure them. The exact size of the paper leaves cannot be determined, owing to the mutilation of their upper and lower edges, but they seem to have been about  $295 \times 230$  mm. The vellum leaves, ff. 32, 51–53 are considerably larger about  $333 \times 250$  mm., though their edges have been cut away. And another sheet of vellum, numbered as a leaf of our volume (f. 33), is clearly an intruder. It measures  $450 \times 250$  mm., and is bound in sideways, and folded. It may have been part of a roll.

It can further be proved that the leaves have, in some cases, been displaced from their original positions. We find, for example, the earlier part of a

<sup>&</sup>lt;sup>1</sup> See nos. 78, 129, 143, 179, 200, 232, 242. <sup>2</sup> See nos. 115, 121, 130, 184.

<sup>&</sup>lt;sup>3</sup> See nos. 105, 200, 211.

<sup>&</sup>lt;sup>4</sup> Perhaps the first two of three digits. If the number was 117 it would prove that ff. 28, 29 had been transposed. It is worthy of note that when the leaves are placed in the reverse of their present order the documents follow one another in chronological sequence.

document on f. 40,<sup>v</sup> and its conclusion on f. 19.<sup>1</sup> We find also on f.  $42^2$  a cross-reference to "the beginning of the second leaf," which is apparently satisfied by the first entry in f. 40.<sup>3</sup> And, since f.  $38^v$  preserves a document which was apparently intended to be read as a sequel to one on f. 40,<sup>4</sup> it would appear that the latter leaf originally preceded the former.

Finally, on the recto side of f. 43, a citation of the colidei, clergy and people of Armagh for the archbishop's ordinary visitation appears,<sup>5</sup> though it is stated on the recto of f. 42<sup>6</sup> to have been copied "in *alia* parte folii *precedentis.*" Ff. 42, 43 have therefore been transposed; and apparently one of them was reversed in the process, so that the recto became the verso of the leaf. That f. 42 was the leaf so treated may be concluded, since the documents on what is now the verso belong to 1367, while those on the recto are plainly later additions. All these facts are explained if we suppose the original order to have been 43, 42 (reversed),<sup>7</sup> A, 40, 19, 38, where A is the lost leaf after 42 already mentioned.

It may be conjectured that the derangement of the order of the leaves has gone much further than we could safely infer from this single example. And there is some evidence in support of this hypothesis. In a Register which records the Acts of an archbishop from month to month, we might expect some sort of rough chronological order. And this we actually find. Thus, for example, the documents on ff. 5, 6, which can be proved to have been always consecutive, are in chronological sequence from June, 1368, to February, 1371. And many instances might be given of single leaves where the arrangement is, at any rate approximately, in the order of time : it is so in the greater number of cases. This fact raises the suspicion that, on the one hand, departure from such order in passing from one leaf to another is due to displacement, and on the other that leaves which, taken together, present a chronological sequence originally followed one another, however far apart they now stand. Thus ff. 12, 13 have documents from June to November, 1366, placed nearly in the order of date. We may assume that they were originally, as now, consecutive. A similar inference may be drawn regarding ff. 15, 16 the documents on which are of October and November, 1365. But f. 14, on which are written letters of 1368, is clearly out of place. Grouping the leaves together on this principle we may conclude that ff. 36, 29, 28, 15, 16 February-November, 1365), if not immediately consecutive, at least followed the order in which I have written them. So also, it seems, did ff. 41, 24, 23, 25 (reversed) (February, 1366-May, 1367). Again f. 45 (May, June, 1367) probably preceded f. 42

<sup>&</sup>lt;sup>1</sup> No. 188. <sup>2</sup> No. 199. <sup>3</sup> No. 186. <sup>4</sup> Nos. 186, 183. <sup>5</sup> No. 202. <sup>6</sup> No. 195. <sup>5</sup> Judging from the dates of the documents, we may suspect that f. 43 was originally left blank, and the following leaf (now 42) written on one side only.

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(June, July, 1367), and the latter was followed by ff. 17, 18 (June-September). Combining this with what has already been proved, we get the sequence ff. 25, 45, 43, 42, A, 40, 19, 17, 18, 38. In like manner we may connect ff. 44, 49 (September, 1367–February, 1368) and ff. 34, 9, 10 (January, 1369–June, 1370). And combining the results an inference may be drawn which includes nearly half the existing leaves, and shows that a very great amount of displacement has occurred. It has, in short, been made probable that the following leaves originally stood in the order indicated : ff. 36, 29, 28, 15, 16, 41, 24, 23, 25, 45, 43, 42, A, 40, 19, 17, 18, 38, 44, 49, 34, 9, 10.

This may be as appropriate a place as any other to mention that f. 35 has been imported from a Register of Archbishop Swayne.

Thus it appears that what is called Sweteman's Register is a collection of leaves of vellum and paper, containing no doubt in almost all cases records of his administration, but drawn from different volumes, and bound together in haphazard order.

A few words must be said about the Calendar of Sweteman's Register which is now presented to the Academy. My aim has been to give a summary of each document sufficiently full to serve the purposes of a historical student. The summaries have been made from Dr. Reeves's rough copy of the Register in Trinity College. But by the kindness of the Governors of the Public Library of Armagh the original manuscript has been lent to the Library of Trinity College for my use; and I have checked my summaries by it throughout. All personal and local names have been included exactly as they stand in the manuscript, except in the case of common Christian names, for which the modern forms are used. In the index I have collected the various spellings of surnames, prefixing in each instance, where I considered that little or no doubt was possible, the modern form, and in the case of Irish names the equivalent Irish spelling. I have succeeded in identifying most of the places named; but a margin remains which I hope may become smaller as I extend my knowledge of the later Registers.

Throughout this Calendar the words 'archbishop' and 'primate' always stand for Archbishop Milo Sweteman, unless the contrary is indicated. When a letter neither emanates from him nor is addressed to him the fact is stated-

In the dates of documents issued by Sweteman the years are indicated not only by the ordinary A.D. reckoning, but also by the year of the archbishop's consecration. I have not thought it necessary, as a rule, to give the year in the latter form. It will suffice to say here that a comparison of two documents summarized below<sup>1</sup> shows that Sweteman's sixth year began  $17 \times 21$  November,

<sup>1</sup> Nos. 76, 121.

1366, and therefore that he was consecrated  $17 \times 21$  November, 1361. All other indications agree with this conclusion.

In preparing the Calendar I have received help in identifying places from the Rev. J. B. Leslie, the Rev. W. M'Alister, and the Rev. Canon Healy. Mr. E. J. Gwynn has read the proof of the index, and has made many valuable suggestions. And once again, as so often before, I must acknowledge the kindness of Mr. James Mills and of Dr. H. F. Berry, who have aided me with their stores of learning. To all these friends I tender my sincere thanks.

AUTHORITIES REFERRED TO.

An. Boll.:

Analecta Bollandiana.

### C. P. R. I. :

Rotulorum Patentium et Clausorum Cancellariae Hiberniae Calendarium, vol. i, pars i (Irish Record Commission), 1828.

### Cal. Close Rolls:

Calendar of the Close Rolls preserved in the Public Record Office (Record Series).

### Eubel:

Hicrarchia catholica medii aevi, e documentis tabularii praesertim Vaticani, by C. Eubel and W. van Gulik, Regensbergianae, 1898-1910.

### Inquis.:

Inquisitionum in officio Rotulorum Cancellariae Hiberniae asservatarum repertorium (Irish Record Commission), 1826–9.

### Papal Petitions:

Calendar of entries in the Papal Registers relating to Great Britain and Ireland. Petitions to the Pope, ed. W. H. Bliss, London, 1896.

### Reeves, Antt. :

Ecclesiastical Antiquities of Down, Connor, and Dromore, by William Reeves, Dublin, 1847.

### Reg. of St. Thomas:

Register of the Abbey of St. Thomas, Dublin, ed. J. T. Gilbert (Rolls Series), 1889.

### Ussher, Works:

The whole works of the Most Rev. James Ussher, D.D., ed. C. R. Elrington, Dublin, 1847-1864.

### Ware:

The whole works of Sir James Ware concerning Ireland, revised and improved, by W. Harris, Dublin, vol. i. (1739).

### CALENDAR.

1. Acts of Archbishop David (Mageraghty) in his metropolitical visitation10 June,  $1335 \times 1345$ .of the diocese of Meath.f.  $1^{*v}$ .

The abbot and convent of St. Thomas the Martyr, Dublin, claiming to hold the churches of Grenok, Donaghmore (also written Donagmore) near Grenok, Killegelan (also written Kyleglan), Knocmark, Culmolyn, Maynclare Balimaglassan, Kylmore, Dirpatrike (also written Dirpatric), Kyltale (also written Kyltat), Villa Scurlage, and Lethircore (also written Lethyrcore) [In other lists lower down Knocmark is omitted, and Crikestoun (also written Crikistoun, Crikystoun), Rathtouh, Donaghmore near the bridge of Balbus, Sydan, and Donagh[mowe] are added] were ordered to show by what right they held them, and to show cause why in certain of them which had no vicars-viz.: Grenok, Donaghmore near Grenok, Kyleglan, Crikistoun, Dirpatrike and [ . . . ]-vicars should not be appointed by the archbishop. The abbot and convent having exhibited the grants of the churches and confirmations of the same, including one from the chapter of the former cathedral church of Meath, and having pleaded immemorial usage for placing chaplains rather than vicars in the churches just named, decision was given in their favour, in the church of St. Mary, Droghda.

The year in the date is partly cut away.

Compare Reg. of St. Thomas, 241, 243, 246.

2. Acts of Master Isaac O Culean, canon of Armagh, and commissary of the **April**, **1361**. dean and chapter, during vacancy of the see, regarding the vicarage of Carlingford. f. 2\*.

The following documents are included :---

(1) Thomas de Burley, Prior of the Hospital of St. John of Jerusalem in Ireland, having presented Sir Thomas Waleys, priest, to the vicarage, O Culean orders the archdeacon, or his commissary, to make the customary inquiries, 6 April.

(2) Hugh Germey, vicar of Drummeskyn, commissary of the archdeacon, informs O Culean that having made inquiry as ordered, he finds that the vicarage is vacant by the death, last Easter, of Sir Henry Mowir, that the prior aforesaid is the true patron, and that the person presented by him is fit. Dated 26 April.

(3) O Culean, having admitted Waleys, orders the official or commissary of the archdeacon to cause him to be inducted. Dated at Drogda 27 April.

(4) Certificate of admission of Waleys, here styled 'chaplain,' by the giving of O Culean's gloves. Dated at Drogda, 27 April.

(5) Germey orders Sir Adam, rector of Marillis[...](?) to induct Waleys. Dated at Drummeskyn, 28 April.

3. Certificate of Richard (Fitz Ralph), Archbishop of Armagh. f.  $2^*$ . 1348 × 1360. States that Sir Thomas Waleys, chaplain of the diocese of Armagh, was ordered to appear before the archbishop at his ordinary visitation.

Mutilated, only the first few words remaining. Probably a certificate of orders put in by Waleys at the archdeacon's inquisition (see no. 2).

c. 1600. 4. Table of contents.

Inserted leaves.

f. 1\*\*.

5. Documents partly illegible.

The following words have been read by the late Bishop Reeves :-

"[...] archiepiscopus dominum Johannem Peshelle excommunicavit denunciavit et ipsum inde absolvere noluit quousque oportebit [...].

"Okaughian quod ipse extunc de cetero dictum Philippum non nominaret custodem sedu priorem domus predicte et super hoc [...] literas suas patentes predictas tunc majori et Ballivis testificantes dictum Walterum per ipsum auctoritate ordinaria fore excommunicatum [...] custodis et pro donis ab eo receptis ad excludendum dictum Walterum de actione sua in [...] predicta per quas literas [...] sua remansit sine die ad grave dampnum ipsius Walteri."

6. Letter to John Keppock, justiciary of the King of England and 14 November, 1379(?). Ireland. f. 1\*\*.

States that the writer had given judgement in a matrimonial cause concerning Agnes Laundey, who married three men who were still living, and in an action against her for adultery with John Whyte of Dundalke, while he lived (?), for about twelve years, enjoining upon her corporal penance, viz., that she should be beaten round the churches for seven years; that this judgement was modified, at the instance of friends of Agnes Laundey, the archbishop substituting pecuniary for corporal penance; that the sentence having been reported to Keppock he charged the archbishop with extortion, and with having, by the imposition of the pecuniary penalty, invaded the prerogatives of the civil courts (imponitis penam illam pecuniariam eidem adultere per nos impositam et forte receptam fuisse factam per intrusionem), and summoned him to appear before him at Droghda on 17 November. The archbishop announces that he will appear on that day to defend the rights of his church. He also certifies that he has to-day (14 November) received letters from Niallan Oneyll to the effect that Geoffrey Whyte and others from Doundalke have broken the peace of Christ and the king which by his mediation had been made, concerning the matters about which the day of parliament (viz. 17 November) had been appointed, LAWLOR—A Calendar of the Register of Archbishop Sweteman. 221

He therefore requires Keppock, lieutenant of the king in Ireland, in that parliament to do justice between the parties.

The year is not given; but it lies between c. 1374, when John Keppock first appears as a justice (C. P. R. I. i. 86, nos. 33, 87), and 1380 when Sweteman died. Since 17 November is said to have been Thursday its Sunday letter is B: it is therefore probably 1379, but possibly 1373.

7. Letter to the son of Niallan Oneyl.

### f. 1\*\*.

29 May, 1376. States that when the archbishop was last in his manor beside (infra) the lake near Armagh (Armachia) Niallan Oneyl and his wife had informed him that the clerks of the chapter had risen against him with all their men. Then Oneyl and his wife, of their own motion, took oath to defend him against the chapter. Relying on this oath, the archbishop made Oneyl his arch-seneschal, to which office belonged the collection of the rents of Armagh and Telachoge and other places. He afterwards sent to him his messenger Gylcomy Orylchan, who stayed with him fifteen days, but received no rents. Afterwards, hearing that this was due to information given by false clerks to Oneyl that the archbishop had been excommunicated at the Roman curia, he sent him by the same messenger a copy of his absolution, with a letter. It is reported, however, that the messenger has been taken prisoner by the pretended dean of Armagh, and deprived of his clothes and of the absolution and letter (above the line it is added, and was three days in a wood). Oneyl's son is asked to intimate all this to his father, in order tha he may be induced to give satisfaction regarding the rent, and that the archbishop may not be obliged to proceed against him for perjury. The archbishop sends for Oneyl a copy of his absolution, which like the aforesaid letter is not closed but open so that all whom it concerns may see it.

8. Letter to Masters Odo (M<sup>c</sup>dinim), dean, and Maurice (O'Corry) 6 August, 1374. chancellor, and other canons resident in the chapter of Armagh. f. 1<sup>\*\*</sup>.

Certain charges have been brought against Niallan Oneyll, under the seal of confession (in secreto quasi confessionis) by persons who would not otherwise have dared to make them—viz. 1. that since the archbishop last left the church of Armagh, he threatened to make his manor (facere manerium sive lanfordum) at Hewynnae near Armagh, which is the archbishop's land; 2. that he aims at making his own all the lands of Clondouyll; 3. that he claims all the archbishop's lands and tenements, and will leave the archbishop and his clerks nothing at Armagh except the cathedral church. If he says these things he has relapsed into heresy, from which he had been restored by the archbishop. But the archbishop does not believe these reports, and he has promised not to proceed against Oneyll without consulting the chapter. And further Oneyll has wasted the deanery

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[31]

of Tulachog. Therefore the archbishop requires the chapter to certify him concerning all these things within eight days. The chancellor is also to proceed on behalf of the archbishop against Gilbert Omolduyn, pretended canon of Armagh, Clogher, and Rathbo, son of a presbyter, especially since he has given false information to Oneyll, the archbishop's lay friend, against him and his church, thereby incurring the guilt of perjury. The archbishop is to be informed of these proceedings without delay.

Memorandum of debts due to the church of Armagh during the
 approximate (de toto tempore) of Milo (Sweteman).

John Plunket, Lord of Beaulu, and the other lords of the same are bound in 3 lbs of wax for Beaulu; also for Kerwillestoun 3 lbs of pepper which have not been paid since the death of Archbishop Richard (FitzRalph).

It seems to be implied that the document belongs to the period immediately following Sweteman's death (August, 1380).

10. Letters patent.

### f. 2\*\*.

15 July, 1373. States that the archbishop, elected (eclesie Ardm in krepidinem Ardm) at the Roman curia by the cardinals, and by authority of the Pope confirmed, and consecrated there by the said (?) lord [Pope (?)] (a dno  $d[.]\delta(!)$  [...], since his coming to his church had laboured among the English and Irish for the peace of the Church and of the King of England and lord of Ireland, and had suffered much. At length on Thursday, 15 July, 1373, with the aid of Sir Robert de Aysstone, justiciary, and the English, a concordat was made between Niallan Magunussa (also written Megunissa and Megunussa) Memaguna (also written Megmahouna). Terence his brother and Medoundyll captain of the Scots dwelling in Ulster, on the one hand, and the justiciary, Sir Thomas de Verdon, knight. [...] James de Verdone, John Doudall, sheriff of Louth, Geoffrey Whyte, Roger Gernoun, Nicholas Houth, Lord of Beaulu, and many other English magnates, on the other hand, all of whom swore on the "crux dominica" which was carried before the Archbishop as it had been carried before St. Patrick, except the justiciary, who swore by his own faith (fide sua media ... jurauit). The Irish were to maintain peace, especially in Ergalia and Midia: and the English were to keep peace towards the Irish. If rapines, depredations, spoilings, incendiarisms or accidental (casualia) homicides were committed by the English among the Irish, or wrong done by the Irish to the English, complaint was to be made to the justiciary so far as they concerned the king's right, and to the archbishop so far as they concerned the Church's right. And it was agreed by Meginissa that he himself would do justice (quod ipse paratum se optulit facere justiciam) [... and] receive [...] from them, as by his letters the justiciary promised to write to them, within the term [fixed] by the archbishop, viz. 1 November;

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and meanwhile that on the part of M<sup>c</sup>gunissa there should be truce (tr'ige) if the Ulstermen were willing. Sealed by the archbishop and William Pyrroun, notary public, who drew up the instrument.

Ends: "Magistro Johanne de Strode, rectore ecclesie de Stabanann, magistro Mauricio [Odone M<sup>c</sup>] di [nim..... can]on[ici]s ecclesie cathedralis Ardmachane et Thoma Ologheran decano decanatus de Tulaghoge testibus ad premissa vocatis et [specialiter] rogatis."

There is an error in the date, since 15 July, 1373, was Friday. The true date was probably 15 July, 1372, which was Thursday. This would allow time for Taney's tenure of the office of justiciary, which is said to have lasted eighteen months, and to have preceded the second period of office of William de Windsor (C. P. R. I., i., p. 86, no. 41), which began in April, 1374 (ib. no. 19).

11. Acknowledgement by Maurice Ocorry, Chancellor of Armagh, of money 10 September, 1373. due by him to the archbishop, made before the archbishop sitting in his capitular place at Armagh cathedral. f. 2\*\*

Ocorry owed 10 silver marks, viz.  $2\frac{1}{2}$  marks "in prece vel pretio" then payable, the like payable on 1 November and 25 December, and 3 marks on 2 February for corn and animals (?, sold to him. And thus a delay is granted (respectuatur) of all his other debts "sub bono suo gestu futuro scriptis presentibus decano Ardmachano et ceteris residentibus de capitulo Ardmachano." A notarial certificate, for the most part illegible, follows. Two names, perhaps of witnesses, have been read : Malachias M<sup>c</sup>K[...] and William Ohmr (?).

12. Verses of a religious character.

A considerable part is illegible.

13. Letter to Pope Gregory (XI).

14 August, 1374. States that Nicholas Fer [...] received from the archbishop collation and institution to the rectory with cure (curata) of Dunbeynge, and was instituted and inducted, and remained there some years without being ordained priest. He then received the rectory with cure (curata) of Mourne, to which he was instituted by the Bishop of Down and inducted, still retaining Dunbeynge for some months. When called upon at the ordinary visitation of Armagh in 1374 to produce his titles and dispensation he did not do so, and appealed to the Pope. The archbishop, disallowing (non deferens) the appeal as frivolous, now addresses these refutatory letters to the Pope.

Dated at the manor of Dromeskyn.

On f. 3\*\* we find "Milo Swet[eman] 13 [. .]," partly cut away.

14. Letter to Master Maurice (O'Corry), Dean of Armagh. f. 3 \*\* v.

24 [...] 1380. States that brother Simon, Bishop of Derry, had been guilty of various crimes, e.g., simony, squandering the goods of his church, neglecting to correct the sins of his subjects, false [obtaining (?) of a bull] of

f. 2\*\*\* col. 1.
f. 2\*\*\* col. 2.

 $[31^*]$ 

Pope Gregory XI by the instrumentality of the abbot of Cella Nigra at Derry, and in virtue of it, by the counsel of the abbot and other prelates of his diocese, oppressing many persons. He was guilty of divers other crimes throughout the province, and especially in the dioceses of Armagh, Raphoe [and Derry], and is bound by certain debts to the archbishop. The dean is given power to proceed against the bishop in the archbishop's name.

Dated at the manor of Drummeskyn.

The beginnings of the lines of this document have been cut away, and in consequence the purport of much of it cannot be ascertained.

f. 1.

15. Appointment of proctors by the archbishop.

6 March, 1366. The proctors named were John Phil[....lptoun and Sir [Gilbert] Cauntoun [....]. They were to state to Leonellus Duke of Clarence, son and lieutenant in Ireland of the king, the cause why the archbishop could not at mid-Lent give him a full reply concerning the "mutual" carrying of the crosses of himself and the Archbishop of Dublin, each in the province of the other, and the evidences and reasons for the archbishop's right to the primacy of Ireland and to the carrying of his cross.

Dated at the city of Down.

16. Letter of the archbishop, chaplain of Edward (III), to the 27 September (?), 1365. king. f. 1.

States that on 28 August he had received the king's brief, ordering that, if any impediment hindered him from doing the things contained therein, he should appear before the king within fifteen days of Michaelmas. In obedience thereto he repaired to certain places on the border of the provinces, on 17 and Thursday, 24 September, to treat with the Archbishop of Dublin about the matter contained in the brief. The Archbishop of Dublin did not appear; but on the latter day he sent proctors, desiring the archbishop to obey the brief in all things, and especially in regard to the mutual carrying of the crosses in both provinces. This the archbishop could not do, (1) because it was impossible for him, in so short a time, to hold the necessary consultation with his chapter and suffragans, who were 100 miles or more away; (2) because, by grants of the Apostolic See, and of the crown, some of which he sends for inspection, the Archbishops of Armagh have the right of primacy in the province of Dublin, and of carrying their cross throughout the whole of Ireland; (3) because a suit brought by him many years ago at the Roman curia against the Archbishop of Dublin on that matter was still pending; while concerning the right of the Archbishop of Dublin to carry his cross in the province of Armagh no question had ever been raised, notwithstanding suggestions to the contrary, and so the case of the Archbishops of Canterbury and York was not parallel to that of the Archbishops of Armagh and Dublin; (4) because, of

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right and ancient custom, the Archbishop of Armagh, Primate of Ireland, has three archbishops subject to him, and when one of them—the Archbishop of Tuam—was recalcitrant, the primate got judgement in his favour at the Roman curia, and a bull entitling him to hold quinquennial visitations. Therefore, he begs to be excused on account of the shortness of the time from appearing personally before the king as required by the brief; and that the king will command that no similar brief shall henceforth issue from his chancery.

Dated at the manor of Dromeskyn "die sabbati etcet."

Printed, with an omission, in Ussher's Works, i., p. cxxxviii.

This document evidently belongs to the same year as no. 17, to which it is the archbishop's reply (1365). It follows that the statement made in it that 24 September was the Thursday before Michaelmas is erroneous. In 1365, 24 September was Wednesday. It was written on a Saturday, and apparently on that which followed 24 or 25 September, i.e., 27 September.

17. Letter of King Edward (III) to the archbishop in regard to the **9 June, 1365**. controversy about the carrying of the crosses. f. 1 <sup>v</sup>.

Enjoins that the archbishops shall meet and arrange a concordat, on the understanding that each may have his cross carried before him in the province of the other, following the example of the Archbishops of Canterbury and York, who, at the intervention of the king, made peace on this understanding after a similar controversy. If by any impediment the Archbishop of Armagh is hindered from so doing, he is to appear before the king in England within fifteen days of Michaelmas.

Dated at Westminster.

The month and year in the date cannot now be read. The date, however, is undoubtedly 9 June, 1365: see *Cal. Close Rolls*, 1364-1368, p. 181. Ussher (*Works* i. p. cxxxviii) wrongly gives the year as 40 Edward III (1366).

18. Letter of the same to the same and the Dean and Chapter of **22 September**, **1366**. Armagh. f. 2.

States that on account of the recent appointment of the archbishop they are bound to give an annual pension to one of the king's clerks nominated by him until he is provided by the archbishop with a sufficient benefice in the archbishopric, and nominates accordingly Walter Brygge, who had been previously nominated without effect.

Ends : "Teste Leonello duce Clarencie filio nostro carissimo locum tenente nostrum in terra nostra Hibernie apud Kylkenniam," &c.

Acquittance for rent of the Castle of Trym.
 f. 2.
 January, 1365. Acknowledges the receipt from Walter de Dalby, clerk, treasurer of Ireland, and chamberlain of the exchequer of Ireland, of £33 18s. 4d., from the 35th to the 38th year of Edward III, in part payment

of a yearly rent of £8 16s.  $7\frac{1}{2}$ d., and arrears thereof, now in the king's hand during the minority of the heir of Roger de Mortuo Mari, late Earl of March.

Dated in the Exchequer aforesaid.

20. Letter from King (Edward III) to the Archbishop. f.  $2^{\tau}$ . 22 October, 1363 (?). After mentioning the disastrous consequences of the controversy between the two archbishops (see no. 16, &c.), gives an injunction similar to that contained in no. 17, the Duke of Clarence, son of the king, to whom the king has written, being named as mediator between the archbishops. If this is not carried out the archbishops are to appear personally before the king at London in the quinzaine of Easter.

Dated at Westminster.

In French.

The year is not given in the date. But this letter, and the concurrent letter to the Duke of Clarence mentioned in it, are referred to in nos. 23, 110. It must therefore have been written in the October preceding their dates—i.e., apparently in 1363.

21. Letter of Richard Stury, keeper of the king's market and measure in 21 December, 1366. Ireland, to John Clyntoun, John Strode, rector of Stabanan, Roger Swayn, and John Whyt, clerk. f. 2<sup>v</sup>.

Since his deputy William Ilgere is for a time unable to continue to exercise his office in the lordships of the Archbishop of Armagh in the counties of Loueth and Midia, the above are appointed to do so until Easter.

Dated at Droghda.

22. Letter of Edward (III) to the archbishop. f. 2<sup>\*</sup>.

**6** July, 1371. He is to cause the Dean and Chapter of Armagh to appear before the justiciary at Cathirlagh within fifteen days of Michaelmas, to answer the Abbot of Mellifont, who claims that they owe him  $\pounds 80$ .

Ends: "Teste R. de Prestoun apud Cathirlagh," &c.

23. Letter of [Lionel] Duke of Clarence, Lord Lieutenant of Ireland, to the 18 January, 1364 (?). archbishop on the controversy about the carrying of the archiepiscopal crosses. f. 3.

The archbishop is to meet Robert de Asshetone, chancellor, and Thomas de la Dale, at Donboyne, this day week, viz.: Thursday, 25 January, before the first hour (die Iovis proxime futuro ad octos dies ante horam primam), so that answer may be given regarding the things contained in the letters sent by the king to the archbishop.

Ends : "Datum sub nostro sigillo privato in castro Dublin," &c.

The year is not given in the date. But the letter must have been written between 1362, when Lionel was made Duke of Clarence, and 14 December, 1366, when he had left Ireland (no. 24; Cal. Close Rolls, 1364-1368, p. 151). And if the obscure phrase "die Jovis," &c., has been rightly interpreted as "this day week being Thursday," 18 January was Thursday. The only year within the limits named in which this happened was 1364. On the other hand, it is difficult to believe that no. 15 was parted from nos. 20, 23 by an interval of over a year.

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24. Letter of Edward (III) to the Archbishop and the Dean and Chapter 14 December, 1366. of Armagh. f. 3.

This is a demand in almost identical terms with no. 18, Brigge being substituted for Brygge, but ending, "Teste Thoma de la Dale custode terre nostre Hibernie apud Trym" &c. It is stated in the heading to have been received by the archbishop in St. Peter's Church, Droghda, on Ember Saturday, (19) December.

25. Acquittance for rent of the Castle of Trym. f. 3.

f. 3<sup>v</sup>.

12 December, 1364. Identical with no. 19, except in the date.

26. Payments made out of the rents of Trym.

1363×1372. On Wednesday [....] John Betis crossbearer of the primate and Sir (?) [.... obtained from (?)] the chancellor of the king in Ireland liberates directed (vocati liberate directi) to the treasurer and barons of the king's [exchequer] out of the rents of the Castle of Trym, which were in arrear, and he (it does not appear who) received, by the hands of the said Sir John, messenger of the primate, tallies to be delivered to the following on behalf of the primate for their salary: viz. (1) a tally directed to Peter Penteney, sheriff of Uriel, for £4 10s. to be delivered to Richard Whit, narrator, as part of his fee-an acquittance therefor to be received by Master J. Strode or Betis; (2) a tally for  $\pounds 4$ , directed to the same, delivered to John Plunket, narrator, as his fee by Strode and Betis; (3) a tally for £3, directed to Simon Crux, sheriff of Dublin, delivered to John Kepoke, narrator, as his fee by the same; (4) a tally for  $\pounds 4$  10s., directed to the same, remaining with the primate, who will hand it to Sir R. Prestoun when he comes to him. Edmund Mortimer, Earl of March (born 1351), was still a minor when this document was written

Edmund Mortimer, Earl of March (born 1351), was still a minor when this document was written It may therefore be dated not later than 1372. It is later than no. 142.

27. Safe conduct handed to Gilbert messenger of the primate in the **13 May, 1366.** chamber of the latter at Drumeskyn on 10 March, 1367, in the presence of John Strode and R. Dencourt. f. 3<sup>v</sup>.

It was granted by Leonellus son of the king, Duke of Clarence, Earl of Ulster, Lord of Connaught and lieutenant of the king in Ireland, to Edward, Gilbert and Paulinus, messengers of the primate, and was valid in Ulster for a year.

Dated at Down.

28. Letter of Edward (III) to the sheriff of Loueth, obtained by 26 February, 1367. John Haddesore. f. 3<sup>v</sup>.

The Sheriff is to command the archbishop to deliver without delay to John son of Peter de Haddesore the manor of Inesken, which Jordan Darditz gave to Richard de Haddesore and his wife Margery and their heirs, and which on the death of Richard and Margery and their son John, and his sons John, Richard and Peter, ought to descend to the aforesaid John son of Peter their kinsman and heir. If he is not obeyed, and if John gives security that he will prosecute his claim (fecerit te securum de clamio suo  $p\tilde{s}$ )<sup>1</sup> he is to summon the archbishop to appear before the justices at Carthirlagh within fifteen days of Easter.

Ends : "Teste Thoma de la Dale custode terre nostre Hibernie apud Droghda," &c.

A note stated that John Haddesore gave 10s. security for this letter. A second note (in a different hand) states that another letter was sought, for (ad) 3 November, of which a copy appears below (no. 32).

29. Summons to a parliament at Kylkenny on the morrow of Holy 27 April, 1367. Trinity (14 June). f. 4.

Ends: "Teste Geraldo FitzMorice Comite Dessemoñ justiciario nostro Hibernie apud Dublin," &c.

30. Letter to Edward (III).

**6** October, 1367. Informs him that Adam Hauberi, senior (?), of Dervere (?) in the diocese of Armagh had been sentenced for contumacy to the greater excommunication by the archbishop's official principal, at the instance of Maurice Bensices (?) of Louth, and that he has remained obdurate for over 40 days. Prays that the king will compel him to make satisfaction.

Dated at the manor of Drummeskyn.

31. Acquittance.

**9 October, 1366.** Peter Derepentency, sheriff of Loueth, acknowledges receipt from the archbishop of  $\frac{1}{2}$  mark for a letter concerning the holding of a convention, viz.: in extracts of fines and amercements of the Chancellor of Ireland in an. 40 (1366): and of 40s. for licence to make agreement, viz: in extracts before Robert de Prestoun and his fellow-justices of the Irish Bench, Hilary term 1365.

32. Letter of Edward (III) to the Sheriff of Loueth, f. 4,

14 October, 1367. Identical with no. 28, except that 'on the morrow of All Souls (3 November)' is substituted for 'within fifteen days of Easter,' and that it ends: "Teste Geraldo FitzMorice Comite Desmond, justiciario nostro Hibernie apud Carthirlagh," &c.

33. Letter of the same to the sheriff of Uriel, obtained by the malice of 12 February, 1368. John de Troye without the knowledge of the king. f. 4<sup>v</sup>.

The sheriff is commanded to have at the Irish Exchequer at Cathirlagh by the morrow of the close of Easter (17 April) the following sums, 'viz. super remotionibus comp' of the county of the Cross of Ulster in our 41st

 $^1$  Or 'gives, as security for his claim, 10s': p and x being difficult to distinguish.

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f. 4.

f. 4.
year (1367): From the archbishop, guardian of the spirituality of the bishopric of Down, *sede vacante*, and John Langestoun, clerk, for many defaults 100s.; from the same for unjust impediment 100s.

Ends : "Teste Johanne de Troie thesaurario nostro Hibernie" &c.

34. Summons to a parliament at Dublin on 1 May.

12 March, 1368. Ends : "Teste Geraldo &c. (as no. 32) apud Corke " &c.

35. The Archbishop appoints John de Clynton lord of Drumcassell and **29 April, 1368**. Robert Galys his familiar, his proctors at the foregoing parliament. f. 4<sup>\*</sup>.

Dated at the manor of Tarmefeghyn.

36. Brief of *Quare impedit* obtained by the Prior of St. Mary, Loueth (also **20 June, 1368**. written Louthe), against the primate and John Kenan, clerk.

Edward (III) directs the sheriff of Loueth to command the last-named persons to permit the prior to present a fit person to the vicarage of St. Feghin of Tarmefeghynn, vacant, and in his gift, as he says. If the command is not obeyed, and the prior gives security, as in no. 28, they are to be summoned to show cause before the justices at Cathirlagh within 15 days of 24 June.

Ends: "Teste Geraldo &c. (as no. 32) apud Drogheda" &c.

37. Another brief relating to the same matter.

f. 5.

11 (?) July, 1368. Edward (III) directs the sheriff of Loueth to take recognisance and sureties (vadium et salvos plegios) of the same to appear before the justices at Cathirlagh within three weeks of 29 September to answer the plea of the prior about the vicarage of St. Feghin of Tarme Feghyn, and to have there the names of the sureties.

Ends "Teste R. de Prestoun apud Cathirlagh."

38. Letter of the archbishop, guardian of the spiritual jurisdiction of **10 January**, **1369**. the bishopric of Down in the vacancy of the see by the death of Bishop William (White), to Sir Ralph de Poley, Kt., seneschal of the Liberty of Ulster. f. 5.

States that the presentation to the parish church of Kylkeyl in the Mourne, diocese of Down, belongs to the Earl of Ulster or his locum tenens in Ulster; that it is now vacant by the deprivation by the archbishop, during the vacancy of the see by the death of Bishop Richard (Calf), of Master John de Preez, late rector, for homicide and perjury; and that the presentation has now devolved upon the archbishop. Out of respect for the earl and Poley the archbishop calls on the latter to present, notwithstanding any appeal made by Preez, the *de facto* incumbent, to the Roman curia. It seems to be added that if Poley does not soon make a presentation he will confer the rectory on a fit person.

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Dated at the manor of Drummeskyn.

The latter part is almost wholly illegible.

The dominical year in the date is partly illegible, but the document is said to be of the 8th year of the consecration of Milo, i.e. 17 November,  $1368 \times 20$  November, 1369.

39. Summons to a parliament at Dublin on 30 July, 1639. f. 5<sup>°</sup>. 18 June, 1369. Ends: "Teste Willielmo de Wyndesore locum nostrum tenente in terra nostra Hibernie apud Dublin" &c.

40. Appointment of Master John de Strode, rector of Stagbanan, and **27 July**, **1369**. John de Clyntoun, lord of Drumcassell, as proctors of the archbishop at the foregoing parliament. f.  $5^{v}$ .

Dated at Tarmefechyn.

41. Letter of Edward (III) to the primate received by the latter in the hall 29 December, 1369. of his manor of Drummeskyn on 2 January (*MS. wrongly* December), 1370, in the presence of Sir Thomas de Verdoun, Kt., William Fouler, Prior of St. Leonard's, Dundalke, Master Nicholas Beth, William Vt[er]aton (?), William Gernoun, Robert Beth, and others. f. 5<sup>r</sup>.

The letter (quoted in full) summons the archbishop to attend a parliament at [. . .] on 2 January, 1370.

Ends: "Teste Willielmo &c. (as no. 39) apud Dublin" &c.

An endorsement states that the letter not having been received till after 9 o'clock on the day of the parliament, the archbishop could neither attend it nor send proctors.

f. 6.

f. 6.

42. Letter of the same to the same.

13 January, 1370. The archbishop is commanded to cause 18d. out of every librate of ecclesiastical benefices, according to the taxation (taxas) of the same, granted by the archbishop and the clergy of his diocese to William de Wyndesore, to be paid before 2 February.

Ends: "Teste Willielmo &c. (as no. 39) apud Dublin " &c. " Thelwalke."

43. Letter of the same to the same.

13 January, 1370. The archbishop is to compel the Abbot of Mellyffont, the Prior of the Hospital of St. John of Jerusalem in Ireland, the Abbot of St. Mary's, Dublin, and the Abbot of Newry (de Viridi Ligno) to satisfy him concerning a sum of 18d. out of a librate &c. (as no. 42) so that it may be paid to William de Wyndesore before 2 February.

Ends as no. 39.

44. Brief of the king for a council at [Dublin before William de Wyndesore,
c. 1 March, 1370. 22 April] 1370. f. 6<sup>v</sup>.

A blank space is left for the text of the brief.

Summonses to parliaments are usually dated about seven or eight weeks before the date of meeting (see nos. 29, 34, 39, 54, 106, 111, 112, 114, 239). Hence this brief probably belongs to the early days of March.

45. Letter of the archbishop appointing John de Strode, rector of **20 April**, **1370**. Staghban and [blank] his proctors at the foregoing parliament. f.  $6^{\vee}$ 

Dated at Tarmefechyn.

46. Letter to William de Wyndesore, lieutenant of the king in 17 February, 1371 (?). Ireland. f. 6<sup>v</sup>.

By a letter of 18 January, received 15 February, de Wyndesore signified his will that an agreement should be made between the Archbishops of Armagh and Dublin, in the same form as that made between the Archbishops of Canterbury and York, and that if they would not acquiesce in this a reasonable delay should be allowed that meanwhile by his mediation an agreement might be made in some other form. He desired a reply by the bearer. The archbishop excuses himself from replying immediately, as the matter concerns his chapter and suffragans.

Dated at the manor of Dromeskyn.

The year is not given in the date. But de Windsor was viceroy from a date between June, 1368, and April, 1369 (nos. 36, 64), to 21 March, 1372 (C. P. R. I., p. 84, no. 131), and again from April, 1374, to 1376 (ib. p. 86, no. 19, p. 100, no. 27). The possible years are therefore 1369, 1370, 1371, 1372, 1375, 1376. But this is the last document of the series (nos. 36-46) on ff. 5, 6, which have always been consecutive leaves; and the preceding documents are arranged in chronological order from 20 June, 1368, to 20 April, 1370. This points to 1371.

47. Letter to the Bishop of Clogher.

f. 7.

7 August, 1366. States that Malachy M<sup>c</sup>guydir having been deprived of his canonry in the church of Clogher by the archbishop at his metropolitical visitation, and the right of appointment having devolved on the bishop through negligence of the chapter of Clogher, he has conferred it upon Master Dionysius M<sup>c</sup>cyngoband, official of Clogher, at the request of the archbishop. M<sup>c</sup>gyngoband being disturbed in his possession thereof the bishop is commanded to protect him.

Dated at Dromeskyn.

48. Commission to Master Philip Odalchan (Odallachan in no. 52), 8 August, 1366. archdeacon, and Sirs Macrobius, vicar of Lyethmanan (Lyechmanan in no. 52), and Christin Obuachall, chaplains, of the diocese of Clonmacnoise (Cluanen.), to hold the metropolitical visitation of that diocese for the archbishop. f. 7.

Henry is mentioned as the Bishop of Clonmacnoise.

Dated at Dromeskyn.

A note refers to no. 52.

49. Memorandum.

f. 7.

16 September, 1366. Records the taking of the usual oath in the chapel of Tarmefechin by Augustine (Oromga), Dean of Dromore, in the presence of

 $[32^{\times}]$ 

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Master John Kenan, notary public, John Whyt, clerk, and Gilbert, messenger, prior to the issue of the commission to him and Cornelius Omakrel (no. 50).

50. Commission to Masters Augustine Oromga, [Dean] and Cornelius 16 September, 1366. Omacrel, canon of Dromore, to hold the metropolitical visitation of such parts of that diocese as the archbishop had not personally visited, according to a composition entered into between the archbishop and the bishop, chapter, and clergy of the diocese, when the archbishop was last there.  $f 7^v$ .

Dated at Tarmefechyn.

51. Letter to the Bishop of Dromore.

f. 7<sup>v</sup>.

1 October, 1366. The archbishop has heard that, contrary to the composition (see no. 50), the bishop has impeded the dean and Cornelius Omagrela, canons of Dromore, in their visitation. He orders the bishop, under the penalty of greater excommunication, not to impede them, and to certify him by the bearer of this letter what he considers meet to be done in regard to this matter.

Dated at Tarmefeghyn.

A note states that the primate sent a copy of the foregoing by Molcalym Omagrela, messenger, who was sworn concerning the bringing back of a reply from<sup>1</sup> the Bishop of Dromore, to his commissaries above named; another letter to M'genosa, King of Oueach; and a third to the above-named commissaries. These letters Omagrela received, 2 October, in the presence of Master R. Sampford, vicar of Tarmefeghyn; Sir John Rosell, chaplain, and John Whyt, clerk.

52. Letter to the commissaries named in no. 48. f. 8.

16 November, 1366. The archbishop requires them, or one of them, to come to him in accordance with their oath regarding the procurations, taken 29 September. The letter is borne by Edward, a messenger.

Dated at Dromeskyn,

53. Remission for Odo (O'Neill), Bishop of Clogher (also written 9 July, 1367. Clocher). f. 8.

The archbishop remits any action he might have against him regarding 145 marks demanded by the archbishop from him before, by reason of a collection of money concerning (the archbishop) of Armagh himself, and, according to the latter, not paid before Odo became bishop, and (by reason) of rents of the archbishop's lands farmed to him, in which the archbishop judicially condemned him at Louth; so that it will (not) be competent to the archbishop to take any action against him, so long as he observes the promises made in his letters patent of this date.

Dated at the manor of Dromeskyn.

<sup>1</sup> The word ' ab ' is inserted above the line.

54. Summons to a parliament at Cassell on the octave of Holy 25 April, 1371. Trinity (8 June). f. 8.

The archbishop is to attend in person, together with proctors of the dean and chapter and others of the clergy of the diocese.

f. 8v.

Ends : "Teste Willielmo &c. (as no. 39) apud Balydoill," &c.

55. Letter to the Bishop of [Meath ?].

17 July, 1366 (?). The Bishop is to cite certain princes (reguli), who are under the archbishop's sentence of greater excommunication and interdict, to appear before the archbishop on a fixed day in the March of Kenlys, that those who desire and deserve absolution and relaxation may obtain it; he is to certify to the archbishop the names of the persons cited and willing to appear, at least two days before the day appointed, which is to be before (infra) the end of next week.

Dated at Dromeskyn.

On the date see note to no. 57.

56. Letter to Philip Oragilich, King of Brefnia.
f. 8<sup>v</sup>.
17 July, 1366 (?). States that the archbishop is unwilling lightly to begin the things contained in the king's last letter to him. He therefore proposes that the latter should meet him, or someone on his behalf, on 26 July on some march of his country beyond Kellmagnean Beg, and asks to be informed of the king's will in this matter, within three days.

Dated at Dromeskyn.

The letter is crossed out.

On the date see note to no. 57.

57. Letter to Philip O'Rayly, King of Brefnia. f. 8<sup>r</sup>.

17 July, 1366 (?). The will of the king having been explained in his last letter, with regard to the Bishop of Kilmore (Triburnen.), the archbishop replies as follows: That if the king finds a clerk (not a layman) in whose hands the fruits of the bishopric may be sequestrated, and will help such clerk in levying the fruits, he will so sequestrate the fruits and will cause the king to receive fitting satisfaction for his labour in that regard. And the archbishop desires the king to bind himself, by letters containing his oath, that, in case the archbishop should of necessity take action for the deposition of the bishop at the Roman curia, he will be obedient to the archbishop and the church of Armagh while such action is pending in matters concerning the action and in the levying of the fruits. If the king so binds himself, the archbishop will pledge himself not to make any agreement with the bishop without his consent.

Dated at Dromeskyn.

After the date the following is added : "Item mandatum nostrum aliud

vobis directum circa defensionem Nimee Memolmartyn nostro ac vestro clerico (*sic*) quoad prebendam suam de Macharinebair debite executioni demandatis nostris precibus et amore."

The year is omitted in the dates of the three documents, nos. 55-57. But they are written by the same hand, and are all dated 17 July. Hence they almost certainly belong to the same year. The contents of the present document seem to indicate that it followed no. 71 and preceded no. 73, and it is therefore to be placed in 1366. It will be observed that with the exception of no. 54 (which is at the end of a page, and may be a later addition), all the dated documents on ff. 7, 8, which were always consecutive, are of the year 1366 or 1367.

58. Letter to the Bishop of Clochor.

f. 8<sup>v</sup>.

8 March c. 1367 (?). States that the archbishop, during the vacancy of the see of Clochor, had excommunicated Philip Rog (?) son of Bernard M<sup>e</sup>magmuna, who now claims to be King of Ergallia, and interdicted all the lands in the diocese of Clochor whither he might go, for spoiling the goods of M<sup>e</sup>Comgan, a principal citizen and tenant of the archbishop, and other citizens; that the archbishop had also excommunicated and interdicted the same P. and Ardgall, Katholicus, Sean, Balbe, Odo, Engus, and another brother, sons of the said B., for their crimes in the diocese of Armagh, especially burning churches; that they remained obdurate under these censures a year or more; that they were excommunicated as suspected of heretical pravity, and remained obdurate over two years. Demands that they shall be publicly denounced as excommunicated, interdicted and suspected of heretical pravity.

Dated at Drommeskyn.

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The year is omitted in the date. If the bishop of Clogher referred to is Odo O'Neill, it cannot be put earlier than 1364, since the document implies that the see had been vacant three years earlier, and O'Neill's predecessor, according to Ware (p. 184), became bishop in 1361. It is probably not far apart in date from no. 53. Both documents convey that the bishop had not been long in office.

59. Letter to the bailiffs of Carlyngford. f. 9.

**24 January, 1369**. They are commanded to imprison John Brodok of Carlyngford, suspected of heretical pravity.

60. Letter of Edward (III) to the archbishop ordering him to cause the **26 June**, **1369**. revenues of persons holding ecclesiastical benefices within his province, and residing outside Ireland, to be sequestrated and kept in sequestration until he receives further order. He is to certify in the Chancery of Ireland the amount of such revenues and the names of the beneficed, from time to time. **f. 9**.

Ends: "Teste Willielmo &c. (as no. 39) apud Dublin" &c.

61. Letter to William (Mercier), Bishop of Coner, requiring him to fulfil28 August, 1369. the provisions of the foregoing letter (no. 60) in his diocese. Dated at the manor of Dromeskyn.

The letter was sent by the messenger Gylcoimy (O'Relihan).

Similar letters were sent on the same day by Gilcoimy to brother Simon, Bishop of Derry; to Christopher, Bishop of Dromore; to Sir John Logan, Archdeacon of Down—he not being recognized as bishop of that see until his bull has been presented to his metropolitan; to Odo (O'Neill), Bishop of Clocher; to the Bishop of Raphoe (Rathboten.), and to Richard (O'Reilly), Bishop of Kilmore (Triburnen.): and by the messenger Paul to Henry Powle, Archdeacon of Kenlys in the church of Meath, that see being vacant, as archdeacon, not as guardian, for a reason sufficiently known; to the Archdeacon of Meath, as archdeacon, for the same reason; to brother Richard, Bishop of Clonmacnoise (Cluanen.), and to William (MacCormack), Bishop of Ardagh: also to Master William Morice, Archdeacon of Armagh.

62. Letter to Edward (III) acknowledging the receipt of the king's letter **19 September, 1369.** (no. 60), announcing the despatch of the letters to the bishops (no. 61), to which no reply has yet been received, and stating that the king's command has been obeyed in the diocese of Armagh. f.  $9^{\circ}$ .

A schedule of beneficed persons &c., as required by no. 60, is appended, as follows :

Deanery of Droghda. Prior and Convent of Lanthonia prima in Wallia, rectors of St. Peter's, Droghda, £40 a year.

> The same, rectors of Kyllaneyr, 5 marks a year. The revenues of these two churches were sold to Sir Richard Rosse, vicar of St. Peter's, long before the arrival of the letter, and payment made up to three weeks after 1 May next.

> The same, rectors of Dunnany, 9 marks a year. The revenue was sold before the present year and payment made therefor long before the arrival of the letter.

Andrew Waryng, rector of Beaulu, 10 marks a year. Licensed by the archbishop to study at Oxford.

John Cusake, rector of Rath, 10 marks a year. Licensed by the same for general study.

Deanery of Atrium Dei. David Brakdan, rector of Derver, 13 marks a year. Licensed to study at Oxford.

Deanery of Dundalke. James Stantoun, vicar of St. Nicholas, Dundalke, 20 marks a year. Licensed by the same to study at Oxford.

> The fruits of the last two churches were sold long before the arrival of the letter and payment made therefor,

63. Letter to Master Henry Powle, Archdeacon of Kenlys in the church September, 1369. of Meath, or his official. f. 9<sup>v</sup>.

Identical with no. 61 (*mutatis mutandis*), except that the archdeacon, instead of sending the certificate 'from time to time,' is required to do so in time to allow the archbishop to make his report at the chancery before 29 September. He warns him of the consequences of disobedience to this, his second letter.

64. Letter of Edward (III) to the archbishop. f. 10.

6 April, 1370. The prelates having, at a great council at Dublin, on 22 April, 1369, granted in aid of the expedition of William de Wyndesore the king's lieutenant, a mark out of every carucate of cultivated land belonging to them, on condition that their free tenants, gavellers and betaghs should be included in the grant in relief of the prelates, but should not be further burdened on this occasion; and the prelates, on behalf of their clergy, their consent having been first obtained, having granted two tenths out of the benefices of their subjects in Ireland according to the current and accustomed papal taxation-both grants to be paid within a year, in equal parts on 1 August and 2 February following; and the condition having been made that the prelates through their servants, and the clergy through clerks appointed for this purpose by the ordinary should collect the money, and pay it to certain persons deputed for each diocese by the king's lieutenant, by indenture between such collectors and the persons so deputed; the archbishop is commanded (1) to appoint collectors and have the grant of the mark collected and paid, (2) to call a convocation or council of his clergy to give their consent, and (3) to certify the names of the collectors at the Irish chancery within 15 days of 24 June.

Ends: "Teste Willielmo &c. (as no. 39) apud Dublin &c. Thelwall."

A note states that the archbishop appointed the collectors, and held the convocation of his clergy among the English, at which the whole clergy granted the two tenths, except the Abbots of Melifonte and St. Mary's, Dublin, and the Prior of the Hospital of St. John of Jerusalem in Ireland, who though summoned did not appear.

A schedule of the collectors is appended, as follows:

Collectors of the mark.

Baronies of [Atrium Dei and . . .]: [.....]

Baronies of Loueth, Dundalke and Coly: Robert Pomerell, Roger Perotes, John [...], John Wolffe, John Whyt of Coly.

Baronies of [. . .] and Margallyn in Midia: Stephen Cor, John Bernard, [Thomas] Duffe.

### Collectors of the tithe.

Deanery of Atrium Dei: Sir Thomas Conchlach (corrected to Condlach), vicar of Kylmodymoke.

Deanery of Drogda: Sir John Bagote, vicar of Port.

Deanery of Dundalke: William Galwey.

65. Commission to Sir Thomas Condelagch, vicar of Kylmodymoke, for 30 June, 1370. raising the tithe in the deanery of Atrium Dei. f. 10<sup>\*</sup>. Dated in the city of Armagh.

66. Commission for raising the subsidy, as directed to laymen. f. 10<sup>\*</sup>. 30 [June], 1370. Thomas Duffe of Rathode in the barony of Margalyn is empowered to collect the mark from the archbishop's free tenants &c. of the tenement of the Nobyr and in the barony of Margalyn.

Dated in the city of Armagh.

67. Memorandum.

Masters Patrick Okorry, Dean, and Maurice, canon of 9 June, 1367. Armagh, Robert Odoyll, canon of Derry, and Sir John Bette, rector of Droumynge, having appeared before the archbishop in the manor of Tarmefechin, it was intimated that the rectory of Termoncayncomayn (?) was vacant by the death of Niall Mccamul. The archbishop, with the counsel of the above-named, collated it to Master Maurice Okasidy, canon of Armagh. f. 11.

68. Memorandum.

15 January, 1368. Richard (O'Reilly), Bishop of Kilmore (Triburnen.), having committed adultery and incest with Edina (? Ediua) Oraygill (elsewhere Oraigill), daughter of his uncle (patrui) and wife of one Meguyer, and incest with Edina (? Ediua) Megauueran (elsewhere Megauuergan), and having repeated the offence, was sentenced to greater excommunication by the primate, and subjected to the penalty of £100 and 40 marks, to which he had been sentenced by the same in case of repetition. He made confession, and submitted himself to the grace of the primate and his commissary. The archbishop accordingly issued a commission (quoted in full), dated at Dromeskyn, 12 January, 1368, to Masters James Scotelare and John Kenan his clerks. It states that owing to the demerits of the bishop the archbishop had assumed and was exercising episcopal jurisdiction in his diocese, and authorizes the above-named clerks, jointly or severally, to treat with the bishop about his offences, and the recurrence of the same, to give him absolution from his excommunication, to relax the sequestration of his bishopric, and to pronounce that in case of a repetition of his offences he shall again ipso facto fall under these penalties, as well as under that of £100 and 40 marks decreed for recurrence, and that in such case action shall be taken at the Roman curia

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f. 11.

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with a view to his deposition. The said clerks are also desired to treat with Philip Oraigill, King of Breffinia, and with other clerks of the diocese of Kilmore elected and deputed as custodians of the sequestration, as to what action should be taken about the sequestrated fruits of the bishopric, and whether the goods of the church itself have been diverted (distracta et dissipata) to alien uses. They are to report to the archbishop together with the return (retradicio) of this commission. Bishop Richard appeared before James Scotelare, learned in law, clerk and commissary of the primate. acting under this commission at Rathdycke, a place in the diocese of Kilmore near Monalthy, in the diocese of Meath. There, with the express consent of the bishop and the consent of the major and principal of his clergy, Scotelare gave sentence as follows :- He is to pay the penalty of £100 and 40 marks, and if his offence is repeated his episcopal jurisdiction is to be resumed by the primate, he is again to fall under the greater excommunication, and to have the fruits of the bishopric sequestrated, and action is to be taken at the Roman curia with a view to his deposition. The bishop was then sworn to abide by the commands (de stando mandatis) of the Church, and received absolution from Master Thomas Ossiridean acting for the commissary, as well as relaxation of the sequestration, restoration of jurisdiction, and dispensation on account of his offences. He promised, in part payment of the above-named sum, 20 marks within a month, 5 marks on 17 March, and 5 marks on 1 May, failure of these payments to incur greater excommunication. The bishop and the major of his clergy present, viz. Master Thomas Ossiridean, his official general, Luke Megauuergan, Dionysius Ossiridean, Luke Memonchan, Patrick Mebraddy, and others, swore that they would cause that letters about the foregoing, to be drawn up by the primate in the name of the bishop and clergy, should be sealed with the common seal of the bishop and clergy, and returned to the primate.

Ends: "Testibus ad premissa presentibus et vocatis magistro Willielmo Offergavll, Johanne Tia[..]rloge, Edwardo cursore dicti primati et aliis."

69. Memorandum.

f. 12.

14 November, 1366. At a metropolitical visitation personally held by the primate in the parish church of Kylmaynan in the diocese of Kilmore (Tirburnen.), Richard (O'Reilly), Bishop thereof, submitted and confessed that he was involved in the sentence of excommunication for impeding the commissaries of the primate in their visitation of the diocese, and that he had not put away Edina (? Ediua) (Oraygill, see no. 68), and that he had incurred the penalty of 40 marks for the repetition of his offence with her, and he put himself on the grace of the primate, praying to be absolved from the excommunication. The primate, when the bishop was

sworn to abide by the commands (de stando mandatis) of the Church, absolved him and relaxed his suspension, and pronounced that he had incurred the fine formerly decreed (in multam antiquam incidisse) except (preter) 18 marks already paid. A penalty (pena) was laid upon him in case of repetition of his offence, viz. (1), that he should *ipso facto* again fall under the sentence of greater excommunication, and (2) into the penalty of paying £100, and (3) that he should be brought before (ipsum . . . deferendi) the Pope with a view to his deposition. The declaration of the grace to be shown him by the primate concerning the fine (multa) for the present offence was reserved—(to be made) more ample (et in tanto amplioris) if he treated his clerks and laymen kindly, and especially the commissaries of the primate and those who obeyed them. By way of procurations to the primate, who was two days in the diocese, the bishop granted 4 marks, to be paid within 15 days, and the clergy, because they were poor, 4 marks, although the visitation was not parochial.

Ends: "Testibus ad premissa magistris Petro cancellario Ardmachano, Petro Houth, juris perito, et Johanne Strode, rectore de Stabanan et domino Johanne Bette rectore de Dromynge Ardmachane diocesis et Johanne Kenan notario publico et ibidem eisdem presentibus testibus."

An additional note states that the bishop and Patrick M<sup>c</sup>bradi, proctor of the whole clergy of Kilmore (Tirburnen.), and many others of the clergy, in the cemetery, towards the east part of the said church, conceded that the primate should complete his visitation by Master Peter Okerbyllan, his commissary.

Ends: "Testibus ibidem officiali curie Triburnensis, magistro Luca M<sup>c</sup>anachana (?), Johanne Whit clerico et me notario publico supradicto."

70. Letter to Richard (O'Reilly), Bishop of Kilmore (Triburnen.). f. 12<sup>v</sup>.

12 June, 1366. The bishop having contemned his excommunication and denunciation by the archbishop, is cited to show cause in the parish church of Kylmaynan beg on 20 June, why the fruits of his bishopric should not be sequestrated.

Dated at Dromeskyn.

71. Letter to the noble Catholus Oragilich.

12 (?) June, 1366. He desires Oragilich to deliver, or cause to be delivered, the letter of citation (no. 70) to the Bishop of Kilmore (Triburnen.), and to nominate promoted native clerks (de terra oriundos et promotos) to carry the intended sequestration into effect. Master Peter (O'Carolan), Chancellor of Armagh, greets Oragilich and his wife, who is his foster-sister.

72. Commission to Master Peter Okerbyllan, Chancellor of Armagh, to **27 August**, **1366**. hold a metropolitical visitation of the diocese of Kilmore (Triburnen.). f.  $12^{v}$ .

[33\*]

f. 12v.

Master William (O'Farrelly), comarb of St. Medoc, had been appointed commissary for this purpose, and his commission holds good in regard to matters begun or accomplished by him.

Dated at Dromesky.

73. Letter to Peter O(kerbyllan), Chancellor of Armagh, and the dean 27 August. 1366. (siv) and officials offic') of the deaneries of [blank]. f. 13.

Richard O'Reilly), Bishop of Kilmore (Triburnen.), having committed adultery and incest with Edyn ?? Elyu), daughter of Oragilich, his cousin (consanginea) and a married woman, the archbishop has had him and those obedient to him denounced as excommunicate in Kenlys, Nobyr, and Fauoria, in the diocese of Meath, and near that of Kilmore, and has caused the fruits of the bishopric to be sequestrated. He now commands the above to make similar denunciations through the diocese of Kilmore and elsewhere, and having proclaimed the sequestration of the fruits of the bishopric to levy the same.

Dated at Dromeskyn.

74. Memorandum.

f. 13.

**29 August**, **1366.** A letter from the archbishop was sent to the Bishop of Kilmore (Triburnen.) by Edward, messenger, urging him to cease from his adultery and incest with Edyn ? Edyu), daughter of Oraylly, his cousin and a married woman, on pain of delation to the Pope.

75. Letter to Richard (O'Reilly), Bishop of Kilmore (Triburnen.). f. 13. 9 October. 1366. The archbishop's metropolitical visitation, which was begun in the bishop's diocese by Master Peter O(kerbyllan), Chancellor of Armagh, and is being continued by Masters William Oferallaich, comarb of St. Medoc, and Adam M<sup>4</sup>tiarnan, dean of Drumleachan, not having been finished in the case of the bishop and others in the deanery of Kellmor, the bishop is cited to appear before the archbishop on 20 October, in the parish church of Kilmagnean beg. in Kilmore diocese. to submit to said visitation. and is commanded to cite by (?) his official general (cum official' vestrum generalem) the dean of Kellmor, and all rectors, &c., of the deanery of Kellmor.

Dated at Tarmifechyn.

76. Final citation to the metropolitical visitation of the diocese of Kilmore16 November, 1366. (Triburnen.).f. 13<sup>\*</sup>.

Bishop Richard (O'Reilly) is commanded to summon all dignitaries, nectors, &c., in the deanery of Kellmore, to appear in the church of Kellmor on 1 December, and those of the deaneries of Dromlechan and Dartra, in the church of St. Medoc of Drumlechan on [... December].

Dated at the manor of Dromeskyn. The year is also given as the 5th of Milo's consecration.

77. Commission to Master Peter Okerbullan, Chancellor of Armagh, to hold 16 November, 1366. a metropolitical visitation of the same. f. 13<sup>r</sup>.

The visitation was to be held in so far as (quatenus) the diocese had not been visited by the archbishop's authority that year.

78. Letter of the archbishop during his metropolitical visitation of the 14 November, 1366. diocese of Kilmore (Triburnen.), to the official of Kilmore and the dean of Drumleachan. f. 13<sup>°</sup>.

States that Bishop Richard (O'Reilly) had been sentenced to greater excommunication for his adultery, &c. (as no. 73), and had afterwards been absolved, apparently on the conditions mentioned in no. 69.

Incomplete, breaking off at the end of the page.

This letter seems to refer to no. 69, and therefore to have followed it. But the archbishop's personal visitation terminated with the acts recorded in that document (cf. no. 77), and two days later he had left the diocese and was at Dromiskin (no. 76). From these facts the date given above has been inferred. The inference is confirmed by its proximity to the dates of the other documents on the same leaf (nos. 73-77).

f. 14.

79. Rents of Nobbir.

#### c. 1368.

Name.	Holding.	Yearly Rent.
[]	Cristokislond.	[]
Adam White	do.	6d.
Heirs of Stephen Newe-	do.	3d.
toun: Robert Port[er]	]	
now holds it		
John Doudale	7 acres by (infra) the water of Nobir, between	16d.
	Heighrath and the water	
Nicholas Halle	Litgarlon and Moche garlon	4s. 2d.
do.	$T[\ .\ .\ ]$ milclone(?) on both sides of the water	•
Simon Vineter	" qui ista deponit per (above line dĩ) annun	ı
	debet vs (above line viz: quos solvere	e
	iurauit (?) ad festa apostolorum Philippi e	b
	Jacobi et omnium Sanctorum termine	)
	incipiente &c. lxv), pro vi acris terre	9
	(above line arabilis) de Clonbil (addee	l
	later et iii acr parci et pro toto Clonbi	1
	etc. (?) summa illius parcelli de Clonbil per	r
	annum xis.)."	
Archdeacon of Kenles, rector of Nober	Whitehildisyar	4 geese.
Thomas de Veldoun	Garden formerly belonging to John Doffe	2 geese.

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Name.	Holding.	Yearly Rent.
Milo de Verdoun	Garden	$2 \text{ geese}_{\bullet}$
Heirs (corr. to heir) of	do.	do.
Jordan White		
Heirs of John Rede	Park or pastur	e do.
John son of Walter	Brakschise	do.
White		
Heirs of Master Adam		do.
Vinter		
Thomas Palmer		do.
William Heyroun	Orchard	8d.
U U	Tolbolle of the Nobir	"valet de qualibet ceruisia
		padox(?) tercio(?) [.] lagon."

Heirs of Simon HannyllynNewmylclone8d.Each butcher is bound to give the lord [a pound] of fat (de cepo) a year.For the last provision see also no. 246.

Neither date nor name of the archbishop appears. The entry about Simon Vineter seems to imply a date at least as late as 1366. The other documents on the same leaf belong to 1368.

80. Letter of the archbishop, guardian of the spirituality and spiritual **16 December**, **1368**. jurisdiction of the bishopric of Down, the see being vacant [by the death of William (White)], to [John] Logan, Archdeacon of Down, and brother Angelicus [..]. f. 14<sup>\*</sup>.

Empowers them to exercise his jurisdiction in the bishopric, and commands them to do so on pain of deprivation.

Dated in the city of Armagh.

81. Letters patent of the same.

13 December, 1368. Dispensation of Sir Robert Ogean, [...] of the bishopric of Down from the vacancy, who had carnal intercourse with Mati[lda] Stokys, a professed nun of the house of nuns at Down.

Dated in the city of Armagh.

82. Grant to Simon Gernoun of Atrium Dei, narrator, for his counsel, 16 October, 1365. service, pleading (patrocinio), and aid, past and future, of a pension of 20s. a year. f. 15.

Dated at the manor of Dromeskyn.

83. Appointment of Master Arthur M<sup>c</sup>bruyn, canon of Armagh, as 8 November, 1365. seneschal in the city of Armagh, the tenements of the same, and the surrounding churches, in succession to John M<sup>c</sup>birragra, removed. f. 15.

Dated at the manor of Dromeskyn,

<sup>1</sup> So Reeves : only the letter '1' now remains.

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f. 14<sup>°</sup>.

84. Letter to the Pope on behalf of Robert de Aketoun, of the order of **25 November, 1365.** hermits of St. Augustine, bishop-elect of Down. f. 15.

On the voidance of the see by the death of Bishop Richard (Calf) the monks of the church of Down had postulated him.

Dated in the city of Down.

The year in the date is illegible. It is fixed by no. 85.

85. Decree of postulation of a Bishop of Down. f. 15<sup>\*</sup>. 20 November, 1365. The present instrument is a copy of the original decree made and certified by a notary public, whose name does not appear. The decree is as follows: Nicholas, prior, Richard, subprior, and other monks O.S.B. of the cathedral church of St. Patrick, Down, declare that Bishop Richard (Calf) having died, and having been buried on 26 October, they assembled in chapter, and appointed 18 November as the day for election of a bishop. On that day, proceeding by way of compromise, they appointed as compromisers (compromisimus in) Richard Persoun and John Rosse their fellow-monks. The compromisers determined to postulate brother Robert de Aketoun of the order of hermits of St. Augustine, and Richard Persoun having signified this to the chapter according to a form quoted, Robert de Aketoun gave his assent (form quoted) to the postulation. Thomas Crompe, of the order of hermits of St. Augustine, and Master John Macadam, were appointed proctors to proceed in the matter at the Roman curia, by letter dated 20 November.

86. Grant to Thomas Rountre of 40s. yearly pension, payable 24 June, and 27 November, 1365. a robe at Christmas, when and as the archbishop gave robes to others of his council, commensales excepted, for the archbishop's life, in return for faithful counsel and pleading (patrocinium) to be rendered against all except former lords (prioribus dominis), masters, and relatives (consanguineis) up to the fourth degree, to whom he was under obligation before the date of this letter. f. 16.

A note follows stating that on 28 November, 1365, in the chamber of masters [... of the monastery of St.] John of the English, Down, Thomas Rountre swore to perform the duties above mentioned.

Ends : "Testibus dompno Johanne Rosse<sup>1</sup> [...] Johanne Kenan clericorum (*sic*) domino Gylberto Cauntoun."

87. Grant to Master (?) John Preez, rector of Mourne, in the diocese of **30 November**, **1356**. Down, of a pension of 20s. during the archbishop's life, for counsel and pleading (patrocinium) to be rendered. f. 16<sup>\*</sup>.

Dated at Down.

<sup>&#</sup>x27; The name "Rosse " is from Reeves's copy. It is now torn off.

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f. 16<sup>v</sup>.

A note states that he took oath accordingly.

88. Instrument of Archbishop Richard (Fitz Ralph).

26 [...], 1356. He acknowledges that he owes to the Abbot and Convent of St. Mary of Lonleye, in the diocese of Le Mans (Cenomon.) in Normandy, O.S.B., the sum of  $\pounds 200$ ; and he binds himself to pay this sum at St. Paul's Church, London, before 24 June, 1360, if before that date he is able to get possession of (appropriare) the house or cell of St. Andrew in the Ards, in the county of Ultonia and diocese of Down, for himself and his church of Armagh, making good his claim to it against (a . . defendentes) the monastery of Lonleye in virtue of a dimission (ex dimissione) of the said abbot and convent made (facte seu etiam faciende: *sic*) by licence of the Pope, the King of England, and other lords and founders of said house; but if not, he binds himself to deliver the said cell to the abbot and convent. If any part of the above sum is paid before the day named all the fruits received by him out of the cell shall be (sint) allocated to the abbot and convent, and he promises to render an account thereof to them.

Opposite this article is written in the margin in a modern hand "Black Pryory."

See Reeves Antt., pp. 18, 382.

89. Acquittance, acknowledging to the heirs and executors of John 25 March  $\times$  20 November, 1365. Rath, senior, receipt of account and full payment in the matter of rents of the church in the parish of Drom[eskyn] due to the archbishop. f. 16<sup>\*</sup>.

Dated at Dromeskyn.

90. Letter to the Prior of the Friars Preachers of Mollingher. f. 17. 27 July, 1367. To a letter from the latter brought by Kylpatrick [...] the archbishop replies that though he is conservator of the privileges of their order in Ireland he is ignorant whether his letters conservatory (conservatorium) give him power to absolve one who has offended as the bearer has; besides he believes, though he has not seen the letters conservatory, that he is unable to absolve from excommunication in cases reserved to the Holy See, the more so because his duty as conservator is to defend the order, not to absolve easily those who offend against it. Therefore he commits to the prior, if, after examination of the conservatory bull, he finds that the archbishop has such power, authority to absolve the bearer in his stead.

Dated at Dromeskyn.

91. Letter making prebendal the churches of Dompnachfynry and 5 June, 1367. Diryluran. f. 17.

The letter is addressed to Peter Okerbyllan (*in title* Okerbillan), canon of Armagh, to whom, by reason of his canonry, the church of Dompnachfinnry,

made a prebend, and the rectory of Diriluran, united thereto, are to be assigned or collated, and who is dispensed to hold other preferment with them.

Dated at Tarmefeghan.

92. Letter of recall.

### f. 17.

10 September, 1367. Richard Hoper, rector of Kylkerley, who had licence to study in London for a period not yet expired, is ordered to return to his cure before the first Sunday in Lent (27 February, 1368) and to reside therein, the licence being re-called from that date.

Dated at the manor of Dromeskyn.

The day of the month in the date-not now legible-is taken from Reeves's copy.

93. Commission of Master Odo (M<sup>c</sup>dinim), canon of Armagh, as proctor Summer, 1366 (?). of the archbishop and the church of Armagh. f. 17<sup>v</sup>.

He is to be their proctor in all causes, and especially in that concerning the custody of the spirituality and spiritual jurisdiction of the diocese of Down during vacancy of that see, between Nicholas Langtoun, bearing himself as prior of the monks of the cathedral church of Down, and the convent thereof, and certain others, religious and secular, of the clergy of Down, plaintiffs, of the one part (MS. mea parte, or in ea parte, probably for ex una parte), and the archbishop and his church of Armagh, defendants, of the other part, at the Roman curia or elsewhere.

The dates of other documents on the same leaf (nos. 90-92, 94) suggest that this commission belongs to the latter part of 1367. But so late a date is excluded by no. 179, which proves that Mcdinim was then actually at the Roman curia. He made ready for his journey thither in the summer of 1366 (no. 123), though he did not start till early in 1367 (no. 130). The date given above is based on the supposition that he began his preparations, probably soon after, certainly not before, the issue of his commission.

94. Letter to Ohandeloyn.

#### f. 17<sup>\*</sup>.

18 September, 1367. States that the Dean of Armagh is afraid to leave his church, according to report, on account of the threats of the above and of Donald Oneyll and their malefactors, made only because the dean had always been faithful to God, St. Patrick, the church of Armagh and the archbishop; that Ohandeloyn had prevented the dean, canons and colidei from performing divine offices in their church; that he had despoiled them, and hindered them from visiting the archbishop, and interdicted the archbishop's messenger. Nevertheless the dean twice wrote letters asking for Ohandeloyn's absolution. The archbishop will not grant such petitions till the dean and the rest have free access to him. And because Ohandeloyn has often deceived him, being recalcitrant after absolution, he intends to consult the more carefully with the said clerics and other magnates of Ireland on this matter,

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for Ohandeloyn's destruction (ad vestrum exterminium faciendum), which he is unwilling to do unless compelled by Ohandeloyn.

The year is omitted in the date. But it may be inferred from no. 96.

95. Letters of administration to Henry FitzRow, burgess of Dundalk, for1370. the goods of Johanna [his] wife, who died intestate.f. 17<sup>\*</sup>.

96. Letter to the Dean [and Chapter] of Armagh.

18 September, 1367. The latter had written on the Monday within the octave of the na[tivity of B.V.M.] (13 September), asking the archbishop to commit to some one among the Irish authority to absolve Ohandelovn and Donald Oneyll from the sentences passed on them for depredations against the church of Armagh, for which they are prepared to give pledges sufficient for the claim (placitum) of the men of Armagh. To which he replies that their absolution from excommunication and the relaxation of the interdict principally concern him, and only in a secondary degree the men of Armagh. If the men of Armagh are willing to receive pledges satisfactory to them, then they are to write to him on the subject, and he will deliberate about the pledges to be delivered to him, and when sufficient amends have been made for their offences, or pledges (pignoraticia cautione) given, absolution will be granted. The archbishop has also sent a letter to Ohandeloyn by the hands of Cristin the colideus, the bearer of the dean's letter, stating among other things that absolution cannot be given till the dean and chapter have access to him (no. 94). He is doing what he can about sending a messenger to the curia, and he has also sent a letter about John Mariman, to which he will affix his own seal, to be sealed with the common seal.

97. Memorandum.

f. 18.

f. 18.

**21 September, 1367.** Donat M<sup>c</sup>clogyn (*in title* M<sup>c</sup>cloigyn), appointed bailiff of Armagh in succession to Benedict M<sup>c</sup>keuwan deceased, swore to be faithful to the primate in his chamber at Tarmefeghyn in the presence of William Jordaen, Robert Gilys, and James Scotelare, the writer of the instrument, and also to pay  $\frac{1}{2}$  mark, of which 3s. 4d. was then paid, the remainder to be paid before 1 November.

98. Commisson of Donat M<sup>c</sup>cloygyn as bailiff (as in no. 97).
f. 18.
21 September, 1367. All the archbishop's subjects among the Irish are required to obey him.

Dated at Tarmefeghyn.

99. Letter to Richard O'Reilly [Bishop of Kilmore].
1367 (?). The archbishop received at Dromeskyn on the Monday before
29 September the bishop's letter asking aid against Philip Oragill, chief (principe) of the bishop's country, who had despoiled him and his clerks.
He replies that the bishop from the time of the archbishop's coming has been

recalcitrant and has been living in mortal sin for many years, and that he therefore deservedly suffers. As to his request for absolution the archbishop cannot give it till he has paid  $\pounds 100$ , the penalty imposed for repetition of his offence.

This document belongs to the series nos. 70, 71, 56, 57, 72-75, 69, 78, 76, 77, 121, 68, which ranges from 12 June, 1366, to 15 January, 1368. It seems to suit the end rather than the beginning of the period. The earlier documents on the same leaf all belong to September, 1367.

100. Letter to the chaplain of Castrum Ohanloyn. f. 18<sup>v</sup>.

c. 1367 (?). Commands him to admonish Malachy Ohanloyn, King of Erthyr, (1) to compel his subject Gylchalmyn Merory Megingussa to restore goods taken by violence by him on Friday on the road near Derrys, viz.: from Paulinus, messenger of the archbishop, a black coat (cotam), a belt (zonam), a new hood (cuputium), linen breeches (braccas), a new pair of shoes (sotularis); from Donochi a servant of Master John Kenan, the archbishop's clerk, a good black coat, a black hood (caputium), new breeches, a belt, a cloak (falingua) and a new pair of shoes (sotularium); from Gylcomy Oschandyll a cloak, two hoods, a belt, a pocket knife (cultellum braccale), a pair of gloves and  $\frac{1}{2}$  peck of corn; from Okynnychan a draught horse of the archbishop (caballum de carriagio nostro) with 4 pecks of corn; from a servant (garsione) of the same a cloak, a hood, a belt, a knife; from Gilbert Odonnegan  $\frac{1}{2}$  peck of corn, a hood: and on Thursday last from Offehegan  $2\frac{1}{2}$  pecks mostly of corn, 4 'donarrecus' (?) of salt, two silver pennies, two 'oeciae' of steel (de calibe); from Mcchaskarl a belt, a knife, a pair of shoes; from a servant (of) M<sup>c</sup>gillamura (?), a belt, a knife, a pair of shoes; (2) to compel Donald the younger (juvenem) son of Malachy to restore the goods violently taken by him last Friday, viz.: 4 [..] of corn from the son of Oschandyll; from Mcchuskarl a cloak; from the son of Oremy a cloak. If this is not done the chaplain is to proceed against Malachy with ecclesiastical censures by authority of the archbishop, intimating to Malachy through his son Eugenius and Odo the son of Peter that although he might have proceeded against them with a severe sentence, he will wait until the Monday before 6 December, when they are to appear at Armagh. The chaplain is to execute this mandate within ten days.

The date is inferred from those of the other documents on the same leaf.

101. Letter to brother Simon, Bishop of Derry.

f. 19.

12 July, 1367. Informs him that Master Peter (O'Carolan), Chancellor of Armagh and canon of Derry, on this day, at the church of Armagh, has appealed against burdens (a gravaminibus) imposed by the bishop on the chapter, clergy, herenachs and coloni of the diocese of Derry. In place of notification and petition of apostles, a copy of the appeal is sent with the

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letter for the bishop's inspection. He is prohibited, in the meanwhile, from demanding such collection (collectam) or contribution.

Dated at Dundalk.

102. Letter to the prelates, secular and regular, rectors, vicars, chaplains,12 July, 1367. herenachs and coloni of the diocese of Derry. f. 19.

Since by the appeal (no. 101, they are made immediately subject to the archbishop, and freed from the jurisdiction of the bishop pending its decision, they are ordered not to obey the latter in the matter of a collection or contribution.

Dated at Dundalk.

103. Confirmation of the postulation of Master Peter Okerballan to the **30 July. 1367**. deanery of Derry, by the archbishop, on whom the right has devolved. f. 19<sup>r</sup>.

Okerballan receives dispensation as the successor of his father in the deanery. The confirmation took place at St. Nicholas's Church, Dundalke.

Ends: "Presentibus magistro Arthuro Mckewen officiali Ardmachano, domino Petro Fowler domus sancti Leonardi de Dundalke et domino Thoma Wals perpetuo vicario de Carlingford, domino Johanne Talboot presbitero presbitero (sie) parochie de Dundalke ac multis aliis et me Jacobo Scotelare clerico et in omnibus istis actis scriptore et locum notarii tenente (?)."

104. Letter to Brother Simon, Bishop of Derry.
81 July. 1367. He is ordered to cause Master Peter Okerballan, canon of Derry. or his proctor, to be inducted into the deanery, his postulation to which had been confirmed, by devolved right, by the archbishop.

Dated at Dromeskyn.

A note states that similar letters were sent to the comarb of St Kynicus and John Ocui[g], canons of Derry.

105. Letter to the same.

June  $\times$  July (?), 1367. States that when confirmation of the postulation of Master Peter Okerballan, canon of Derry, was sought through Master John Kenan. clerk of Armagh diocese, special proctor of the majority (pro majori parte of the canons of Derry, reasons were given why the confirmation belonged to the archbishop and not to the bishop.

The document breaks off at the end of the page.

It is followed by the note, "Require supra in xi. folio ad idem signum **X**." In the date the month does not appear. It is inferred from no. 187.

106. Summons to a parliament at Kylkenni on 7 January, 1371.

The archbishop is to appear in person, together with proctors of his chapter 8 November, 1370. and clergy. f. 20.

Ends: "Teste Willielmo, &c., (as no. 39) apud Adare" &c.

f. 19<sup>\*</sup>.

107. Appointment of Roger Gernoun and Robert Gilys (?) as the **2 January**, **1371**. archbishop's proctors at the parliament (no. 106). f. 20.

Dated at manor of Dromeskyn.

108. Letter to the king.

January, 1371. The archbishop begs to be excused from attendance (at the parliament: no. 106?) since he is detained by a case pending at the Roman curia between him and the Archbishop of Dublin about the carrying of the cross.

The date seems to be determined by nos. 106, 107.

109. Letter to [. . . .].

f. 20°.

f. 20.

15 March (?), 1370. The letter of his correspondents has been received in which they certified [the contumacy] of Masters Benedict Oculean, rector of Clonfechkena, official of the deanery of Tolaghoge, Maurice Ocorry, dean of Tolachoge, and Salmon and John Mcbirragra (also written Mcbragra), all canons of Armagh, who did not appear at the appointed (ipsis) day and place. These persons have been for many years disobedient to the archbishop [and have not allowed those] to whom it belonged to levy the rents of Tolaghoge to pay them to him. The archbishop therefore intends to deprive them of their benefices, and to pronounce them contumacious and incapable of holding ecclesiastical benefices, and that especially because through their misconduct he is in arrear to the extent of 200 marks, out of which he might have paid his dues (de quibus satisfecissemus) to the Roman curia. It is certain that they incurred the sentence of greater excommunication as well "a domino nostro papa in qualibet die Iovis [. . . . ] proinde late et [publice] denunciate," as by the provincial and synodal constitutions of the church of Armagh. And although the sentence of their deprivation for not appearing at the assigned term had been written by him, yet to demonstrate (ad convincendum) their malice he has postponed (expectauimus) (the case of) Oculean until 4 April and that of Ocorry and the M<sup>c</sup>birragras until the second juridic day after Low Sunday (21 April) to hear sentence, in the chapel of the manor at Dromeskyn. But Oculean and Ocorry shall pay (soluturi) all the money due to him or else hear sentence as above. He commands that they are to be cited before him for this purpose at the above-mentioned terms and place.

A note adds that on the same day a letter was also sent for absolving Bernard M<sup>c</sup>mahuna from the sentence of greater excommunication passed upon him by the archbishop on account of pillage (predam) of M<sup>c</sup>comgan, and for relaxation of the interdict on his lands, on condition of (dum tamen) giving satisfaction to the injured person.

The former document is dated the 15th of the 'aforesaid' month; but no month seems to have been named. Since 4 April is spoken of as still future, though apparently not far distant, it was probably March.

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110. Letter [to Lionel, Duke of Clarence].

f. 21.  $20 \times 23$  January, 1364. The king had written, both to the archbishop and to the duke, about the contest between the Archbishops of Armagh and Dublin in regard to the carrying of the cross. Accordingly (super quo) the duke wrote to the archbishop, as in no. 23. The archbishop replies that he cannot give the required answer fully without consulting those of his council, who are in remote parts, and that this cannot be done by the day named.

Undated. Since it is the reply to no. 23, it must have been written a day or two after it, and before the date fixed for the meeting at Dunboyne.

111. Summons to a parliament at Dublin on 20 January, 1375. f. 21. 20 November, 1374.

Ends: "Teste W. de Wyndesor gubernatore et custode terre nostre Hibernie apud le Naas" &c.

112. Summons to a parliament at Kylkenny on 19 February, 1366. f. 21<sup>\*</sup>.

January, 1366. Ends: "Teste Leonello, &c. (as in no. 18) apud 1 Dublin" &c.

113. Appointment of John de Clyntoun, lord of Drumcassel, and William, 7 February, 1366. son of Adam, as the archbishop's proctors at the parliament (no. 112). f. 21<sup>°</sup>.

Dated at Tarmefechyn.

114. Summons of the guardian of the spirituality of the bishopric of 1 January, 1366. Down, sede vacante, to the parliament (no. 112). f. 21<sup>\*</sup>.

A note directs the issue of a commission in identical terms with no. 113, except that the archbishop receives the additional title of "guardian of the spiritual jurisdiction in the bishopric," &c. (as above).

115. Note (?) about the delivery of a letter to Philip Oragill on 26 November, 1368. Sunday. f. 22.

The words "[Litera mi]ssa Phillippo Oragill" are crossed out, and the greater part of the remainder is lost.

116. Appointment of William Galwey, clerk, as principal and general 24 October, 1369. apparitor in the diocese of Armagh among the English. f. 22.

Dated at the manor of Drummeskyn.

117. Institution of Stephen Stauntoun, clerk, to the vicarage of St. Fechin's, 12 November, 1369. Tarmefeghyn (in title, Termonfeghin). f. 22.

He had been presented by John, Prior, and the Convent of St. Mary's, Loueth, and was invested by handing to him the archbishop's ring. Heis to be inducted by the Archdeacon of Armagh or his official.

Dated at the manor of Drummeskyn.

118. Letter to Richard Clyntoun, the archbishop's chamberlain 15 December, 1369. (domicello.) f. 22.

The archbishop had given him an annual pension for life of 20s., of which 10s. were chargeable on certain tenements to the north of the parish church of St. Patrick, Trym, and on 3 acres of land near the town of Trym, and 10s. on the archbishop's chest (coffris). Of the latter portion  $\frac{1}{2}$  mark is now to be received at Kylkerly from John Germyn and Robert Heyroun, and 3s. from the Prior of the Hospital of St. John at Kenlys, which the vicar is bound to pay.

Dated at Armagh.

119. Letter of the archbishop, guardian of the spirituality and spiritual 1 October, 1367. jurisdiction of the bishopric of Down, sede vacante, to Master Peter Okerballan, Dean [of Derry and] canon of Armagh. f 22<sup>v</sup>.

Okerballan is appointed commissary of the archbishop to exercise his jurisdiction in the bishopric of Raphoe (Rathboten.), vacant by the death of Patrick (MacMonigal).

Dated at the manor of Drummeskyn.

A note adds that on the same day a similar letter was sent to Master Peter Okerballan and the Archdeacon of Raphoe (empowering them to act) jointly or severally.

120. Letter to [...].

#### f. 22<sup>v</sup>.

1 September, 1366. The archbishop cannot commission Catholicus Oragill, brother of the bishop of Kilmore (Triburnen.), to collect the fruits in his neighbourhood as his correspondents (correspondent?) ask, since with the consent of Philip, King of Breffinia, clerks have been appointed to do so, and their custody has been refused to Philip and all laymen. He is surprised that the Bisbop of Derry is not coming (venit) to him at the present (sic) festival of St. Michael (29 September) and does not pay to the archbishop what he promised to Master Robert; he is to be bidden to pay his debt without delay and keep his promises more faithfully, on pain of being brought before (deferre) the Pope with a view to his deposition. He is to be urged to pay before 11 November.<sup>1</sup> The archbishop desires his correspondents' presence, if they can come without loss. He desires them to send by Master Robert whatever emoluments they can get from the diocese of Derry or elsewhere, as he has a messenger ready to start for the Roman curia. A commission is sent, as asked. Greetings are conveyed from Master John Strode, John Kenan, and James Scotelare. Godfrey Olucheran, canon of Armagh, has lately died.

Dated at Dromeskyn.

The year is omitted in the date; but it seems to be fixed by nos. 70, 72. Cf. also no. 123.

<sup>1</sup> This sentence is crossed out.

121. Letter to [...].

f. 23.

21 November, 1366. States that the archbishop has received a report (quoted in full, but much mutilated) relating to a mandate of the archbishop to (erga) Richard [..], to the effect that [Richard] has been [recalcitrant] not only to the writer, but also to every other who was willing to execute it. The archbishop therefore commands certain vicars to proclaim Richard as excommunicated by him, on Sundays and festivals at mass in their several churches, and in the public market at Droghda, and to cite Patrick to appear before him in St. Ronan's Church, Dromeskyn, on the juridic day next after the feast of Pope Clement (24 November).

The year is also given as the sixth of the archbishop's consecration.

The early part of the document was written on a leaf now lost. The person referred to as Richard is probably O'Reilly, Bishop of Kilmore, and Patrick, Patrick M<sup>e</sup>Brady (see no. 69). The mandate referred to is apparently no. 76.

122. Letter to the Dean of Armagh. f. 23.

11 November, 1366. The archbishop is amazed that Master Odo (M<sup>c</sup>dinim) does not prepare for his journey as had been arranged, and has decided (prefinivinus) that he has deceived the church of Armagh and him a second time. When the archbishop had 100 marks ready, by [his] negligence the money was lost, and since then his delay has given occasion of recalcitrance everywhere; for when once the journey of the messenger was reported the recalcitrants [became] quiet. The dean is to admonish Odo, on pain of deprivation of his priory and benefices, to [...]. (Some lines follow of which the greater part is lost, in which mention is made of the King of England, and [the dean is directed so to act that] the archbishop may have [the marts due] from the issues of the visitation and from the Bishop [of Derry].)<sup>1</sup> The dean is to cause Odo to undertake the journey without delay: otherwise the archbishop will go himself or send the dean or another "in periculo suo." The archbishop has granted to the dean, as Master Peter (O'Carolan), the chancellor, has informed the archbishop (nos), the lands of Taulachbo (?) and Tristirnan, for which he will have a charter on his arrival, which the archbishop desires to be within eight days, so that Odo may come with him. He is to bring the seal for sealing letters of the curia.

Dated at Dromeskyn.

Some words, now lost, are restored with the help of no. 123.

123. Reply of the Dean of Armagh to the foregoing.
f. 23<sup>v</sup>.
15 November, 1366. States that he would have executed the archbishop's

<sup>1</sup> Cf. no. 237.

command to admonish Master Odo (Mcdinim) to set out for the Roman curia, were it not for the following reasons :---1. The archbishop imputes to Odo the loss of 100 marks though then not he but another member of the chapter, Master Patrick Orrechgi, had been sent as messenger (nuncius), who was prevented from transacting the archbishop's business with this money at the curia, not by his own fault, but because his journey was hindered (impedimento passagii). 2. Last summer Odo made ready for the journey, and the last time the dean was with the archbishop he was ready, and is now ready, if so large a sum can be obtained (vel esse poterit), when the archbishop's honour and the advantage of the Church can be set forward without calumny in the The dean cannot be with the archbishop on 18 November unless the curia. latter wishes him not to take proceedings about the plundering of the archbishop's tenants by Niallan Oneyll, junior, at Kellemor, and by William M<sup>c</sup>ugylyn and Eugenius Ohanloyn's men, in Ohanloyn's absence, at Armagh, which amounted to at least 160 cows. The dean is not able to levy the Bishop of Derry's debts, since he has no authority from the archbishop to do so. As to the marts<sup>1</sup> (martos) due out of the issues of the archbishop's visitation, he awaits the day of the common chapter on 24 November, to the end that he may be able to demand something from the archbishop's debtors.

Dated at Armagh.

The year is omitted in the date. It is determined by no. 122.

124. Institution of Laurence Bacycantori, clerk, proctor of Sir Geoffrey Tangard, to the church of Baronnestun. f. 24.

He was invested by the giving of the archbishop's ring. He or another proctor is to be inducted by the archdeacon or his official.

125. Grant in farm to John Clyntoun with the consent of the dean and 17 June, 1366. chapter, for his services as seneschal and otherwise, on lease for 28 years, or for his life if he dies within that period, of the lands of Ballygaudyr: rent a rose at 24 June. f. 24.

Dated at the manor at Dromeskyn.

126. Letter of Patrick (O'Corry), Dean of Armagh, commissary of the 27 August, 1362, archbishop to Patrick M<sup>c</sup>kamyll, clerk of the diocese of Armagh, exempting him from the cure of the church of Tamlatta (*in title*, de Tamlatto), which the archbishop assigns to (suscipientes in) the cathedral of Armagh and the chaplain of Tamlachta. f. 24.

Dated at Armagh.

127. Letter to [Patrick M<sup>c</sup>Ka]mayll, clerk of the diocese of **27 August, 1362**. Armagh. f. 24.

<sup>&</sup>lt;sup>1</sup> Marts = fatted oxen. See Murray's New English Dictionary and Dinneen's Irish Dictionary s.v. R.I.A. PROC., VOL. XXIX., SECT. C. [35]

The church of Tamlactathylister, being not now under the care of M<sup>c</sup>Kamayll, is made a prebend, and M<sup>c</sup>Kamayll is instituted thereto, and invested by the giving of the archbishop's biretta (buretti). He is to provide a chaplain to exercise the cure, and he is to be responsible for the burdens of the rectory.

Dated at Armagh.

The document is much mutilated, and the nature of the transaction which it records is somewhat obscure.

128. Letter to Master Arthur (M<sup>c</sup>bruyn), the archbishop's official at 1 or 8 October or 19 November, 1366. Armagh. f. 24<sup>v</sup>.

He is commanded to cite Nicholas, Abbot, and the Convent of SS. Peter and Paul, Armagh, to appear before the archbishop in St. Ronan's Church, Dromeskyn, the following Thursday, to answer for their usurpation of the tithes of his dominical or mensal lands at Armagh and also for despoiling his servants of the tithes of Caban (*in title*, Cabban) and Dounorrecaynd in the present autumn, and to show receipts for the rents of a portion of the lands of Drumanderyuaich, in which they were bound to him for over four years.

Dated at Tarmefeghyn.

The date is given as the Thursday before the festival of St. Dionysius 1366 = the 5th year of the archbishop's consecration (which ended  $16 \times 20$  November, 1366); and the reference to the autumn implies that it was in the latter half of the year. Hence the festival referred to must be either Dionysius, bishop and martyr, 3 October, Dionysius, Rusticus and Eleutherus, 9 October, or Dionysius, 20 November. The date is therefore one of the three days given above: most probably 1 October.

129. Letter for the excommunication of Richard Verdoun of Glaspistyll 1366 (?). to the vicars of St. Peter's, Droghda, and St. Fechin's, Tarmefechyn. f. 24<sup>\*</sup>.

Informs them that Verdoun having confessed that he had committed the mortal sin of perjury, the archbishop by letter dated [...] 1366 had commanded Patrick Sampford, chaplain, to admonish him to keep his oath and perform the penance imposed by the archbishop, and, in the event of this admonition being ineffective, to excommunicate him in the church of Tarmefechyn on Sundays and festivals till further order.

Breaks off at the end of a page.

130. Letter [to the Pope] commending to him the archbishop's proctor at **20 January, 1367**. the Roman curia, Master Odo (M<sup>c</sup>dinim), prior of the community of the chapter at Armagh. He desires restoration of the title of primacy, which had always appeared in papal letters to his predecessors, but which he through ignorance had omitted to ask for in the bulls relating to his provision, notwithstanding the controversy long pending between the

Archbishops of Armagh and Dublin about the right and effect of primacy. f. 25.

Dated at Dromeskyn.

The early part of the letter was written on a previous leaf now lost.

131. Letter to Master Arthur (M<sup>c</sup>bruyn), official or seneschal in the city14 January, 1367. of Armagh. f. 25.

States that the Abbot of Armagh has written to the archbishop (Ms. vobis = Arthur, an obvious error for nobis), complaining that Arthur makes a claim on (censuretis) his convent for 2 marks, 5s, and (et, probably inserted in error) procurations due on account of visitations, and nevertheless retains (portetis) the ecclesiastical cup pledged with the archbishop for three ounces. Arthur is commanded to be at Dromeskyn on 21 January, bringing the above sum, if paid, or the cup, and any other money he may have collected (quamcumque aliam pecuniam collectionem vestram qualitercumque concernentem), in order to treat with the archbishop about these and other matters, considering among other things (cogitantes inter cetera de) a mark for the entrance (introitu) of Arthur's nephews and the payment of the farm of the people of Ometh occupied for two years. Arthur is to consult the dean about these things.

Dated at Dromeskyn.

132. Letter in which the archbishop binds himself to pay 21 marks to **24 May**, **1367**. John, Prior, and the Convent of the house of St. Mary, Loueth (*in title*, Louth), for the titles of corn and hay in Kyclogher, Glaspistyl, his dominical lands at Tarmefechyn, Betaghtoun (*in heading in modern hand*, Kilclogher, Glaspistell, Termoñ, Betaghton) and Canountoun, for 1367, on 1 August.

Dated at Tarmefechyn.

133. Letter to the archbishop's official at Armagh and the vicar 7 December, 1366. [of ...] f. 25<sup>v</sup>.

States that since his coming to Armagh he has many times proceeded by excommunication and interdict against Malachy Ohanloyn, King of Erthir, and his people as usurpers of the goods of the Church. But, on promises of amendment and restitution, Ohanloyn and some of his followers were absolved and the interdict relaxed, whereupon they behaved worse than before, and fell again under the same sentences. The persons addressed are accordingly commanded to cite to appear before the archbishop, in the chapel of Nerny near Rathskeagh on 22 December, Patrick and Peter Ohanloyn, Odo and C'onluch sons of Peter, and Eugenius Ohanloyn, with their principal accomplices, to show why they should not be proceeded against with extreme measures, including the invocation of the secular arm.

 $[35^*]$ 

Dated at Dromeskyn.

134. Grant to Master Odo M<sup>c</sup>dynim, prior of the community of the chapter, 16 January, 1367. the archbishop's proctor at the Roman curia, of a pension of 20 marks a year, payable out of a parcel of the lands of Trientulcha in the tenement of Armagh, as long as he is engaged in the archbishop's business at the curia. f. 25<sup>v</sup>.

#### Dated at Dromeskyn.

The month is illegible in the date. But since year was 1366 (O.S.) it was between April, 1366, and March, 1367. But the archbishop can scarcely have been at Diomiskin on 16 May (no. 27), and he was certainly not there on 16 September (no. 49). He was there on 16 November (no. 76); but he cannot have granted the pension on that day (see nos. 122, 123). Further, it must have been granted prior to the departure of M<sup>c</sup>dinim for the curia, which seems to have taken place on or shortly after 20 January (no. 130). Hence we have to choose between April, 1366, June-August, 1366, October, 1366, and December, 1366-January, 1367. The grant may have been made when the commission (no. 93) was issued—in which case April seems too early and August too late—or more probably on the eve of M<sup>c</sup>dinim's journey, i.e. 16 January, 1367, when the archbishop was certainly at Dromiskin (nos. 130, 131). In confirmation of this date we find that the other four documents on the same leaf (nos. 130-133) belong to December, 1366, and January and May, 1367.

135. Grant to Brother Si[mon] Bishop of [Derry] of the manor of Kyllroe
17 November, 1368 × 24 March, 1369. in the diocese of Derry. f. 26.

The lease is for [...] years, from 1 May, 1369, and the rent 40s. and 1000 small (mediocres) and 60 large eels together with other customary burdens. This writing is to be void if the bishop transfers the land to any layman for cultivation or custody.

The date is given as 1368 (O.S.) and the 8th year of Milo, which began  $17 \times 21$  November, 1368.

136. Citation of Brother Simon, Bishop of Derry. f. 26.

2 August, 1369. The bishop having been charged before the archbishop with certain excesses confessed them in the chapel of the archbishop's manor at (apud) the lake near Armagh, when the archbishop last stayed there, and voluntarily swore to pay ten marks on 1 May, and the same on 24 June last; but he did not pay these sums. He is to appear before the archbishop in the chapel of the manor at Drummeskyn on 22 August, to show cause why the archbishop should not write to the Apostolic See for (pro) his deposition.

Dated at Drummeskyn.

A note states that the bearer of the letter was Gyllachomy Orellochan, messenger, to whom it was handed 3 August.

137. Letter to [Nicholas], Abbot, and the Convent of [SS. Peter and Paul],October, 1366. Armagh. f. 26<sup>°</sup>.

States that the archbishops by immemorial right had received dues from certain lands. The abbot and convent, however, and some of their predecessors, usurping their rights, had received tithes out of  $[\ldots]$ , Tirnasagart and other places within the said city, parish, or tenement of Armagh.

For this usurpation of tithes to the value of 100 marks, the abbot and convent have incurred sentence of greater excommunication. They have incurred the same sentence for despoiling the archbishop's servants of part of the tithes of Dun and Caban Obreanynd in the same parish for 1366, which they were receiving in his name. The archbishop intends to proceed against them.

A note adds that in the chamber of his manor of Dromeskyn on 15 October, 1366, the primate appointed Master Patrick Oreych, learned in law, his commissary in regard to the foregoing : 'testibus magistris [Patri]cio decano, Petro, cancellario, et Odone priore communitatis ecclesie Ardmachane presentibus.' On the same day the commissary sat in St. Ronan's Church, Dromeskyn, and, the abbot and convent not appearing, adjourned the sitting (expectavit) to the next day.

138. Memorandum of instructions to R. Decorris and Master Dionysius
2 November, 1367. Menabid, messengers of the primate to the Roman curia.
f. 26<sup>\*</sup>.

Supplication is to be made of the Pope, privately (cameraliter) if possible, if not, in public consistory (1) that—because from the coming of the archbishop to Armagh the church and province had been destroyed, first by pestilence and afterwards by war, especially for the last two years. so that the archbishop has not been able to carry on his visitations completely or to receive the dues connected therewith—he should be permitted to visit his province by commissaries, and to receive procurations as if he had done so in person; (2) that [some concession may be made] although a case is pending in the Roman curia about vacancy in the see of Down.

The latter portion is for the most part torn away.

 139. Letter to Masters [...] and [.....] of the deanery of

 16 June, 1375. Tulachog.

 f. 27.

Masters Arthur [M<sup>c</sup>bruyn], John [. . .], Magonius [. . .], Cornelius Olorcan, and Gilbert Omoduim, canons, having, with others, been condemned by the archbishop as [indebted?] to the colidei, and having remained obdurate for a year or more, are to be excommunicated in the churches of the persons addressed, viz. that of Armagh and those of the deanery of Tulachog, at mass on Sundays and festivals, until further order, and to be cited to appear before the archbishop in the cathedral church on the next juridic day after 29 June to answer for their contempts and disobedience in this matter, and for their refusal to reside at the cathedral in accordance with many admonitions of the archbishop.

Dated at (infra) the archbishop's lake near Armagh.

140. Letters patent stating that the Archbishop has sold the tithes,

**3 May**, 1375. greater and less, of Carlynforde and Coly for a year, to Thomas Walssche, perpetual vicar of Carlynforde, for  $\pounds 20$ .

141. Letter to (...)

f. 27.

18 July, 1375. States that Henry and Catholicus, sons of the person addressed, have committed rape on married and unmarried women, and have been excommunicated by the archbishop. He intends to proceed against them as suspected of heretical pravity, being compelled thereto, especially by the fact that all the citizens and all his tenants intend to surrender the lands of the church of Armagh on account of their iniquities. He therefore commands the person addressed, under every penalty contained in the indenture between him and the archbishop, to coerce and punish his sons.

142. Letter of [Edward III to the Escheator of Ireland (?)] concerning the 12 December, 1363. Castle of Trym. f. 27<sup>°</sup>.

States that the archbishop made petition to the king in which he alleged that the Castle of Trym was held by the archbishops in right of the church, and from them by Roger de Mortuo Mari, Earl of March and lord of the Castle of Trym, for service of £8 16s.  $7\frac{1}{3}d$ ., on whose death, his heir being a minor, it had been taken into the king's hand, and that the rent had been in arrear for the two years following the death of archbishop Richard (FitzRalph); and prayed that he might receive satisfaction for rent and arrears while it was in custody. An inquisition before the king's lieutenant in Ireland having proved the correctness of the above statement, and the Rolls of the Irish Chancery proving that the temporalities were restored to the archbishop on 5 February, 1361, the king gives judgement that the above rent, together with arrears, amounting to £17 13s. 3d., should be paid to the archbishop, and orders delivery of the same.

Ends : "Teste Leonello comite Ultonie filio nostro karissimo locum tenente nostrum in terra nostra Hibernie apud Dublin " &c.

The date given for the restoration of temporalities seems to be incorrect. Sweteman was not consecrated till November, 1361: hence the year should probably be 1362.

143. Letter to Master N. Beth.

f. 27<sup>\*</sup>.

June, c. 1363 (?) States that the archbishop received a letter from John, Bishop of Kilmore (Triburnen.), on the 6th of the present month of June, to the following effect: (1) The bishop is surprised that after he had appealed to the Roman curia, inasmuch as (pro eo quod) the archbishop, at the instance of John Croysse, pretended Prior of St. Fechin of Fore (Fauoria), had cited him to Dromeskyn, where he could not safely appear, notwithstanding which (quibus non obstantibus) the archbishop cited him to the parish church of Atrium Dei, which was unsafe for him and his, inasmuch as, when he sent proctors to appear at Dromeskyn, on their way through Atrium Dei they

were robbed of their clothing etc.: further inasmuch as there was and is no safe access for him to Atrium Dei, being again aggrieved he appealed and appeals to the Roman curia : further inasmuch as the archbishop appointed as his commissary the bishop's enemy Beth, being again aggrieved he appealed and made final protest. (2) The bishop will not retire from the said appeal, but will prosecute it (procequi) on condition that the archbishop when the protest has been sent forward will proceed (si tamen premissa dicta protestatione procedere velimus) in the church of Armagh or in any place among the Irish to which he shall have safe access, and that (quod) the adverse party may appear by proctor or by—

Incomplete, breaking off at the end of a page.

The name of the archbishop does not appear; but he was most probably Sweteman, and the date of the letter nearly the same as that of no. 142, since the two documents appear to be in the same hand. On the other hand it must be observed (1) that the documents on the other side of the leaf, nos. 139-141, belong to the year 1375; (2) that there is no other evidence of a Bishop of Kilmore named John between 1355, when Connor MacKinawe died, and 12 June, 1366, when Richard O'Reilly had apparently been bishop for a considerable time (no. 70, cf. no. 99); (3) that a Bishop John O'Reilly died in 1393. The document is scarcely grammatical and is difficult to translate, but the drift of so much of it as remains is clear enough.

144. Confirmation of the collation, by Masters Matthew, Archdeacon [of **31 July**, **1365**. Clogher . . .], and Magonius M<sup>c</sup>abaird, clerk of the diocese of Armagh, commissaries of the archbishop for his metropolitical visitation of the diocese of Clogher, of the comorbia or rectory of St. Tigernacus at Cloneoys, to Master John Macangeanaic, canon of Clogher. f. 28.

He was inducted by the archdeacon, and presented the letters of the commissaries at Tarmefechyn on the above date by [his proctor].

145. Commission of Sir William de Karleil (also written Karliel), treasurer 15 (?) August, 1365. of the Duke of Clarence and guardian of his lands in Connacia, as the archbishop's seneschal in Connacia. f. 28.

A previous commission to William, son of Remundus de Burgo, is revoked. Dated in the manor at Tarmefechyn.

146. Letter to Sir Thomas Dale, justice of the king. f. 28. 15 September, 1365. The archbishop asks him to use influence that the Duke of Clarence may write to William de Karliel, sanctioning his undertaking the transaction of the archbishop's business in Connacia, so far as it does not interfere with his transaction of the duke's business there.

The year is not given in the date. It is determined by no. 145.

147. Commission to Masters Patrick Ocorry, Dean of Armagh, and **30 August, 1365.** Odo M<sup>e</sup>doymyn, prior of the community of the chapter of Armagh, to hold a visitation of Brother Simon, Bishop of Derry, and his clergy and people, in the stead of the archbishop. f. 28<sup>r</sup>, Matters concerning the person of the bishop are exempted from their jurisdiction.

Dated in the manor at Tarmefechyn.

A note adds that a similar commission to the same for the diocese of Raphoe (Rathboten.) was issued the same day.

148. Privilege granted to the nation of Ymolkallan, having the custody 26 March × 20 November, 1365. of (pro tempore habenti) the bell of St. Patrick. f. 28<sup>\*</sup>.

Cunlad Omolkall (*in title* Ymolkall) and his successors, the men of his nation and his subjects in lands or tenements of the bell of St. Patrick within the diocese of Armagh are to be exempt from any general interdict pronounced in the name of the archbishop; on condition that Cunlad and his successors, by the authority of the bell, will fast upon (super) molestors of the subjects of the archbishop. Cunlad and his successors are not to admit or receive, by authority or privilege of the bell, persons excommunicated by the archbishop.

Dated at Tarmefechyn, Wednesday after [...] 1365, in the fourth year of Milo's consecration.

Probably belongs to August or September. The other four documents on the same leaf, three of which are dated at Termonfeckin, range from 31 July to 15 September, and there is evidence that the archbishop was there on 30 July and 27 September (nos. 154, 225). He also spent parts of March and April in the same place (nos. 172, 223, 229, 230).

149. Indulgence to those who contribute to the repairing of the fabric of **3 May**, **1365**. the church of Armagh, of 40 days of penance enjoined upon them. f. 29.

Dated at Dromeskyn.

150. Letter to Master John M<sup>c</sup>birragra, canon of Armagh and rector of 10 May, 1365. Dysertlyne, making the rectory into a prebend for his life, and exonerating him from the cure. f. 29.

The vicar is to have the cure.

Dated in the Chapter-house (loco capitulari) of Armagh.

151. Letter to the Archdeacon of Armagh or his official.

1365. States that the church of Keen (*in title*, Kene), which has cure, is vacant by the induction of the rector, James Cotelere, to another cure in lands beyond the sea, attested by sworn witnesses; and that the archbishop has collated it to William, son of Adam, his clerk. He orders him to be inducted.

f. 29.

Dated at Tarmefechyn [...] m [cccl] xv, the [..] year of Milo's consecration.

The date lies between 25 March, 1365, and 24 March, 1366. Of this period parts of March and April, the closing days of July, and the months of August and September, were spent by the archbishop at Termonfeckin (see note to no. 148). With the exception of a single document dated

there (no. 113), 7 February, 1366, there is no indication that he was at Termonfeckin at any other time during the period. The remaining documents belonging to it are dated at Dromiskin, Armagh, or Down. On 5 January he was either at or just starting for Carlingford (no. 181). The other documents on the leaf are of May, June, and July; and the latest of them (no. 154, 30 July) was written at Termonfeckin. These facts point to July or August.

152. Commission to the dean of Atrium Dei to collect procurations and 5 July, 1365. synodals in his deanery for the current year. f. 29<sup>\*</sup>.

Dated at Dromeskyn.

A note adds that similar letters were issued to the deans of Droghda and Dundalk.

153. Commission to Thomas Duffe to let in farm the lands of Leke and 23 June, 1365. Drummyndyll. f. 29<sup>v</sup>.

The leases are to run for six years from 24 June.

Dated at Dromeskyn.

154. Grant to Richard de Verdoun, son of Sir Milo de Verduno, Knt., of **30 July, 1365.** custody of Richard fitz Richard and of the lands of Glaspistyll (*in title* Glaspystell) during his minority, and in the event of the death of Richard during his minority, without heir of his body, similar custody of his brother John.

Dated at Tarmefechyn.

A, memorandum follows that on the same day Richard swore to pay 20s. to the archbishop at Christmas and  $[\ldots]$  on 24 June following.

155. List of rents.

#### f. 31.

[36]

The earlier part of the document, including the title, is lost. The latter part contains the following names :

Ena, [..]; lands of Oceffad [..]; lands of Omartanan, [..] 8 [d.]; Athnasy [..]ach [..] 8 [d.]; lands of M<sup>e</sup>gillamura, 10s.; Trensaxan, 3½ marks; Trenmor, 1 mark; lands of the "bajulator canonis," 5s.; lands of M<sup>e</sup>comgan. 10s.; lands of M<sup>e</sup>gynabage, 2s. 4d.; Clondabayll, 3½ marks.

156. Grant to Roger Gernoun lord of Gernounnestoun of the manor of **28 September**, **1375**. Yneskene (*in title* Ineskene) in farm on a lease of 5 years. from 1 November, at a rent of 40s. and a mease (meysa) of eels a year. f. 31.

The rent is to be retained by Gernoun in the name of a pension granted to him by other letters, and if owing to the ravages of pestilence or the king's enemies the manor yields him no profit, he is to be at liberty to distrain on the lands of the church of Armagh for his pension.

Dated at Dromeskyn.

157. List of Rents of the primate at the Nobir. f. 32.

The names and rents are as follows: [...] 16d.; [...] 16d.; [D]yllianestoune, 4s.; [...], 2 carucates, 2s.; Freynstoun (?),  $1\frac{1}{2}$  car., 2s.  $0\frac{1}{2}$ d.; Paynestoun,  $1\frac{1}{2}$  car., 2s.  $0\frac{1}{2}$ d.; Lucianestoun,  $1\frac{1}{2}$  car., 2s.  $0\frac{1}{2}$ d.; Lagagħ, 3 car.,

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5s. 6d.; Mounteneyestoun, 1 car.,<sup>1</sup> twelfth part of knight's fee,<sup>2</sup> 16d.<sup>3</sup>; Casteltoun, 2 car., 2s.  $0\frac{1}{2}$ d.; Raff[yn], 3 car., 4s.  $1[\frac{1}{2}]$ d.; Rathode, 3 car., 4s.  $1\frac{1}{2}$ d.; Lytylrath,  $\frac{1}{2}$  car.,  $8\frac{1}{4}$ d.; Poterelestoun, 1 car.,  $16\frac{1}{2}$ d.; Graunge,  $\frac{1}{2}$  car.,  $8\frac{1}{4}$ d.; Moretoun,  $\frac{1}{2}$  car.,  $8\frac{1}{4}$ d.; Stemstoun,  $1\frac{1}{2}$  car., 2s.  $0\frac{3}{4}$ d.; Jodestoun,  $1\frac{1}{2}$  car., 2s.  $0\frac{3}{4}$ d.; Ardmagh, 8 car., 11s.; Hyrchayr, 8 car.—ought to be distrained at Ardmagh —11s.; Lack and Dromdyll, 12 car., 13s.  $8\frac{1}{2}$ d.; Termoun and Rathrewah, 8 car., 11s.; W. de Londoun and [ . . . ]; Molagh||loch and Karkeagh, 8 car., 11s.; Baron of Slane and [ . . . ]; Nobir, 5 car., 7s.  $10\frac{1}{2}$ d. Sum total, £5 8s. 10d.

After this follows "Quomodo Regale servitium debet levari de dominio del Morgalyin ex parte primatis Hibernie."

Endorsed "Regale seruicium de Nobir."

The actual total of the rents given above is £5 0s.  $0\frac{3}{4}$ d.

158. Record of a metropolitical visitation of the diocese of Meath. f. 33. End of June, 1377. *Parish of Rathcouil.* Maurice Broun, of Mortoun, and Felicia Aleyn lived in fornication for over seven years. The man will purge himself on 30 June; the woman, not appearing, is to be cited for 7 July at

Droghda.

John [....], servant of John Birford, committed fornication with Micall Hardyn. Both confessed, and were absolved under penalty of 12s. [...] 6s. (?).

William Gay, excommunicated for tithes and oblations, disregarded the sentence. Confessed and was absolved under penalty of 12s. [...] 6s. (?).

Thomas Mathen swore to serve John Birford, of Lochgor, half a year, and broke his oath. To be cited to appear at Droghda.

Nicholas Corner (?), who has abandoned his wife, and one Alice, live together. Both have fled.

John Whit, son of John Corniser, betrothed to (affidavit) Alice Springan, refused, after banns were published, to marry her (desponsare). He paid a fine of 6d. to the dean, and the marriage was solemnized.

Robert Kene and Johanna Rede, of Ballitake, his wife, live apart (non adherent simul). The man is at Dublin. The woman must complain to the Archbishop of Dublin.

Stephen Eccod and Johanna Monteyn, his wife, live apart. The man purged himself; the woman is to be cited.

Jake Archbold, in Fyngal, harbours (receptat) Johanna Sollon, wife of a man of Fyngall, and Thomas Monteyn committed adultery with her. Jake has not been found. The woman is in the diocese of Dublin; Monteyn, excommunicated for non-appearance, afterwards absolved, will purge himself in Fyngall.

<sup>1</sup> Crossed out.

<sup>2</sup> Inserted by another hand.

*Dompmore.* Roger, bailiff of the rector, i.e., the Abbot of St. Thomas's, Dublin, with the knowledge of the abbot, allows animals to feed in the cemetery, and a body has been exhumed by swine. He is absolved under penalty of 12s.

Robert West, senior, detains 15s. 7d., " qua nunc per vi annos legatis capelle sancti Petri in Themiltoun." To be cited.

David Magwyr swore to live with his wife, and after receiving the Lord's Body last Easter broke his oath, and has left Midia. To be cited. An almost wholly illegible entry follows.

Rathbegan. No crimes reported.

Dompnachshachlyn. [...] committed fornication with Enoca Whit. He is in Leinster, and she ill. Both to be cited.

[...]. The woman, who is in child-bed, is to be cited.

 $[\ldots\,.]\,$  Ball fyn committed fornication with Isabell Goldinge. She purged herself.

Ballymaglassan. No crimes reported.

Villa of Rathtouth. [...] of Stokystoun. Brother Robert Hull stole a choir cope.

Killeglan. No crimes reported.

*Crykystoun.* [...] Bange committed fornication with Magyn Gydy. The man was convicted, the woman is absolved, and both have the same penalty of 12s. They afterwards made a fine of 6d., which (the man) paid.

John Wythir, purchaser of a crannogue (crannocis), does not pay tithes of his money. The man is in the deanery of Dyueleke.

Thomas Colman : same offence. To be cited. Confesses and is excommunicated. Absolved after swearing to stand to the commands of the Church.

*Grenoke.* The chancel is in bad repair. No decent books. The Abbot of St. Thomas's to be cited.

Sir William Magenich, chaplain of the parish, does not know how to read, sing, perform offices, baptize, or teach his parishioners. Among other irregularities, he celebrated a second marriage between (ultra) Roger Froysell and Johanna Marche, saying the collect *Propitiare*; he threw out the first ablution after the reception of Christ's Blood on Palm Sunday; he is quarrelsome and violent in behaviour to his parishioners; he [...] the light, 'viz. the trendill' [= a roll of wax], did what he pleased (fecit voluntatem) with the wax, and sold the candles to many women who gave blessed bread. When another chaplain was appointed by the rector, the Abbot of St. Thomas's, and the church put in custody of Robert Belyns and closed, he sent in a boy (parvulus) through the chancel window to open the door, and kept it open for three days.

[36\*]

He placed the pix [...] so that rats or mice ate Christ's Body and destroyed the pix, which was worth a mark. [He is to appear on] Monday (6 July ?) near Droghda, in St. Mary's Church.

The time of year at which the visitation took place is fixed by the dates in the first and last entries. Assuming that it was held under Sweteman 'see no. 161 note), the year was either 1366 or 1377, since 7 July is said to have been Tuesday. But 1366 is impossible (see no. 240). For the rules about second marriages referred to in the last entry see *Mistale Ecclesiae Sarum*, ed. Dickinson, col. 559\* ff.

159. Memorandum.

 $1377 \times 1380$  (?). Partly illegible. It seems to state that two brothers, Molys and Patrick Ohirlan, who had lands at Balybolan and elsewhere, refused to allow the primate to collect tithes therefrom.

The dates of nos. 159-163 are probably after June, 1377, as they are written on the back of the record of the visitation then held (no. 158). They probably all belong to the episcopate of Sweteman, as no. 161 (see note there) almost certainly does.

160. Memorandum.

1377  $\times$  1380(?). States that Thomas Dencrite received from Master John 5s. on 26 November: for "locu" 3d., for flesh (charnib.) 3d., for malt 2s., for fish (pissibus) 2s., Gilrewac for [...] 6d.

For date see note on no. 159.

161. Memorandum.

1377  $\times$  1380. States that Richard [FitzRalph) obtained (prosequebatur) a brief of *ad quod damnum* in regard to the church of Athboy, 31  $\times$  33 (Edward III) (1357  $\times$  1359), and another in the same year or [...] in regard to Amurhyr, and that he agreed with the proctor general of St. Taurinus in the Roman curia regarding the cell of Fore (Favoria, for 1000 florins, of which he paid 100 "upon union, [as] Sir Richard Hoper will better and more fully tell you."

The date seems to be fixed to the time of Milo Sweteman by the mention of 'Richard' as 'our predecessor.' This is confirmed by the reference to Hoper: see nos. 92, 229. If that be so, no. 158, which is earlier see note on 159, must also be placed under Sweteman, if not under Fitz Ralph. See for earlier limit of date, note on no. 159.

162. Memorandum.

f. 33<sup>\*</sup>.

1377  $\times$  1380 (?). States that Sir William de London had no status in the manor of the Nobyr on the part of R. (de parte R., unless at the will of R., that concerning the agreement between them no part of the indenture was sealed, that he has  $(\hbar t)^2$  no right on the part of (de parte tangente) the primate before the concord between them was sealed, that he ought to

\* Protably an error for \* had \* (huit).

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f. 337.

f. 33<sup>\*</sup>.

f. 33<sup>\*</sup>.
have made quitclaim to "dominus R." in regard to the manor of Nober, "et faciet [...]R. habere quietam clamatam [...] aliis de suis aliquod ius in manerio predicto aliquo modo habentibus."

For date see note on 159.

163. Memorandum.

f. 33<sup>°</sup>.

 $1377 \times 1380$ . States that an agreement was made between Primate R(ichard FitzRalph) and Sir Simon Flemynge, Baron of Slane, about the acquisition of the advowsons of Slane, Kyllauery, and Drumconragh in exchange for a part of the manor of the Nober.

For date see note on no. 159. This is in the same hand as no. 162.

164. Letter to the chaplain of St. Feghin of Tarmefechyn directing him to 16 May, 1369. cause the clergy of the deanery of Droghda to appear before the archbishop or his commissaries on [28] May, and the laity on 29 May, at St. Peter's Church, Drogheda, for his ordinary visitation. f. 34.

Dated in the manor of Drummeskyn.

Notes—which begin "Progress of the visitation of Primate M. among the English in his diocese of Armagh, after the visitation of his cathedral church, the dean and chapter of the same, (and) the clergy and people among the Irish A.D. 1369 "—add that the visitation for Droghda deanery was to be held in St. Peter's Church, Droghda, for clergy 28 May, for people 29 May; for . Atrium Dei deanery in St. Mary's, Atrium Dei, for clergy 1 June, for people, as regards the execution of the office of the apparitor of Atrium Dei, 2 June, and as regards that of the apparitor of Loueth, 4 June; for Dundalke deanery, for clergy 5 June, for people 6 June. It is also stated that letters similar to the above were issued for the deaneries of Atrium Dei and Dundalke.

165. Citation of [William (MacCormack)], Bishop of Ardagh (Ardacaden. 10 March, 1369. Ardakaden.). f. 34<sup>\*</sup>.

He is to appear in the chapel of the manor of Tarmefechyn on 21 March, to answer concerning the petition of Sir John Offyne, who had been presented by the king to the vicarage of Granard, and concerning certain charges made against him, and to show cause why proceedings should not be taken before the Pope for his deposition.

Mutilated at the beginning. Some words, now lost, are taken from Bishop Reeves's copy.

166. Acts before the archbishop in the chapel of the manor of **21 March, 1369**. Tarmefeghyn, in the cause of Sir John Offyne, chaplain of the diocese of Meath, against William (MacCormack), Bishop of Ardagh (Ardacaden.). f. 34<sup>\*</sup>.

Hosep Ohoghy, messenger of the archbishop, certified the delivery of the citation no. 165. The bishop did not appear, and was cited to appear in St. Ronan's Church, Drumeskyn, 22 April.

Ends: "Presentibus magistris Patricio ecclesie Ardmachane decano, Patricio Omukeghan (?) ejusdem ecclesie canonico, Bartholomeo Dullard ecclesie Lymericensis canonico et aliis."

167. Account in regard to Kylmone (in title Kilmone). f. 35. 1429 (?). Richard Asheborne, receiver of the rent, accounts for (onerat se) £31 21d. lower down, in a different hand £31 16d.) for the year beginning 24 December, 1427. Of this he has credit (exonerat se) by warrants, (1) 19 November, 1427, for 36s. 8d.; (2) 20 January, 1428, for 20s.; (3) 7 April, 1428. for 10s.; (4) 13 December, 1427, for £11: also by an indenture made between Richard Whit and him, £6 10s. 2d.: also in expenses at Kylmon on two occasions during the metropolitical visitation of Midia in 1427, 1 mark. He also prays allowance 'allocationem for 2s. 8d. to Alice Bayard which the primate granted in charity, and for 20s. which the primate spent at Kylmore in his metropolitical visitation about the end of his first year (?), in 1430. Also he paid the tithes of Donbyldey in expenses at the same time, 1 mark, and by various warrants £10 12d. [...] 9 (?) marks in regard to Cruys, and it is about £8 in arrear. He renders (reddit exactions (exactiones) of Kylmone in his time for which he prays allowance, viz. : 4 carucate of [John] Cusak, 2s., and the farms of the following: the late John Coff, 4s. 8d.; William Tuyt, 6s. 8d.; the late Robert Bulhed, 3s. 6d.; Thomas Wate, 7s. 6d.; John Stalloun, 24s.; William Lacy, 3s. 4d.; Thomas Donbylday-16 acres-4s.; do.-25 acres in the Rath-2s. 1d.; Richard Mynoth, 7s; the late William Clardoun, 6s.; William Bege, 6s.; Nicholas Rede, 2s. 8d.; John Blake, 6s. 6d.; William Coke, 2s. 6d.; William Bulhed, 3s. 4d.; Richard Asheborne, 7s. 6d.; Richard Algan, 12d.; Thomas Wottoun, 6s. 8d. Sum, £5 6s. 11d. He also prays allowance for the repairs and [...] to the following lands: farm of William Frensh, 6s., farm of 25 acres in the Rath, 6s. 3d.; repair of Nicholas Rede's house, 6s. 8d.; the farm of the late Robert Broun, 18s.; the farm of John Bryse, 8s. 8d. Sum, 45s. 7d.

The indications of date are conflicting, the account purporting to cover the year 1427-8, while lower down expenditure for the year 1430 appears to be mentioned. Perhaps in the latter place we should read 'spondebat' for 'spendebat,' a promise to pay the sum named being recorded, in which case it was not due till the year following the drawing up of the document. Or the meaning may be that allowance was to be made in the account for 1430 for money paid at an earlier date.

168. Letter of (Archbishop) John (Swayne) to his commissary Sir 20 March, 1432. Donald Okellachan, prior of the colidei. f. 35<sup>°</sup>.

Commands him to levy the procurations due for his last visitation, and orders all whose procurations are due, especially Sir T. Oloucheran, to give him satisfaction concerning them.

169. Appointment by the same of of John Bernivale of F[...] shenston 25 [...], 1431  $\times$  1432. as seneschal and principal receiver (receptorem) of the manor of Kylmo[ne]. f.  $35^{\circ}$ .

The year is given as 10 Henry VI, i.e. 1 September 1431-31 August 1432.

170. Document almost entirely torn away. f. 36.

5 March, 1365. Dated at Tarmefeghyn.

The year in the date is lost; but all the other documents on the leaf are dated between February and May, 1365.

171. Grant to M [...], clerk of the archbishop, of a pension of 3 marks a **21 March**, **1365**. year, of which 30s. were chargeable on the tithes of Rathcoull near Dromynge and 10s. on the issues of the curacy of Testa [...] in the deanery of Atrium Dei. f. 36.

Dated at Droghda.

172. Grant to John Weneloke in farm, on a lease of six years from **8 April, 1365.** 25 December, of a carucate of the archbishop's land of the Dallys, at a rent of 5 marks a year and the accustomed services and burdens. f. 36.

Dated at Tarmefechyn.

173. Protestation concerning payment of the dues of common service of 23 February, 1365. the Apostolic Camera. f. 36.

States that the archbishop, in the presence of his notary public and others, protested that he was ready to give satisfaction for such dues according to the means (facultates) of his church, and that for that purpose he had within a month past appointed Master Patrick Orechgi, canon of Armagh, his proctor.

Ends : "Presentibus [magistris .....] Patricio decano, Petro cancellario et Odone priore communitatis capituli cat[hedralis ecclesie Ardmachane, Johanne Bette] rectore ecclesie de Dromynge et Roberto Gylis literato Ardmachano et [....] vocatis specialiter et rogatis."

A notarial certificate followed, of which only a few words remain.

174. Letter to Stephen Cor, his receiver at Kylmon, or [...] f. 36<sup>°</sup>.

**26 April, 1365.** Out of the next money received there, at 24 June, he is to deliver to John Clerke, rector of Clonmore, 10 marks in part payment of tithes of Clonmore due by the archbishop last autumn, and he is to make allowance (allocancia) for such payment in his next account.

175. Letters patent appointing Master Gydo Okene, clerk of the church 3 May, 1365. of Armagh, proctor of that church for making known throughout his diocese and province the indulgences granted to benefactors of the church, and ordering all rectors, vicars, and parochial chaplains to assist and protect him and his clerks, questors (questores). f. 36<sup>\*</sup>.

Dated at Dromeskyn.

176. Letter to the clergy of the diocese of Armagh. f. 36<sup>\*</sup>.

2 May, 1365. Commend Guydo Okene and his fellow-questuaries (questuarii, to them, directing them to admit them to their churches and chapels, preferring them to all other questuaries, and calling together their parishioners to hear them. Suspensions and interdicts published in their churches or chapels are relaxed while the questuaries are there.

177. Inventory of goods of [Sir Peter . . . ].
5 November, [. . . ]. He possessed 4 gowns (juppas) worth 10s., 1 maser 2s., 4 planketes 20d., 1 chest (capsam) 10d., a presse 8 (?) [d.], 1 portion (particulam) of Doctor de Lira 2s., 1 basin and ewer 20[d.], in money 12d., 2 candlesticks 4d., 9 spoons 4s., 1 silver cup 2s.

There was owed to him by Robert Birford, brasier for [...] for which the same Sir Peter has a brass pot in pledge, by Richard Palmer 3s., by [...] More for rent 4s., by Richard Browne for rent 3s. 4d., by Nicholas Bowcher [do.] 12d., by Johanna Tyt do. 12d., by Patrick Colgyn do. 6d., by Maria Hoper do. 6d., by Katherine Rogan do. 2d., by Benmy do. 6d., by Jone Tyberoun widow do. 12d., by Master William Somerw[ell] do. 9s. Sum, 43s.

He owed to Sir Henry Collyne, chaplain, 4d., to John Kyntone, clerk of St. Peter's, Drogheda, for stipend 4s. 8d., to Robert Collyne 5d., to William Davy 12d., to Robert Talbot for a cup 7s., to Margaret Browne for 9 spoons 4s. Sum, 17s. 5d.

About five items in the list of goods and a few words elsewhere are lost through mutilation.

178. Testament of the same.

f. 37.

He is to be buried in the chapel of the B.V.M. in St. Peter's, Drogheda. He makes the following legacies: For prayers for his soul, his portifolium; Sir Nicholas Manyne, chaplain, his second gown and a pair of knives (cultellorum); Sir Henry Paton, vicar of St. Peter's, Drogheda, his red hood (rubium capicium) and a portion of Doctor de Lira; Alice Tanner, his cousin, a basin and ewer, a gown of blue (blodii) colour, and a silver spoon; Sir John Mavesyn, chaplain, his better gown, a pair of knives, and a silver spoon; Sir Edmund Cusak, chaplain, a gown; Peter FitzJone, a silver spoon. His executor, Master Henry Paton, vicar of St. Peter's, is to dispose of the rest of his goods for the good of his soul.

179. Document relating to the appointment of a Chancellor of **End of 1367**. Armagh. f. 37<sup>\*</sup>.

States that in a vacancy of the dignity, the right of appointment having lapsed to the archbishop, by his authority Patrick (O'Corry) the dean, and all the chapter except Maurice Okorry (also written Okory) provided Master Odo M<sup>c</sup>donin, prior of the colidei of the chapter—then absent as proctor at the Roman curia—as chancellor, that his proctor Patrick Orethi, canon of Armagh, was inducted and installed, and that the archbishop confirmed the election. The chapter then stated that the chancellorship had no revenue in spirituals, and in temporals nothing but a small (mediam) carucate of land near Armagh, worth not more than 20s. a year, and that Odo would therefore probably not accept office, since he could not retain with it his rectory of Tamlactglyid. On their petition the archbishop annexed the rectory to the chancellorship during Odo's tenure of that dignity. His letters to that effect, sealed by him, were taken to Armagh by the dean, and were sealed by the chapter. After inspection of the letters Odo assented to the provision.

Incomplete, breaking off at the end of a page.

Odo was commended to the Pope as proctor 20 January, 1367 (no. 130), and the chancellorship became vacant by the confirmation of Peter O'Carolan as Dean of Derry, 30 July, 1367 (no. 103). Since the appointment had lapsed to the archbishop, the present document must be at least as late as November of the same year (C. Lat. c. 23 in Mansi, *Cone.*, xxii, 1011).

180. Proceedings before the archbishop regarding the deanery [of 12 July, 1367. Derry]. f. 38.

Thomas M<sup>c</sup>bloscayd, *de facto* incumbent of the deanery, having failed to appear in opposition to the postulation made thereto, is declared contumacious and debarred from further opposition by sentence delivered in the church of St. [Nicholas, Dundalk]. The archbishop has<sup>1</sup> been certified of the general citation mentioned in his letter to the comarb of St. Kynnichus (no. 187), and sends a mandate for a fresh general citation to Master John Ocukyge, canon of Derry, and others, the text of which is said to follow, but does not appear.

In the date only the month is legible. It seems to be fixed by no. 186, a document of similar purport, and nos. 187, 188, which are apparently the letter and mandate here referred to.

181. Letter to Master B. Dullard, canon of Limerick (Lymiricen.). f. 38. 5 January, 1366. The letter of Dullard on behalf of one who claimed to have been provided to Clonmor has been received. By counsel of Masters Peter Okerwyllan and John Strode the archbishop replies that he will place no obstacle in the way of the provision being carried into effect; it will be arranged (ordinabitur) that the archbishop's nephew Maurice (Sweteman) shall not be a danger to the provisor; as regards the judgement of the king's court the archbishop will not burden (gravabinus) him there, but "ipsum salvum

<sup>&</sup>lt;sup>1</sup>At this place the MS. is difficult to read. Perhaps 'not' should be inserted after 'has.' The certificate of the general citation is not mentioned in no. 187.

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fieri voluntate nostra declarabitur." The archbishop cannot fix a date for consummating these things, until he returns from Carlyngford, after carrying out his business and that of (the diocese of) Down there.

The year is omitted in the date. But the document belongs to a period when the see of Down was vacant, and before O'Carolan became Dean of Derry (31 July, 1367: see nos. 103, 104). It therefore falls between the death of Richard Calf (October, 1365: see no. 85) and the accession of William White.

182. Document partly illegible.

f. 38°,

16 May, 1371. [...] having been cited on a charge of perjury and other matters and not appearing is pronounced contumacious and excommunicated in the chapel of [...] by the archbishop.

Ends : "Presentibus magistro Johanne Strode rectore de Stabanan, magistro Arthuro ecclesie nostre Ardmachane canonicum (*sic*), Willielmo Adam clerico rectore de Keen testibus ad hoc specialiter rogatis. Et ego W. Mole publicus auctoritate apostolica et imperiali, etc."

183. Proceedings in St. Nicholas' Church (Dundalk) before the archbishop,
30 July, 1367. concerning the postulation of Master Peter Okerwlan,
Chancellor of Armagh, as Dean of Derry.
f. 38<sup>\*</sup>.

A proctor appeared, and a certificate (certificatorio) was exhibited, containing "the said mandate" (no. 188?) and a form of execution, and sealed by the Abbot and canons regular of the monastery or Cella Nigra of Derry (Derea). No one appearing to answer the citation all objectors are pronounced contumacious and excluded from further opposition to the postulation. The latter is confirmed—the right having devolved upon the archbishop—and Okerwlan is dispensed as in no. 103 and ordered to be inducted. The sentence of contumacy and the decree of confirmation and dispensation are given in full.

There are several indications that this is the latter part of a fuller record, e.g., the opening words, "Quibus die et loco," and such phrases as "the said mandate" and "the said proctor." It was probably intended to be read as a continuation of no. 186.

184. Examination of three witnesses on four articles. f. 39.

15 June, 1367. The second witness (name lost) on art. 1 says that [Simon, Bishop of Derry,] was excommunicated for over ten years in the diocese of Derry and elsewhere, and that this was well known in the dioceses of Derry and Armagh and the neighbouring churches among the Irish; on art. 2, agrees with first witness; on art. 3, says that he saw a daughter of Benmay (also written Benmy), nurtured by her, of whom the bishop was the reputed father, that he believes Affrica bore a son to the bishop, which is well known in the diocese of Derry, and on other points agrees with the last witness; on

art. 4, says that it is notoriously true. The third witness, Master Maurice Okacidi, canon of Armagh, on art. 1 says he heard it from Master Peter and others; on arts. 2, 3 says that he heard that they were true; of art. 4, about the son of the carpenter (fabri), he knows nothing.

The earlier part of this document, containing the evidence of the first witness, has been omitted, probably through the loss of a leaf. The opening lines of what remains are much mutilated.

The document appears to be a record of the examination of witnesses mentioned in no. 185: the accused person was a bishop, and, it would seem, of Derry; and articles 1, 3 refer to charges similar to those which were brought against Simon. Hence the date, which is illegible, may be assumed to have been that of no. 185.

185. Sentence in the case of the postulation of Master Peter Okerrulan to the deanery of Derry. f. 39.

15 June, 1367. The deanery being vacant by the death of Master Donat Okerrulan, Peter, his natural and legitimate son, was postulated by John Ochayge, in his own name and as proctor of Sir Joseph, Archdeacon of Derry, and principal (principalioris) person resident in the chapter, by Augustine M<sup>e</sup>thayd comarb of St. Kynnicus and canon of Derry, by Master Gilbert Odubanaygh proctor of Master Patrick Okorry, Dean of Armagh and canon of Derry, in his own name and as proctor, and by Paul Mewerga, canon of Derry. Peter accepted the postulation, and both he and the postulants desired confirmation from the archbishop-[on the ground], as it seems to be said,<sup>1</sup> that Brother Simon, Bishop of Derry, was suspected of perjury, and was a notorious fornicator, and because from the beginning of his episcopate he was under sentence of greater excommunication (1) both in the Roman curia and in Ireland, by apostolic authority, for non-payment of common service to the camera of the Apostolic See for his provision, and (2) by authority of the presidents of the church of Armagh for notorious concubinages and adulteries, and for non-payment of fines (mulcta) imposed upon him therefor by the same. The archbishop accordingly cited the bishop to show cause why confirmation should not issue. As he refused to appear, and did not appear on the day named, he was pronounced contumacious, and evidence was given of his excommunication and of his fornication, &c. Sentence (quoted in full) was then given that confirmation of the postulation, with dispensation if this should be expedient, belonged to the archbishop, and order was made that Master Augustine (Mac Teague), comarb of St. Kynnycus in the diocese of Derry, should cite Master Tomlinus M<sup>c</sup>ploscayd, de facto incumbent of the deanery, and the other canons of Derry.

This is a record of the proceedings more summarily related in no. 187, and the date (which is not given) is clearly the same as that of the companion document.

<sup>&</sup>lt;sup>1</sup> A good deal is here lost by mutilation.

186. Proceedings in the case of the postulation of Master Peter Okerballan 12 July, 1367. (*in title* Okerbellan) to the deanery of Derry before the archbishop in the church of St. Nicholas, Dundalke. f. 40.

Master John Kenan appeared as proctor of the canons of Derry. Proof having been given of the mandate to Master Augustine (Mac Teague), comarb of St. Kynnicus, for the citation of Thomas M<sup>c</sup>polyscaid (*also written* M<sup>c</sup>ploiscaid) by name and of others concerned in general terms, and of its execution, and none appearing, M<sup>c</sup>ploiscaid was pronounced contumacious and excluded from further opposition. It was also decreed that a further citation should be made in Derry cathedral for all concerned to appear in the same place on 30 July.

A note states that copies of the mandates for the general and special citation are on the next page.

187. Mandate to Master Augustine M<sup>c</sup>thayg, comarb of St. Kynnicus 15 June, 1367. and canon of Derry, with certificate of execution (certificatorium) of the same. f. 40<sup>°</sup>.

The mandate states that Master John Kenan, clerk of the diocese of Armagh, proctor of the canons of Derry, had applied to the archbishop for confirmation of the postulation of Master Peter Okerwalan, canon of Derry, to the deanery: that Simon, Bishop of Derry, having been cited to show cause why it should not be confirmed, did not appear, and was pronounced contumacious; and that the archbishop decreed that the right of confirmation had devolved upon him and that the cause should be proceeded with. He commands Augustine to cite Thomas M<sup>c</sup>bloscayge by name, wherever he should be found, and all others concerned in general terms, in Derry cathedral, to appear in the church of St. Nicholas, Dundalk, on 12 July, if they wished to oppose the postulation.

Dated at Tarmefechyn.

The writer of the certificate states that  $M^{c}$ blayge (*sic*) was found in the chamber of Brother Simon, Bishop of Derry, in his manor of the church of Accadufaychi, diocese of Derry, the writer knowing that he did not reside at Derry cathedral, and that he there cited him by name on 28 June.

He sealed the certificate with the common seal of the chapter of Derry and dated it at the church of Accadufaythi, 28 June.

188. Letter to John Ocuyg, canon of Derry, and the priors of the friars 12 July, 1367. preachers and canons regular of the city of Derry. ff. 40<sup>\*</sup>, 19.

States that Thomas M<sup>c</sup>bloscaid, *de facto* incumbent of the deanery, and others concerned had been cited and had not appeared, and that M<sup>c</sup>bloscaid had been declared contumacious and excluded from further opposition to the postulation of Master Peter Okerballan, canon of Derry, to the deanery

of the same. The archbishop orders the above, as his commissaries, to cite, by a general proclamation in Derry cathedral, all who wish to oppose confirmation thereof to appear before him in St. Nicholas' Church, Dundalk, on 30 July.

Dated at Dundalk.

189. Letter [of the archbishop, guardian of the spiritual] jurisdiction [of **19 Fobruary**, **1366**. the diocese of Down, *sede vacante*], to the clergy of that diocese. f. 41.

States that the Prior of the house of St. Peter at Newtown near Trym, diocese of Meath, has informed the archbishop that his house is in great need of repair, and that the archbishop saw this himself on his last metropolitical visitation of the house. He therefore gives direction and grants indulgence as in no. 176, 149.

Dated in the city of Down.

190. Certificate of the appointment of Sir John Haket, priest, as rector 21 February, 1366. of the church of Nedrum in the diocese of Down, "sede vacante ex resignatione."<sup>1</sup> f. 41.

The church was vacant by the resignation of Sir Maurice M<sup>e</sup>Kerly, made with a view to exchanging it with Haket for the church of St. Tassanus of Rathcolp in the same diocese. The archbishop, as guardian of the spiritual jurisdiction, collated the church to him, invested him by tradition of his ring, instituted him, and ordered that he should be inducted by the archdeacon or his official.

Dated at the city of Down.

191. Certificate of the appointment of [Sir Maurice M<sup>°</sup>Kerly], priest, to 21 February, 1366. the church of St. Tassanus of Rathcolp (also written Rathcolpe). f. 41.

In the same terms, mutatis mutandis as no. 190.

192. Letter to the vicars of Tuyna and Clonfechena. f. 41<sup>v</sup>.

**3 March, 1366.** They are commanded to denounce as under sentence of greater excommunication at mass on Sundays and festivals Donald Okarry, who has invaded the archbishop's lands of Clondawyll, and to place his subjects under ecclesiastical interdict; and to continue doing so till he leaves the lands and gives satisfaction for the injury done to the archbishop and his subjects. They are also commanded to call on Donald, Terence (?) and Eugenius Oneyll, by whose authority Okarri acted, to expel him from the

<sup>&</sup>lt;sup>1</sup> This may perhaps indicate that Robert de Aketoun (see no. 55) had resigned the see, whether before or after consecration. He was not recognized by the Pope, who provided William White in succession to Richard Calf. But White does not seem to have been consecrated till July 1366, or later (*Papal Petitions* i. 530).

lands and to compel him to give satisfaction within ten days from the date of this letter. Otherwise the sons of Oneyll shall themselves be put under interdict.

Dated at Down.

193. Letter to the Prior of the Purgatory of St. Patrick at Loghderge (*in*15 March, 1366. *title* Loghdearg) in the diocese of Clocher and all others, clerics and laymen, of the province of Armagh.
f. 41<sup>v</sup>.

The archbishop commends to their hospitality John Bonham and Guidus Cissy, pilgrims who desire to visit the Purgatory.

Dated in the city of Down.

Printed in An. Boll. xxvii. 37.

194. Grant to Richard Clyntoun of an annual pension of 20s. for the life c. April (?), 1366. of the archbishop, of which 10s. is from messuages on the north of St. Patrick's Church, Trym, and three acres of land attached to them, and the rest from the archbishop's coffers. f. 41<sup>\*</sup>.

He is also to get a robe when the archbishop gives robes to his knights. Dated in the city [of Down].

In the date only the year—1366 (O.S.)—is legible. If, as seems likely, 'the city' is Down, the letter must be of about the same date as the other letters on the leaf (nos. 190-193). It is, however, at least us late as 25 March, the first day of 1366 (O.S.). All the archbishop's letters from 19 February to 13 May are dated at Down (nos. 15, 27, 189-193). He was at Termonfeckin on 7 February (no. 113), and at Dromiskin 12 June (no. 70).

195. Progress of visitations of the diocese.

f. 42.

1370, 1371. In 1370 the dean and chapter were visited at Armagh on 13 [May]; the colidei and clergy and people on the days and at the places mentioned in their citations. In the deanery of Drogchda the visitation was held at St. Peter's Church, Drogchda, on the 27th of same month; in the deanery of Atrium Dei at St. Mary's, Atrium Dei, for the clergy on the 28th, and for the people on the 29th; in the deanery of Dundalke on the 31st.

In 1371 the dates were as follows: dean and chapter 11 May; colidei 13 May; clergy 15 May; clergy of Tullachoge deanery 16 May; laity of the deaneries of Erthyr and Tullachoge, on the days assigned to the clergy of the same.

The month for 1370 is supplied from no. 202.

196. Acquittance, acknowledging that on his metropolitical visitation of **1 June**, **1374**. Meath, he received from Bishop Stephen (Wall) and the clergy of Meath £10 in part payment of procurations for the metropolitical visitation of the year 1373, by the hands of Sir Richard Molys, principal receiver. f. 42.

197. Acquittance, acknowledging the receipt from Sir William, Prior, and 19 July, 1379. the Convent of Louth 8 marks as payment for the tithes (in

pretio de decimis) of Tarmefeghyn sold by them to the archbishop in the name of procurations due to the archbishop at his ordinary visitation on the date of the acquittance. f. 42.

Dated in the manor of Dromeskyn.

198. Mandate (from an Archbishop of Armagh unnamed) to Roger Sway[n]. f. 42.

He is to pay 2 marks to the Prior of Loueth in part payment for tithes sold by him to the archbishop, retaining this document in lieu of acquittance. 199. Citation of [Simon, Bishop of Derry]. f. 42<sup>\*</sup>.

31 July, 1367. States that the bishop intruded Thomas M<sup>c</sup>bloscaich into the deanery of Derry after the case concerning the confirmation of the postulation had begun, thereby displaying contempt for the jurisdiction of the church of Armagh and incurring sentence of greater excommunication. He is cited, and commanded to cite M<sup>c</sup>bloscaich, who was his partner in the premises, to appear in the church of St. Nicholas, Dundalke, on the [blank] after the Assumption of B.V.M. (15 August), to show cause why the archbishop should not declare them to be under sentence of greater excommunication.

Dated at Dromeskyn.

The early part is mutilated.

A note follows, "# Require in principio secundi folii."

200. Letters patent concerning the confirmation of the postulation of 15 June (?), 1367. Master Peter Okerwlan, Chancellor of Armagh, to the deanery of Derry. f. 42<sup>s</sup>.

State that Master John Kenan, clerk of the diocese of Armagh, appeared before the archbishop in the chapel at Tarmfechyn on 24 May, and presented letters of proxy from the chapter of Derry and the decree of postulation-the tenor of which is said to follow but does not appear-and prayed confirmation thereof. The archbishop thereupon by letters patent-the tenor of which is said to follow, but does not appear-caused Simon, Bishop of Derry, to be cited to appear in the parish church of Tarmfechyn on the first juridic day after Trinity Sunday (13 June) to show cause why the petition should not be granted. On that day proof was given of the service of the citation and of the refusal of Simon to appear; and as he did not appear he was pronounced contumacious, and the archbishop found that the right of confirmation had devolved upon him. He gives sentence and has definitively decreed that Thomas M<sup>c</sup>bloscaid, de facto incumbent of the deanery, be cited by name, wherever he is found, and all others concerned in general terms in Derry cathedral, and issues letters to that effect to Master Augustine Mcthaige, comarb of-

Breaks off at the end of the page.

A clause interpolated into the text states that the letters of proxy of Kenan and the decree of postulation immediately followed this document, obviously on the succeeding leaf, now lost. A note adds that the citation of Simon was copied at the beginning of 'fol. vii.'

The date, supposing that the lost portion did not record proceedings subsequent to those here mentioned, is obviously the same as that of no. 187—the letter of citation last referred to in the document.

201. Letter of Edward (III) to the sheriff of Loueth. f. 43.

18 March, 1370. He is to have proclamation made in the plain (plano) of the county and wherever else in the territory he may deem it expedient, that no ecclesiastical person, under heavy forfeit to the crown (forisfactura nostra), shall sell any tithe for next year to any idle man (otioso) or Irishman, but that all such tithes shall be kept for the king's lieutenant William de Wyndesore.

Ends : "Teste Willielmo &c. (as no. 39) apud Tamelyn " &c.

202. Citation for the ordinary visitation of the diocese of Armagh among 17 April, 1370 the Irish. f. 43.

Master Patrick Ocorry, dean, is commanded to appear and to cite the canons of the chapter to appear on 13 May, to cite the colidei of the cathedral, the chaplains serving in the city, and the clergy of the deanery of Ardmach for 14 May, also laics from all parishes of the same for 15 May, at the cathedral; and to have the clergy and people of the deanery of Tulaghog cited for 16 May at the church of Clonfekena.

Dated in the manor of Drummeskyn.

203. Commission to Masters [...] and Patrick Ocorry, Dean of Armagh, 7 May, 1370. to hold the visitation (no. 202). f. 43<sup>°</sup>.

Dated in the manor of Dromeskyn.

204. Citation for the ordinary visitation of the deanery of Drogchda.

15 May, 1370.

The dean of the deanery, John Bagoke, vicar of Portluran, is to cite the clergy, and laity from every parish, to appear at St. Peter's, Drogchda, on 22 May.

f. 43<sup>v</sup>.

f. 44.

Dated in the manor of Dromeskyn.

205. Letter to [the Dean of Armagh].

9 September, 1367. In reply to a letter, received the previous night when he was in bed, asking absolution for Ohandeloyn and Donald (O'Neill), he says that after frequent absolutions, oaths taken, and pledges given by Ohandeloyn they acted worse than before, and are now excommunicated for continual rebellions. He therefore cannot absolve them without counsel from magnates (majores de terra), friends of himself and the Church, who are busy with the

harvest (circa autumpnum), and without security that the offences will not be repeated. He wishes to speak with his correspondent before sending his messenger to the curia; when he comes they can consider the renewal of peace with the malefactors.

Dated at Dromeskyn.

He could wish (vellemus) to write a letter of warning (comminatorie) to Niallan, and to take proceedings against him in the form of the Church, but on account of the tyranny of the two mentioned above it would be impossible to find a messenger who would dare to make the journey.

The year is not given. But the letter from the dean to which this is an answer seems to have been the earlier of the two mentioned in no. 94, the latter being that of 13 September to which no. 96 is a reply.

206. Acquittance, acknowledging the receipt from Master Patrick (O'Corry), 1367. Dean of Armagh, through Master Patrick M<sup>c</sup>umcugan, of the rent of the mensal lands at Armagh for 1367--20s. f. 44.

Dated in the manor of Dromeskyn.

A note adds that at the same date a similar acquittance was given to Master Patrick Oreychi for 20 marks, 20d.; and that he swore to execute faithfully the office of seneschal, in the presence of Masters Arthur M<sup>o</sup>brun, official of the church of Armagh, Patrick M<sup>o</sup>umcughan, John Kenan, and the writer, James Scotelare. This was done before the primate in his chamber, and Master Patrick was ordered to warn the tenants that they must pay their rents, or else be [ejected ?].

207. Note.

f. 44<sup>°</sup>.

**6 January, 1368.** Gives an account of the murder of [...] in the orchard (pomarium) of George Telinge, his servant (administer), when he was in the act of blessing the fruit.

Partly illegible.

208. Letter to Brother Simon, Bishop of Derry.

f. 44°.

**1 July, 1370.** Cites him to appear in Armagh cathedral on 15 July, to make payment of 10 marks due, by his oath, for the redemption of his penance, and  $4\frac{1}{2}$  marks and eels, rent due for the manor of Kyllareo, which he held in farm of the archbishop, for the three terms last past, and to show cause why he should not be proceeded against for perjury.

The summary of this document and no. 209 has been made from Bishop Reeves's copy. They are now almost illegible, the page having been injured by the use of a re-agent.

209. Letter to Master John M<sup>c</sup>birragra, official in the deanery of 1 July, 1370. Tullachog. f. 44<sup>\*</sup>.

Cites him to appear in Armagh cathedral on 11 July, to pay all money R.I.A. PROC., VOL. XXIX., SECT. C. [38] collected by him for the archbishop, and render account thereof, and to treat with the archbishop and his fellow-members of the chapter, concerning the affairs of the church of Armagh. He is to send an escort of his men with the bearer, who is also carrying a letter to (Simon) Bishop of Derry.

Dated at the Lake near Armagh.

See note on no. 208.

210. Note (?).

f. 45.

f. 45.

Only the words "[perpet]uo vicario ecclesie beate Marie de mandelun-[stoun]" are legible. "beate Marie" is crossed out.

211. Citation for an ordinary visitation.

**4 June, 1367.** Sir Walter Haddesor', vicar of Dunler, dean of Droghda, is to cite the clergy of his deanery for 21 June, and laity from every parish for 22 June, at St. Peter's Church, Droghda.

Dated at Tarmefeghyn.

A note states that on the same day similar letters were issued to Sir Thomas Louragh, vicar of St. Mary's, Mandelvillestoun, dean of Atrium Dei, the clergy of which deanery were to be visited on 25 June and the people on 26 June. Also to Sir Roger, parish priest of Feld, dean of Dundalk, the clergy of which deanery were to be visited on 28 June and the people on 30 June.

These three letters were handed to Gilbert the messenger on 4 June after noon in the presence of the primate, the Bishop of Down, and Master John Kenan, notary public.

A further note refers to the commission to Masters Patrick, Chancellor, and Patrick Orethy, canon of Armagh, to visit the diocese among the Irish, copied "in xv folio post illud presenti non computato."

212. Letter to John and William Brysbon, of Ayshe and Castelrynge. f. 45.8 October, 1371. Maurice M<sup>c</sup>mahoun having demanded that justice should

be done to him by the archbishop's tenants at Inneskene, concerning one of his men alleged to have been wounded by the latter for injuring the archbishop's stream and fishery (pro fractura gurgitis nostri et piscarie) at [...], and having appointed the above as arbiters on his side to decide the matter on 9 October, the archbishop appears to accept them as arbiters.

Some important words are illegible towards the end of the document.

213. Dates of the ordinary visitation in [1367]. f. 45<sup>\*</sup>.

1367. Dean and chapter 10 [June] at the cathedral; Abbot and Convent of SS. Peter and Paul and the colidei [12 June]; [clergy] and people of the deanery of Tullachoge at Clanfechkyll.

The year is inferred from no. 215.

214. The same for 1375.

1375. Dean and chapter, 4 June at the cathedral; Abbot and Convent of SS. Peter and Paul and the colidei, 7 June; clergy and people of Erther, 12 June, at the cathedral; clergy and people of the deanery of Tulachoge, 14 June.

215. Citation for an ordinary visitation.

26 May, 1367. Patrick Okorry, Dean of Armagh, is to appear, and to cite the chapter to appear, at the cathedral on 10 June, the Abbot and Convent of SS. Peter and Paul and the colidei of the cathedral at their accustomed places on 12 June, the clergy and laymen of the deanery of Erthyr at the cathedral on 14 June, and those of the deanery of Tullachoge at the parish church of Clonfekyna on 15 June.

Dated at Tarmefeghyn.

216. Memorandum.

26 May, 1367. States that a letter was addressed to Gilbert O[l]orchan, seneschal of Armagh, to bring in (ad portandum) his rents from 1 May, and for 4s. left (dimissis) in the hands of Thomas M<sup>e</sup>moer, for the archbishop. These things are to be done within a fortnight of [blank].

217. Memorandum.

26 May, 1367. States that a letter was addressed to the vicar of Castrum Ohandeloyn, for the rest of the cows due by [...] Ohandeloyn, under his oath; and instructing him to warn (premuniat) Ohandeloyn to give (reddat) pledges to the seneschal of Armagh within a month.

218. Memorandum.

26 May, 1367. States that a citation was issued, to be made by Master Patrick Orochy, canon of [Armagh], to [...] official of Armagh, Benedict Oculean official of Tullaogh, M[aster... of Tulla]ogh, and Marcellus Omichan beadle (bedellum) of Tullaogh, to render their accounts.

Partly illegible.

219. Narrative of litigation between the archbishop and the Prior and c. 1367. Convent of Down. f. 46.

States that the archbishop had issued a citation to the prior and convent and that the prior had gone into hiding to avoid personal service thereof. The citation was entrusted to a chaplain and a messenger, who found the prior and his followers. When the latter saw them he beat the chaplain and wounded him in various ways, and put fetters on the messenger, subjected him to torture (questionibus), and compelled him to eat the letter of citation with its seal of wax. The archbishop having afterwards assigned a place in the diocese of Down at which on a day fixed by him the prior and his followers were to acknowledge their offence, make amends for

 $[38^{*}]$ 

## f. 45<sup>\*</sup>.

f. 45.

## f. 45'.

# f. 45<sup>°</sup>.

f. 45'.

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it, and hear the archbishop's pleasure concerning it, they gathered a band (facta collectione) of the clerks and laymen of nearly the entire diocese, who appeared armed as for war. Among them, as a "tertius principalior" in the rebellion, was John Dommgan, pretended rector of Camlin in the diocese of Down. Two men whom the archbishop had sent beforehand to provide food, in the chapel at Viride Castrum in the diocese of Down, were killed in the presence and with the approval of Dommgan, and many were wounded. Thereupon the archbishop pronounced sentence of suspension, excommunication and interdict against the prior and all who aided him. From this sentence, as it is said, they made a frivolous appeal, without notifying the same to the archbishop, and sent Dommgan as their proctor to the Roman curia. He desired that many objections against the archbishop should be set forth in public consistory, all of which were false (que in omnibus suis partibus requirentur subjecte falsitati). For the archbishop the Pope was therefore prayed to commit to Sir Peter Flandrini, auditor of causes, all the causes to be moved by the archbishop against the prior and others concerned with him, about the spirituality and spiritual jurisdiction, possession and rebellion, &c., though they did not properly belong to the curia, and though a commission had been issued with regard to some of the premises to the Cardinal of Nimes i.e. John de Blandiaco, Bishop of Nimes, cardinal priest of St. Mark) who was absent. The Pope gave an order granting this petition, consisting of a single sentence "written at the end of the sheet (cedule) of the commission or suspension by another hand and in a quite different character (litera)." James de Prato, who appeared as proctor for the archbishop, complained that certain documents essential to his case were detained by notaries and others in the diocese of Down and the two adjoining dioceses, and sought a remedy. The auditor commanded certain persons (not named), within six days after request is made to them to that effect on behalf of the archbishop, to admonish such of the beforementioned notaries and others whom the bearers of the command may consider it necessary to name to them, that they shall deliver the documents to the archbishop or his proctor or transmit them to the curia.

The date is not legible. But the violent proceedings described seem to belong to a period when the see of Down was vacant, and may therefore be placed in the period following October, 1365 (see no. 85), or shortly after the death of Bishop William White (August, 1368). The former date is more likely, since a case concerning vacancy of the see of Down was in progress at the curia in 1366 (see nos. 93, 138). The document was certainly earlier than 30 May, 1371, when Peter Flandrini became a cardinal (Eubel i. 21).

220. Dates of an ordinary visitation.

f. 47.

The visitation began the Thursday after 24 June. At Droghda the clergy were visited 1 July, and the people of the same deanery 2 July. At Atrium Dei the clergy of the part of the apparitor of Ardee (Atrium

Dei) 6 July, and the people 7 July. At Louth the clergy and people of the part of apparitor of Louth 8 July. At Dundalk the clergy 9 July, and the people 10 July.

221. Mandate to Milo, Bishop of Dromore, for a metropolitical visitation 20 October, 1366. of his diocese. f. 47.

The bishop is to cite his clergy to appear on 5 November at Kyllwronaygh. Dated in the manor of Dromeskyn.

222. Commission to Masters Peter Okerbyllan, Chancellor, and Patrick 4 [June,] 1367. Oreghigi (*in title* Orechy), canon, of Armagh, to hold a visitation in the cathedral, of the cathedral and the diocese among the Irish. f. 47.

Dated in the manor at Tarmefechyn.

By alterations of the text indicated in the margin and between the lines this document is transformed into a commission to Cornelius Olorkan, canon of Armagh, and Nemias M<sup>c</sup>molmartyn, vicar of Kylmor in the diocese of Kilmore (Triburnen.), to hold a metropolitical visitation of the diocese of Kilmore.

That the commission was issued in June appears to be established by nos. 211, 215.

223. Letter to the dean of the deanery of Atrium Dei [and ...] vicar of **15 March**, **1365**. Dunler. f. 47<sup>v</sup>.

They are commanded to appear in the chapel of the manor at Tarmefeghyn on 19 March to render account of the subsidy lately granted to the archbishop by the clergy of the diocese among the English, of which they were collectors.

Dated at Tarmefeghyn.

224. Acquittance acknowledging receipt from Sir Yvar M<sup>c</sup>gawyn, the 15 June, 1365. archbishop's receiver of rents at Armagh, of 9 marks 8s. in money, and flesh, beer, &c., of the estimated value of 5 marks, 7d. f. 47<sup>°</sup>.

Dated at the Lake near Armagh.

225. Acquittance acknowledging receipt from the same of 7 marks  $46\frac{1}{2}d$ . 27 September, 1365. for the term at 1 May, and by the hands of Matthew Bulbeke 23s. 4d. f.  $47^{\circ}$ .

Dated at Tarmefeghyn.

226. Acquittance acknowledging receipt from Magnellus Omychan, 27 September, 1365. collector at Tulachoge, in value (pretio) and in money. 20s. 4d., to which amount he was in arrear according to the account rendered by him to the Dean of Armagh at Tulachoge. f. 47<sup>\*</sup>.

Dated at Tarmefeghyn.

227. Letter to Master William Morice, Archdeacon of Armagh, or his 22 December, 1365 (?). official. f. 47<sup>\*</sup>.

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States that the Prior of the Hospital of St. John of Jerusalem at Kylmaynan in Ireland has presented Sir Thomas Conlagh, priest, to the vicarage of Kylmedymoke. The archdeacon is to make the usual inquiries in the deaneries of Droghda, Atrium Dei, and Dundalke.

Dated at Dromeskyn.

The date is given as 1365 and the fifth year of Sweteman's consecration. It therefore lies between 17 November, 1365, and 24 March, 1366. It is further defined as the Monday before the feast of 'Nat[...].' The only 'Nativity' within the limits mentioned is Christmas, 1365, and the Monday before it was the 22 December. But the letters 'Nat' are doubtful.

228. Letter to the Bishop of  $[\ldots]$  the archbishop's suffragan. f. 48. 16 February, 1364. States that the archbishop in his metropolitical visitation of the diocese had discovered that by sentence of commissaries of the bishop, based on false evidence, the marriage of Walter and Johanna had been pronounced null; that the archbishop had quashed that sentence, declared Walter and Johanna to be man and wife and their children legitimate, and warned them, under penalty of greater excommunication, to come together within fifteen days. Learning that Johanna had not obeyed this monition he caused the bishop to warn her to do so within eight days after the foregoing fifteen, and in the event of her continued disobedience required him to denounce her as excommunicate throughout his diocese. Since she is still obdurate he now commands the bishop to warn all his subjects not to communicate with her in any way, and if this monition is not obeyed (alioquin) he is to cause Johanna and all keeping company with her-the king, his consort and their children alone excepted-to be excommunicated with all solemnity until she returns to her duty and he has other order from the archbishop.

229. Licence to Sir Richard Hoper, priest, rector of Kilkerly, to be absent 29 March, 1365. from his cure for the purpose of study. f. 48.

Dated at Tarmefeghyn.

230. Document all but a few words of which is lost. f. 48<sup>\*</sup>. March, 1365 or 1364. Dated at Tarmefechyn.

The year is given as 1364 (O. S.). Since the day of the month is lost this is ambiguous. But 1365 (N. S.) is probably correct, since the archbishop was certainly at Termonfeckin for a considerable part of March in that year (see no. 148, note). We have no dated documents for 1364, unless this be one.

231. Letters to Masters Patrick Orethgi, canon of Armagh, and 20 February, 1365. Robert Derby, the archbishop's proctor at the Roman curia. f. 48<sup>°</sup>.

Commissions them as his proctors for visiting the Holy See. They are to appear before the Pope's chamberlain in his name, and are to obtain letters of acquittance for the performance of the visit, and a dispensation in regard to any perjury or irregularity he may incur in connexion with it.

Dated at Dromeskyn.

232. Letter to the Dean, Chancellor, prior of colidei, and all others of 1363  $\times$  1366. Armagh cathedral. f. 48<sup>°</sup>.

States that the archbishop had received letters from the Duke of Clarence, son and lieutenant of the king in Ireland, at the time of his last coming (a tempore ultimo adventus) to Ireland, informing him that though peace had been restored by indenture up to 1 May between the duke and Oneyll, yet within that term Oneyll had taken possession of the horses (equicium) of Geoffrey Whyt, the duke's constable at Viride Castrum, and praying him to excommunicate Oneyll and his accomplices until satisfaction is made. Accordingly the archbishop commands the above to admonish Oneyll and his son Donald to make restitution to Whyt or his proctor within fifteen days, and if they shall despise their admonitions, to denounce them as excommunicate in the cathedral and in all other churches of the diocese among the Irish on Sundays and festivals at mass, and not to cease therefrom till the horses are restored.

Apparently breaks off at the end of the page.

233. Letter [to William (White), Bishop of Down, for a metropolitical 24 January, 1368. visitation of his diocese]. f. 49.

Dated in the manor of Dromeskyn.

The greater part of this document seems to have been written on a leaf now lost between ff. 48, 49. Of the portion on f. 49, only parts of a few lines, including the date, remain. Its character is inferred from the title of no. 234, and the note following it.

234. Letters of citation to William (White), Bishop of Down, "if he refuse
29 January, 1368. to accept the preceding citation."<sup>1</sup> f. 49.

He is cited to appear in St. Ronan's Church, Dromeskyn, on 10 February, to answer in regard to his contempt and disobedience towards the archbishop.

Dated in the manor of Drummeskyn.

A note states that on 24 January a letter was issued for a visitation of the bishop and chapter on 15 March and of the clergy and people on 18 and 19 March respectively.

235. Memorandum.

f. 49.

1368. States that the first citation was handed to the Bishop of Down by the Archdeacon of Down. It appointed the visitation of the bishop and chapter for 7 February, of the clergy of the deanery of Lescalle for 8 February, and of the people of the same for 9 February. It was dated 24 December (1367). The bishop refused to receive it.

The date is inferred from no. 234.

<sup>1</sup> In the heading only,

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236. Letters patent.

2 January, 1368. Notify that Sir John Logan, Archdeacon of Down, against whom charges had been brought by W(illiam White) Bishop of Down, first appealed (provocavit) to the metropolitical court last summer, and afterwards in regard of (ex) different charges, and especially in regard of (a) a sentence of excommunication passed upon him by the bishop, after and contrary to the appeal, appeared on two occasions. His appeals were received and are still undecided in the archbishop's court.

Dated in the manor of Drummeskyn.

237. Letter to the Bishop of Derry.

14 February, 1368. The archbishop notifies that by advice of [....], men learned in the law, and with the consent of the Dean of Derry he had .... as regards some purpose] for which (ad quod) the bishop was to be (fueritis) cited to appear before him on this occasion up to (hac vice ... usque ad) the first juridic day after [....] with regard to complaints which the dean made against him. The archbishop desires him (1) to confer the rectory of Ardo -which has been conferred on a man under age, a defect with which only the Pope can dispense, and is by custom conferred on a canon of Derryupon another with the advice of the dean and chapter; (2) to give the episcopal third of his rectory of Derry to the fabric of the church, to which it is given by right (a parte juris conceditur); (3) to excommunicate Okaan and place his lordship under interdict until he give security to the dean for himself and his subjects-Okaan having been already excommunicated at the instance of the dean, but absolved by the bishop without summoning the dean; (4) under the penalties contained in the above-mentioned citation, to pay what he owes to the archbishop, in any manner that may be possible (modo possibili), to the dean in the archbishop's name, following the dean's advice about the manner (modo) of payment, viz.: 17 marks 41d. due in the time of Archbishop Richard (FitzRalph), and 52 marks, also 2 marks for procurations at the last metropolitical visitation of the diocese, held by the Dean of Armagh and Master Odo (Medinim) prior of the community of the chapter of Armagh (cf. no. 122). The archbishop wonders much that the bishop does not in his official acts follow the counsel of his dean, 'without whose counsel if we could have the advantage of his presence we would do nothing of difficulty, as we did not in the past when he was with us.' The archbishop desires this letter to be communicated to the archdeacon and other members of the bishop's chapter.

Dated in the manor of Drummeskyn.

238. Memorandum.

f. 49°,

1368. States that by letter dated 14 February, and handed to Gibboinus (?)

f. 49.

f. 49'.

the runner, the Bishop of Clocher was cited to appear on 15 March in St. Ronan's Church, Drummeskyn, to answer for the non-payment of 13 marks and 41d., and to show cause why he should not be punished for breaking his oath.

The year is omitted in the date. It is assumed to have been identical with that of no. 237, which was also written on 14 February.

239. Summons to a parliament at Kilkenny on 6 October. f. 49<sup>\*</sup>. **18 August, 1375**. The archbishop is to appear personally together with proctors for the chapter of Armagh and for the clergy of the diocese.

Ends: "Teste W. &c. (as no. 111) apud Lymeryk" &c.

240 Citation of N[icholas (Allen)], Bishop of Meath, for a metropolitical13 October, 1366.visitation of his diocese.f. 50.

The bishop is to appear in the parish church of St. Patrick, Trym, on 19 January, and to cause the archdeacons of Meath (Midia) and Kenlys and the clergy of the deanery of Trym to be cited for the same day, and laymen from the parishes of the same deanery for 20 January. The clergy of the other deaneries are to be warned to be ready for visitation on dates to be fixed.

Dated in the manor at Tarmefeghyn.

241. Memorandum.

f. 50.

19 January, 1367. Relates proceedings before the Archbishop in the guesthouse at the House of Friars Preachers at Trym, where there appeared Master Matthew Cromp, Archdeacon of Meath, Thomas Wythyntoun, Abbot of St. Mary's, Trym, John Whyt, [Prior] of St. Mary's (Domus Dei), Molynger, Brother Richard Symkoke, proctor of the Abbot of St. Thomas the Martyr, Masters Peter Howthe (?), rector of Dromconragh, and John Holleby, rector of Kyllaloun, and Sir R[ichard] Mollys, rector of Crucistoun, proctor of the clergy of Meath, and many others, clerks and laymen. The archbishop explained the cause of his coming for his metropolitical visitation. The archdeacon and others in reply stated that the Bishop of Meath died 15 January, and made some other assertions which are in part illegible. He said also that Master Henry P[owle], archdeacon of Kenlys, had sworn the previous Tuesday (12 January) that he had not been cited by the bishop to undergo the metropolitical visitation of the primate. The archbishop, since the bishop was dead, and had not received the archbishop's mandate while he was alive, dismissed them with his blessing.

Ends: "Testibus presentibus ad premissa venerabili viro fratre Johanne domus sancte Marie de Louth priore, magistro Petro cancellario Ardınachano, Nicholas Bethun officiali curie Ardmachane, Galfrido Baldewyn notario publico, magistro Johanne Strode rectore de Staghbanan et multis aliis tam diocesis Midensis quam [Ardmachane]."

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A re-agent has been used on this document, and much of it is now illegible which Reeves succeeded in deciphering. I have therefore largely depended on his copy.

242. Citation of William (White), Bishop of Down, for a metropolitical 1368. visitation of his diocese. f. 50<sup>v</sup>.

The bishop and chapter are to appear on 15 March at the cathedral, the archdeacon and the clergy of the deanery of Lechale on 18 March, and laymen from the parishes of the same on 19 March in the church of the priory or cell of St. Thomas the Martyr, Down; and the clergy and people of other deaneries to be warned to be ready for visitation at dates to be assigned.

Breaks off at the end of the page.

243. Letter to [Sir John Offyn, presbyter of the diocese of Meath], canon 26 August, 1373. of the suffragan [church of Ardagh] and guardian of [the spirituality and spiritual jurisdiction of the same], which was committed (deputate) [to him by the archbishop, to] whom it belongs. f. 51.

States that, three persons having been elected to [the bishopric of Ardagh], viz.: Master Charles Offerall, who presented his decree of election to the archbishop, Master Richard Offeral, dean of the same church, elected by letters sealed with the common seal of the chapter, which were presented to the same, and John Aubrey, Friar Preacher of Trym, the archbishop, before the revocation of the Bishop of Kilmore's (Triburnen.) commission (see no. 244), directed the latter to cite the first two of the above-named to appear in Armagh cathedral on 5 September; but that after the issue of the citation the decree of election of Aubrey was shown to him. The bishop's commission having been withdrawn, he now commands [Offyn] to cite all three to appear at the above place and date.

Dated in the manor at (infra) the Lake near Armagh.

The illegible portions of this document have been conjecturally restored with the aid of no. 244.

244. Commission to Sir John Offyn, presbyter of the diocese of Meath, 26 August, 1373. canon of the church of Ardagh (Ardakaden.) f. 51.

States that the archbishop had already granted Offyn custody of the spirituality and spiritual jurisdiction of the bishopric of Ardagh (Ardachaden.), vacant by the death of William (MacCormack); but afterwards, having concluded from letters of the Bishop of Kilmore (Tirburnen.) and some of his clerks that he had appropriated the revenues (vos omnia [sc. de emolumento] vobis inbursasse et vos multa recepisse), he withdrew his commission and granted the custody to the bishop. Finding by the testimony of the magnates and noble clerks of the diocese of Meath that he was deceived by the bishop and his clerks, he now reinstates Offyn. He commits

to him the duties of demanding the palfrey, ring (and) other things which by the custom of his church belong to him by reason of the death of William, and of demanding from the Bishop of Kilmore (Triburnen.), and by ecclesiastical censures compelling him to render, an account of his receipts during his tenure of the commission.

245. Letter to Niallan M<sup>c</sup>hergħ.

11 May, 1373 (?) The archbishop bids him not to wonder that he did not come to the last parliament arranged to be held between them. In the pressure of business he forgot it. He desires him to keep the peace of Christ and His Church and the King of England, knowing certainly that some of the English are culpable, having destroyed ecclesiastical villas of the tenants of the Nobyr, Braktys and Dyliamstoun.

The year is not given in the date. The letter is from Sweteman; but the only ground for supposing it to have been written in 1373 is the date of nos. 243, 244.

246. Inquisition at the Nobyr.

## f. 51'.

f. 51.

November, 1351. It was taken before Richard (Fitz Ralph) Archbishop of Armagh, by the following jurors: John Porter, clerk, William Rede, Robert Whyt, John Troslon, Stephen Colyn, Richard [....]nmount, John Porter, Stephen Monemouth, John Rede, Stephen Neutoun, Simon Taylor, and Henry Colyn. They found (1) that from ancient times the community of the villa of the Nobyr elected two of the community, of whom the lord or his seneschal selected (habet eligere) one to be provost (prepositus) of the villa; (2) that the lord, on the death of a burgess, received from his heir a relief of 12d.; (3) that the lord did not receive a heriot on the death of a tenant who was a burgess from his heir; (4) that no burgess did suit to the lord's mill, against his own will, but that all used to cut (tonsare) the corn and 'macetum' of the mill (molar) for the lord's mill, and if not the lord distrained therefor; (5) that the lord had not his own serjeant (servientem) within the villa, except the serjeant of the villa who acts as serjeant for (serviet) the lord; (6) that the provost had a Tolboll by the lord's gift for his service (servicio); (7) that the lord's clerk of the outer court (de curia forinseca) and of the court of hundreds had toll for his service; (8) that the provost levied all profits (proficua) of hundreds, and gave account thereof to the lord or his seneschal; (9) that the lord had taxes (census) from all taxable persons (censar) in or coming to the villa. All the above had been withheld from Christmas, 1349, to 13 November, 1351. (10) The lord shall have from every butcher who is not a burgess a stone weight of fat (petram sepi), receiving therefor from the lord 4d., at 11 November. (11) The provost may (habet) levy 11 geese at 29 September. (12) From the place (placia) of Richard [39\*]

Belmount, which is a smith's place (locus fabri), (he may levy) four horseshoes (ferra equorum) valued at 4d. every Christmas (ad quodlibet Nat').

247. Acts of a process before the Archbishop of Armagh. f. 52.  $1362 \times 1373$ . While [the archbishop] was sitting judicially (pro tribunali) at [Termonfeckin] on [Monday . . . .], Thomas Britas, vicar of Mandevillston, apostolic [authority] John Taffe, son of Richard Taffe, [called] by [Sir Thomas Verdon, knight, and others], who had been cited to show cause why they should not be pronounced heretics because they had [taken possession of] the parish church of Feld and subsequently had broken a box (cistam) in the church in which the Lord's Body was kept, on the Saturday last past. [On hearing of this outrage] the archbishop had risen from his dinner table (mensa sui prandii) with the Bishop of [...] his suffragan and [...], LL.D., and others, and hastened to the church. But Verdon and his accomplices had left, and heard of the arrival of the archbishop after supper (cenam). Meanwhile the archbishop cited [Sir Thomas Verdon and] Simon Jordan, and having seen that the door of the church and the box were broken proceeded to examine certain witnesses there present in proof of the outrage. The proceedings were then adjourned till Monday. The persons cited not appearing on that day were pronounced contumacious and heretical. Subsequently Sir Thomas went to Tarmefeghyn, where he found the archbishop. On Tuesday in the chapel of the manor of Tarmefeghyn the archbishop pronouncod Sir Thomas heretical in a form of words quoted, in the presence of Masters Bartholomew, official of the Bishop of Meath, Walter de Eldon, Henry Bertyn, Master John de Strode, clerk, William Pyron, notary, Brother John Aubrey, "ad ecclesiam Droghadensem [...]," Sir Thomas Byrford and others; on which Thomas de Verdon, pretended knight, immediately replied that he pronounced the archbishop heretical. But (not)withstanding these proceedings, James, the pretended provisor, asserted that he had been cited to appear on that day with Sir William Redypak. The archbishop asserting that he had been cited for the following day (Wednesday), James, nevertheless, in the presence of the archbishop, "fecit fieri collationem principalis executoris copiam dicto archiepiscopo vel manu publica factam." Apparently a papal mandate (for the induction of James to the church of Feld ?), directed to the archbishop by Peter, Abbot of Anagni, who had been appointed executor of the Pope in this matter, was read by Bartholomew, and was compared with a copy of the same which had been put in by James, and James and William Redypak were cited to appear the next day. The copy was found to be inaccurate, especially in the substitution of the phrase "amoto quocunque detentore" for "amoto

quocunque illicito [detentore]"; and Redypak declared his intention to prove that it was written and falsified by James with his own hand. On Wednesday both James and Redypak appeared.

Much of this document is illegible; and the summary is therefore tentative. It appears to end on the verso of the leaf; but, if so, its concluding lines are undecipherable.

The name of the archbishop does not appear, but the mention of Pyron, Strode, and Aubrey (see index) indicates that it was Sweteman, and that the document belongs to the period before Aubrey became Bishop of Ardagh (see no. 243).

248. Procurations and Synodals of the diocese of Armagh among the English. f. 52<sup>\*</sup>.

Deanery of Dundalke: Dundalke 20s., Dengyn 40d., Kylkerly 40d., Dunbeynge 40d., Keen 40d., Philip Nugente's Villa 3s., Verdun's Villa 6d., Baron's Villa 12d., Felda 16s. 4d., Balybalryk 2s.; sum 56s. 2d.

Procurations of Religious Persons: Hospital of St. John of Jerusalem in Ireland 8 marks, Priory of Louthe 8 marks, Priory of Atrium Dei for the site and the church 9 marks, Priory of Dundalk for the site and the church 9 marks, Abbey of Knok 20s.; sum  $35\frac{1}{2}$  marks.

Deanery of Droghda: Beaulu 6d., St. Peter's, Drogheda 2 marks, Balymakenny 3s. 4d., Karryk 18d., Drumsalan 3s. 4d., Berly 16d., Donany 6s., Rath 6s. 4d., Clonmore  $\frac{1}{2}$  mark; sum 55s. 8d.

Deanery of Atrium Dei: Kyllyncoule 3s. 4d., Deruyr 5s., Drumcar 16s. 4d., Maundevyilistoun 10s., Stabanan 16s. 4d., Dromyng  $\frac{1}{2}$  mark, Keppoc Vicarage 3s. 4d., Kylmadymok 16s. 4d., Smermore 3s. 4d.; sum £4 0s. 8d.

Deanery of Atrium Dei, Synodals: Louth, Kyllincoule, Dyruer, Maundeuilistoun, Athirde, Stackyllynge, Smermore, Kylmadymok, Stabanan, Drummeynge, 12d. each, Keppoc 6d., Drumcar, Drummeskyn, 12d. each, Villa Moresth Chapel, Knoc Chapel, Richard's Villa Chapel, Senlys Chapel, Kylpatryc, 6d. each, Clonkene 12d., Talounistoun Chapel, Serlystoun Chapel, Arthure's Villa Chapel, Villa of Mapastoun Chapel, Clonkean, 6d. each.

Since the synodals for the deaneries of Dundalk and Drogheda do not appear the document seems to be incomplete owing to the loss of a leaf.

249. Letter of citation of [the archbishop, guardian] of the spirituality and 1369 or 1373 (?). spiritual jurisdiction of [the diocese of Ardagh], to the vicar of Clonsallan and his followers. Between ff. 52, 53.

A very small fragment pasted on the back of an inserted slip of vellum, which has some writing upon it.

If Clonsallan is to be identified with Cloonsellan, bar. of Moydow, Co. Longford, the diocese is Ardagh; and if the citation was issued by Archbishop Milo during a vacancy of that see, it may be dated with probability

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immediately after the death of Melaghlin O'Ferrall (1367) or of his successor William MacCormack (1373).

250. Letter to Brother Walter Benge (Prior) of St. John's, Athirde (also written Arthirde). f. 53.

25 April, 1378. States that the priory has been reduced to great poverty by the number of officers of the king quartered upon it (supervenientium). The archbishop therefore permits Benge to serve in the chapel of Senles, having rule both of the chapel and of the souls of the parishioners.

251. Appointment of Master William M<sup>c</sup>Kathmayll (*in title*, M<sup>c</sup>cawyll), 12 June, 1378. rector of Drumglasse, as official of the deanery of Tulaghoge. f. 53.

252. Acts in the chapel of the manor of Dromeskyn, concerning the appoint-10 July, 1378. ment of Master Maurice Sweteman, B.C.L., rector of Kylkerly, the archbishop's special proctor in certain causes, criminal and civil, before Pope Gregory XI. f. 53.

The letter of appointment is quoted in full. The archbishop appears to have been accused of homicide, heresy, adultery, and incest.

The instrument ends: "Presentibus discretis viris magistro Thoma Sylvest' rectore ecclesie de Tolyard<sup>1</sup> et domino Adam Walsh capellano Ossoriensis diocesis testibus ad premissa vocatis specialiter et rogatis."

The certificate of Richard Molys, presbyter of the diocese of Meath and notary, follows.

253. List of dues paid in kind (?).

f. 53'.

The amounts are given in crannocks.

[...]ord vicar of [...] 2 of wheat (frumenti), 2 of barley, 2 of oats; Anglia Grangia, Walter Doudale, 6 of wheat, 7 of barley, 7 of oats; Walter Doudale for Balitarsyn, 3 of wheat, 4 of oats, sworn before Thomas Whyte and Richard Doudale; Balilagan and Whytestoun, Richard Doudale of Anglia Grangia, 4 of wheat, 4 of barley, 4 of oats, sworn before the vicar of Carlyngford and his father; Hychistoun, William Leynagh, 1 of wheat, 2 of oats, sworn before William Walche and Thomas Whyte; Corbaly, Nicholas Hendy, 1 of wheat, 2 of oats, sworn before Thomas Whyte and Henry Brock: Tylacgunsch, William Walche, 1 of wheat, 3 of oats, sworn before Thomas Whyte of Mor and John Langcastel; Tempiltoun, Thomas Whyte of Moretoun, 2 of wheat, 4 of oats, sworn to pay this before John Langcastel and William Walche; Balilugh, Geoffrey Galferd, 4 of wheat, 4 of barley, 5 of oats, sworn before John Clyntoun, apparitor and

<sup>&</sup>lt;sup>1</sup> The word may be read "Colyard." But I cannot find any reference elsewhere to a place of that name. Sylvester seems to have lived in Co. Louth (see no. 253), in which there is a townland of Tullyard close to Termonfeckin, where this instrument was written.

vicar of Carlyngford; Berlesrath and Jonystoun, Nicholas Hendy, 3 of wheat, 3 of barley, 4 of oats, sworn before Thomas Whyte and Henry Brocke; Heycrath, Richard Hobyrgel, 2 of wheat, 1 (of barley?), 4 of oats, sworn before the vicar of Carlyngford and William Walsche; Lucyistoun, Adam Sylvester, of the same villa, 6 of wheat, 18 of oats, sworn before Master Thomas Sylvester and Henry Brocke. Sum, 115 crannocks to be paid, if it please the primate.

254. Statute made in the parish church of St. Mary, Mandeuileston, with 10 September, 1379. the unanimous consent of Master Odo (M<sup>c</sup>dinim, Dean) of Armagh, and the clergy of the diocese, and in conformity with a statute of the king. f.  $53^{\circ}$ .

Enacts that a groat (grossa) of Scottish (Scoticane) money shall be of the value of three pence English. Persons violating the statute shall *ipso facto* incur greater excommunication and interdict.

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<sup>1</sup> Vardanstowne in Petty's map.

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<sup>1</sup> For the identification, cf. *Inquis.*, Meath, Jac. I, no. 21; Car. I, no. 67; C.P.R.I. i. 141, no. 172. **R.I.A. PROC.**, VOL. XXIX., SECT. C. [40] Canterbury, Archbishops of, 16, 17, 20, 46. Cappoge (Ceapp65)-Keppoc, bar. of Ardee, Co. Louth, Vicarage of, 248. Carlingford-Carlynforde-Carlyngford, bar. of Lower Dundalk, Co. Louth, 59, 181. Bailiffs of, 59. Tithes of, 140. Vicar of : see Clinton ; Mowir ; Walsh. Carlow (Ceataplac) - Carthirlagh - Cathirlagh, 22, 28, 32, 33, 36, 37. Letters dated at 22, 32, 37. Carrickbaggot-Karryk, bar. of Ferrard, Co. Louth, 248. Carrickleck-Lack-Leke, par. of Enniskeen, bar. of Morgallion, Co. Meath, 153, 157. Cashel (Carpel)-Cassell, bar. of Middlethird, Co. Tipperary: see Parliament. Castlering-Castelrynge, par. and bar. of Louth, 212.Castletown-Casteltoun, par. Castletown, bar. Morgaliion, Co. Meath, 157. Castletown-Dengyn (Dainzean?),1 bar. of Upper Dundalk, Co. Louth, 248. Castletowncooley-Lucyistoun,2 par. of Carlingford, bar. of Lower Dundalk, Co. Louth, 253. Castrum Ohanloyn-Castrum Ohandeloyn: see Loughgilly. Cathirlagh : see Carlow. Catholicus, brother of Henry, 141. Cauntoun, Sir Gilbert, proctor of the Archbishop of Armagh, 15, 86. Cella Nigra, at Derry, Abbot of, 14, 183. Canons regular of, 183. Prior of, 188. Chaplains, 1. Charlestown-Serlystoun,3 bar. of Ardee, Co. Louth, Chapel of, 248. Christopher, Bishop of Dromore, 61. Cissy, Guidus, pilgrim, 193. Clardoun, William, 167. Clarence, Lionel-Leonellus, Duke of, Earl of Ulster, Lord of Connaught, son and lieutenant of King Edward III, 15, 18, 20, 23, 27, 110, 112, 142, 145, 146, 232. Constable of : see White. Treasurer of : see Karleil. Clerke, John, Rector of Clonmore, 174. Clinton-Clynton-Clyntoun, John de, Lord of Drumcashel, proctor in Parliament, seneschal of Armagh, 35, 40, 113, 114, 125. Clinton, John, apparitor, vicar of Carlingford, 21, 253.

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- <sup>2</sup> Inquis.. Louth, Jac. I, no. 7: 'Luceton, alias Castleton in Couley.'
- <sup>3</sup> Inquis., Car. I, no. 19: 'Charleston, alias Searleston.'

<sup>&</sup>lt;sup>1</sup> Identification uncertain.

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<sup>1</sup> Corbalis in Petty's map.

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<sup>2</sup> Identification doubtful.

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<sup>1</sup> Called Ballihich by Petty.

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- <sup>2</sup> A separate townl. in Petty's map.

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<sup>1</sup> Separate townl. in Petty's map. Inquis. Meath, Jac. I., no. 21.

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<sup>2</sup> Petty calls it '2 Rathes.' Little Rath is mentioned in <sup>3</sup> See M. A. Costello *De Annatis Hibernia*, 1909, p. 232.

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<sup>1</sup> Perhaps we should read Bar(11):s[...], i.e. Barunistoun = Barronstown (q.v.).

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<sup>1</sup> Cf. C.P.R.I. i. 141, no. 172.

<sup>2</sup> Inquis., Louth, Jac. 1, no. 3: "The towne and lands of Muchgrange, called the English grange."

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<sup>1</sup> Identification doubtful.

<sup>2</sup> Identifications doubtful. But both Berlesrath and Heycrath (= High Rath?) seem to have been near Johnstown, q.v.

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<sup>1</sup> C.P.R.I. i. 81, no. 20.

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<sup>1</sup> Kilnenisky in Petty's map?

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## IX.

## REPORT ON THE EXPLORATION OF BRONZE-AGE CARNS ON CARROWKEEL MOUNTAIN, CO. SLIGO.

#### ΒY

## R. A. S. MACALISTER, E. C. R. ARMSTRONG, AND R. LL. PRAEGER.

### PLATES X,-XXV.

#### [Read November 30, 1911. Published JANUARY 25, 1912.]

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#### 1. INTRODUCTION.

IMMEDIATELY to the north of the anticline forming the Curlew Mountains, which rise on the border of the counties of Roscommon and Sligo, stands the hill of Carrowkeel (*Ceathramhadh Caol*, "the narrow quarter"). It looks down on Lough Arrow, which lies at the western base, while the well-known hill of Keshcorran (1185 feet) rises a couple of miles to the north-west (O.S. one-inch map, sheet 66; six-inch Sligo sheet 40). Carrowkeel is an extensive flattopped hill, with a maximum elevation of 1029 feet. The area above 500 feet is approximately circular in plan, and  $2\frac{1}{2}$  miles in diameter. Inside this area the ground generally rises steeply to a height of 700 to 1000 feet, and the flat heather-clad summit which ensues slopes gently from north to south. The hill is formed, like its neighbour, Keshcorran, of the Upper Limestone of the Carboniferous formation, resting almost horizontally, and the slight southward slope represents the dip of the beds. The continuity of the flat top of

<sup>&</sup>lt;sup>1</sup> Section 5 has been written by Prof. Alexander Macalister, of Cambridge, who accompanied the party on their first visit to the site, and Section 6 is the joint work of the three authors, whose several shares in the earlier sections are denoted in the above table by their initials. It should, however, be said that every detail has been discussed as thoroughly as possible, both on the spot and subsequently, and that the contribution of each author has been read and criticised by both his colleagues. All three collaborators, therefore, may accept joint responsibility for every statement and deduction made throughout the report.

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the hill is broken by a series of remarkable cliff-walled rifts which cut across it from N.N.W. to S.S.E. These rifts are about 100 to 300 yards across, and 100 to 200 feet in depth, and they produce a singular and picturesque effect (Plate XI, figs. 1, 2). They appear to be the result of weathering along a series of strong vertical joints; and the presence of the same series of joints in the surrounding country may be seen in the parallel ridges and hollows of the country to the northward, and the consequent direction of streams and roads; and also in the prevailing directions of the shores of the island-studded Lough Arrow.

The country surrounding Carrowkeel is generally fertile, and no doubt supported a large population since early times. These people have left abundant monuments of their occupation, and carns are unusually numerous in the district, ranging in size from the gigantic monument which crowns the summit of Knocknarea, 16 miles to the north-west of Carrowkeel, to small mounds a few yards in diameter.

The series of carns which rise among the heather on the summit of Carrowkeel, and with which the present report is concerned, have been referred to, but no more, by previous writers. Rev. C. Cosgrave, P.P., alludes to them in the Proceedings of the Kilkenny Archæological Society, vol. iii, p. 58 (1854-5), and Colonel Wood-Martin in "Rude Stone Monuments of Ireland," p. 207 (1888), makes a passing mention of them.

The carns were examined by R. Ll. Praeger in 1896, while he was engaged on botanical survey work; and as several of them appeared to be intact, and as the group promised to repay well the labour of opening them, the present investigation has after some years been undertaken.

While on the drift-covered lowlands such carns are frequently formed of clay, here on the hill-top they are formed entirely of local limestone, which is a splintery rock with much chert irregularly disposed. No doubt as originally built they were constructed of blocks such as a man could lift conveniently. But three to four thousand years' exposure to heat and cold, rain and frost, have shattered the already splintery boulders, so that the carns are now mounds formed to a considerable extent of material like coarse roadmetal, with large blocks between—material difficult to excavate, being too coarse and interlocked for spade work, and too much broken up for convenient pitching by hand.

## Relation of the Carns to the Peat.

At present the greater part of the flat summit of Carrowkeel is densely heather-clad, the heather growing on a layer of peat several feet in thickness. Bog much deeper than this is met with in many places on the hill, especially in the rifts, but not in the proximity of the carns on the cliff-walled ridges.

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There the rock shows through the peat only occasionally, though sink-holes are numerous; one fine open cave-mouth, called Poll na aColum, lies close to one of the groups of carns. Around the edges of the carns, and also where the rock shows through, the peat shrinks back, so to speak, leaving a depression between the heather and the limestone; in other words, much, if not all, of the peat has grown since the carns were built. In some places, indeed, the peat has crept up the side of the carn (as on the north side of Carn G), or has completely overwhelmed it (as is the case with the ruined Carn L). But in any case the late age of the peat as compared with the carns is evident. This fact helps us to account for the abundance of material used in the construction of the carns, and the large choice which was evidently available in the selection of the monoliths used for the chambers. It may be assumed that when the carns were constructed, the summit of the hill was more or less devoid of covering, presenting an appearance similar to that of the bare limestone country of Clare and south-east Galway; and that from this old surface, heavily strewn with blocks of all sizes, now buried under the peat, the carn-builders were able to select materials suitable to their needs. The growth of peat in the vicinity of the carns has now stopped; the vegetation consists characteristically of shaggy heath, with hypnums, &c., rather than sphagnums. In consideration of the general acceptance of the view that the "age of peat" is now in most places at a close, the late date of the growth of the peat on these well-drained ridges is of special interest.

The investigation of the Carrowkeel carns and associated monuments was carried out during three visits in April, June, and October, 1911. On the first occasion we had the advantage of the assistance of Professor Alexander Macalister, M.D., of Cambridge, which was especially opportune in view of the large quantity of human remains that we found. His report on the human remains obtained during all three visits appears as a section of the present paper.

The greater number of the carns are situated on the land of Mr. R. S. S. Gardiner, J.P., and our best thanks are due to him, not only for granting permission to excavate, but for rendering valuable assistance in many different ways. We desire also to thank the Misses ffolliott, of Hollybrook House, and Mr. Richard Gorman, for permission to open carns situated upon their land. Mr. W. A. Green, of Belfast, very kindly came down with us on our second visit, and many of his excellent photographs are used for illustrating this paper. Portion of the expense of the work was borne by the Royal Irish Academy, whose generous assistance we would here also gratefully acknowledge. Our thanks are also due to the Director of the National Museum for assistance in the matter of transport and other facilities.

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#### 2. NARRATIVE OF THE INVESTIGATIONS.

We assembled at Tower Hill House on the afternoon of April 13th. Professor Alexander Macalister and R. A. S. Macalister had gone down a few days before that, and had surveyed some fifty of the ring-forts, of which a remarkable number occurs in the district. On the first afternoon we walked over the hill, examined the different carns, and decided upon our plan of operations.

We began work on the morning of April 14th, with two labourers, beginning with the nearest carn (Carn G). Like most of the others, it is a conical mound of angular limestone blocks, shattered by weather into material resembling road-metal on the outside ; but inside the blocks were intact, many of them being as large as a man could lift. Some indications of an entrance were found about half-way up the slope on the west side, and an hour's work here revealed a deep fissure, caused by the upright slab which blocked the doorway having fallen a little outwards. On removing a cover-stone immediately adjoining-a block measuring about 2 feet 6 inches long by 12 inches broad by 9 inches deep-we were able to enter. To our delight, the chamber proved to be not a simple cist, but a large cruciform structure formed of tall slabs, high enough to stand upright in, and consisting of an entrance passage, a central chamber, and three side chambers-resembling in general structure the type of monument which in the British Islands was not known previously to exist except in the County of Meath. The chamber, which is described later, proved intact, and evidently had never been opened since the last sepulture in Bronze-age times. The floor was quite clean, save for a few stones apparently left there by chance. A careful examination of every corner of the passage and chamber was made before any of the bones or stones were removed. Then the materials-burnt bones, earth, and stonesfrom the three side chambers were brought out into the open air, sifted, and carefully examined. By the time the work was finished the light was fading. Meanwhile, two of us, with the two men, had begun work on the promising carn higher up the hill, marked Carn K. No indication of the probable position of the doorway could be detected, so, reasoning from analogy, an extensive excavation was made half way up the western slope, by pitching out the ragged lumps of limestone. This proved fruitless, but an attempt on the northern side was more successful, and three hours after commencing work we had repeated the experience of Carn G, and had effected an entrance immediately behind and above the large upright slab which had closed the passage, and which had sagged outwards. The chamber of this carn proved

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to be similar to that of Carn G, but larger, having a height of no less than 12 feet. But though no actual displacement had taken place, its condition was not satisfactory, the heavy lintels over all three side chambers being cracked across. The approach of darkness now compelled a cessation of work.

On the morning of the 15th, while Professor A. Macalister and Armstrong commenced the transfer and examination of the material from Carn K. R. A. S. Macalister and Praeger were engaged on the plans and sections of Carn G. Our men were at first turned on the excavations of what looked like a dilapidated carn a little to the east of Carn H, but it proved to be a natural mound of limestone blocks. Accordingly, they were set to clear out Carn H from the entrance, which, unlike all the others, was open. A large slab blocking the lower part of the mouth had to be broken up and removed, as also the first roof-stone. The passage was full of small stones, and when these were cleared out we were stopped by a fall some 12 feet in, which effectually barred further progress. However, this carn had already given promise of good results, for when the loose stones in the passage were cleared out, indications of a rough floor of flat stones were seen, below which were obtained a skull and a large number of human bones, many of them unburned, unlike those from Carns G and K. There was nothing for it but to work down from the top of the carn and so uncover the passage and chamber-a laborious process, involving the removal of many tons of loose limestone, most of which had to be pitched out by hand. Daylight was fading by the time that the line of cover stones was cleared ready for raising.

On Monday, 17th, we again divided our forces. Professor A. Macalister and Armstrong continued and concluded the transfer and examination of the large quantity of bones, earth, and stones from Carn K—a task occupying the greater part of the day. The extreme inconvenience of the narrow entrance-passage made this work more laborious than might be expected. The rest of the party were variously engaged in examining and mapping some of the minor monuments, and completing the plans and elevations of the larger chambers.

Next morning R. A. S. Macalister and the workmen finished the opening of Carn H (which proved to contain a square cist at the end of a curved passage), and Praeger did surveying work. In the afternoon the material from the passage and chamber of H was removed and examined—a difficult task on account of the extreme narrowness of the passage, and one which engaged the whole party. An essay was made at the very fine Carn F on map, but to our great disappointment it became apparent that some structural fault had caused a collapse of the roof and possibly also of the walls of the chamber. The remainder of the day was devoted to making plans and elevations of Carn K, and in mapping various outlying monuments. The flagstones forming the floor of Carns G and K were raised, but nothing was found underneath.

The 19th was ushered in by heavy rain, but it cleared partially, and we were at work on the mountain-top by 11.30. Some further surveying was done, and the examination of the material from Carn H was finished. The men were set at clearing out the south end of the interesting long Carn E. In the afternoon the plans and elevations of Carn K were completed by R. A. S. Macalister and Praeger. The south end of Carn E proving barren, the half-exposed cists at its northern end were partially cleared out. Then, in heavy wind and rain, a cut was made across the middle of this monument, again without result, and work had to be abandoned at 6 p.m.

On the 20th, our last day, work was begun early on the lower of the two carns O and P, situated on the eastern spur of the mountain, on the Misses ffolliott's property. On our way up to these structures the remarkable village site described below was discovered. There was no indication of an opening in either carn. We had to work nearly all round Carn O, before we unearthed a cover-stone, and discovered a pentagonal chamber containing a complete urn and some bones; it was covered by a single slab, and had a small antechamber. Carn P, situated on the spur overlooking Carn O, was then attacked. It occupied us almost the whole afternoon, and the entire upper part of it was removed without anything being discovered; we continued work till it became clear that no chamber was present. The weather, especially in the latter part of the day, was miserably cold and wet, and added considerably to the difficulty of the work.

### Second Visit.

We resumed work on June 20th—the party consisting of R.A.S. Macalister, E. C. R. Armstrong, W. A. Green, and R. Ll. Praeger. On that afternoon further excavations were made at Carn E without result; subsequently we divided, and while Macalister and Green photographed at Carns G, H, and K by flashlight and daylight, Armstrong superintended a new attack on the large ruined Carn F, and Praeger surveyed the southern portions of Carrowkeel, traversing some miles of rough ground, and finding one small additional carn, lettered A. The position of the great cap-stone of Carn F, impending threateningly over the excavations, compelled a cessation of work at this carn after a few hours.

The morning of the 21st saw us start work on Carn B (Mr. Gorman's), a very fine carn, magnificently situated on a cliff-walled spur (Plate XI,

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fig. 2). During the whole of that day, and half of the next, we toiled in steady rain. Commencing on the north side, about one-third way up the slope, we cut a trench, which eventually ran completely round the carn, but without finding a doorway. This work revealed two small secondary interments, and also a remarkable semi-circular wall, which details are described elsewhere. In the end we were beginning to cut right down into the carn from the top—a serious undertaking—when almost by chance we discovered the doorway, situated unusually high up on the north side, and well above the top of our trench.

The remainder of the 22nd was devoted to removing and examining the bones, etc., from the chamber, and also to an examination of the small Carn  $A_{,}$  discovered on the previous day; but this we decided was not worth the labour of opening, as it appeared too small to contain a chamber.

Friday, June 23rd, was occupied in making a plane-table survey of the old village site discovered on the plateau below Carns O and P; and on account of the roughness of the ground, the number of the hut-sites, and the inclemency of the weather, this work occupied the whole day.

On the morning of Saturday, 24th, Macalister and Praeger checked measurements and photographed, while Armstrong was engaged in packing the bones and other objects for transport; and in the afternoon the party returned to Dublin.

## Third Visit.

We again assembled at Tower Hill House on the afternoon of October 10th, and next morning started with four men at the group of ruined cists at the north end of Carn E. By the afternoon we had cleared out two almost uninjured side-chambers, which still contained burned bones and some other remains, and had laid bare the whole series of cists. Attention was then directed to the great Carn F, of which, as already mentioned, it was evident that the chamber-roof had collapsed; but the indications of a structure of noble proportions were so pronounced that we had determined to attempt to remove the many tons of material—great slabs mixed with rubble—that had poured into the chamber. The first operation, the breaking up and removal of a huge slab, measuring 9 feet by 6 feet, which impended over the rim of the excavation, was successfully accomplished.

Next morning work was resumed, and the whole day was spent in clearing out the large antechamber inside the doorway, which was by degrees uncovered, and in measuring and photographing it.

The morning of the third day saw us at work clearing the inner chamber, which had become visible behind the antechamber. Some very large blocks had to be removed, and it was decided to drop them into the antechamber, now thoroughly explored, as the labour of removing them entirely from the excavations would have been extremely heavy. Eventually, all the remaining material from the inner chamber was piled into the antechamber, filling it to a height of 10 feet, and by evening the inner chamber, which proved of very exceptional interest, as will be seen later, stood completely clear of material. Burned bones, etc., which were found, were as usual carefully removed for examination.

On the morning of the 14th October, further human remains were removed and examined, and the inner chamber was measured, sketched, and photographed; and about mid-day our party broke up.

#### 3. DESCRIPTION OF THE CARNS, &c.

The structures described in this report are situated on an area comprising part of seven townlands, called respectively *Tulach* ("mound"), *Trian Scrábach* ("rugged third"), *Ceathramhadh Caol* ("narrow quarter"), *Mullach Fearna* ("summit of the alder," also, and I suspect more correctly, called *Mullach Eórna*, "summit of barley"), *Dún na bhFioradh* ("fortress of the ridges"), and the East and West *Carraig na hEórna* ("rock of the barley"). The Anglicized spelling of these simple words is of the usual ugly and cumbrous appearance: both forms will be found marked on the map, Plate X.

This map has been designed and drawn in a form meant to show as clearly as possible, to a reader unfamiliar with the ground, its remarkable character. The summits are left white, the long, straight valleys being deeply shaded. The precipitous walls of rock which line the valleys for the greater part of their length are marked by specially shaded lines which are easily distinguished.

Each of the ridges and the valleys between them have names. The name of the furthest ridge, on which Carn A stands, we did not obtain, nor yet that of the valley which runs to the east of it. The next is called Howley's Rocks, from a former owner, though it is now being named Gorman's Rocks, after its present proprietor. This phenomenon of the change of a geographical name with a change of owner is known to occur elsewhere in Ireland. The wide valley to the east of Gorman's Rocks is called "Shroich," which is a name we cannot explain with any certainty. At the lower end of this valley is a tarn in the bog, known as "Lough Availe." Possibly this is meant for *Loch Aidhbhéil*, the "vast" or "terrible "loch—a name wholly unsuitable for this quiet little sheet of water, notwithstanding a "water-horse" traditionally

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said to haunt its depths.<sup>1</sup> Round this lake the valley assumes the name of "Shroich Availe." A boulder in the bottom of the valley, quite natural, is called "the old gate" by the local people. The next ridge, on which stands the important carns E and F, is still called Carn Mór (carn being here always pronounced corran); but in English, which is usurping the place of Irish in this place-name, it is called "Big Carns," in the plural. The next ridge, on which the smaller carns stand, is always called "Little Carns," the Irish name being lost. Between these two ridges is a long, narrow, and cliff-walled valley, called "Keelcoon," that is Caol Cuan, "the narrow inlet"-a very suitable name. The low-lying boggy tract at the mouth of this valley is called Loch a' Bháithte, pronounced " Lough Awatia" (the last word rhyming exactly with "caught ye"). It is now dry, except after rains, when a little water stands in the hollows. Professor MacNeill has suggested, in conversation, that the name (" Lake of the Drowning ") might indicate that the deathpenalty by drowning had been inflicted here. There are several springs hereabout.

On the ridge of "Little Carns" is a huge and picturesque swallow-hole, which we explored without any result of special interest, known as *Poll na gColum*, "the hole of the pigeons"; though, strange to say, an idea seems to have got abroad in the district that the name means "hole of the foxes." It must be admitted that the latter is a more suitable name. A broad shelf on the east side of this ridge, above one precipice and below another, is called *Bothar na Beinne*, "the way of the hill-top"—this is possibly a tradition of a road followed by the ancient inhabitants. It is not a natural way to follow, but that is not a conclusive objection: there might have been a ritual significance in the road. The precipice below this "road" is called *Caiseal*, "Castle."

The next valley is called "Upper *Clár*," a curious mixture of English and Irish: it means "Upper table," *i.e.* "Upper flat land." In the precipice that bounds this valley on the western side, a short distance north of the mearing between Ceathramhadh Caol and Mullach Fearna townlands, is a curious rift in the rock, which gives easy access to the top of the precipice. It is about fifty-six feet in length, and perhaps on an average five feet wide: the cliff bounds it on the west, and a great isolated wall of rock forms its eastern wall. It is locally called *Boithin an tSagairt*, "the priest's hut," and probably was used during the penal times as a hiding-place for some priest—a purpose which it would well serve, being out of the line of traffic, and quite invisible to anyone not acquainted with 'the district. The Irish name is being lost,

<sup>&</sup>lt;sup>1</sup> More likely, however, it may be simply Loch an Bhéil, the lake of the (valley) mouth, as Mr. O'Keeffe has suggested to us.

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however, and an incorrect English name, "the priest's grave," substituted : to explain which a story about Cromwell shooting a priest and burying him here has evolved itself. A small pile of stones, lying apparently directly on the rock, in a recess just inside the lower entrance to the passage and on the eastern side, is pointed out as the "grave."

The easternmost spur consists of two parts. the towering crest of Dún na bhFioradh and the flat table-land on which stands the settlement presently to be described, called *Corr Logach*, "the hollowy hill," or *Clar Corrach*, "the marshy (or level) table-land."

In the valleys there is nothing of archaeological interest to be seen. On the ridges are the following :---

I. Fourteen burial carns.

II. Two ruined dolmens, or dolmen-like structures.

III. A group of circular enclosures, apparently the remains of an ancient village.

It may here be stated that of the carns only *three* (C, G, and H) are recorded as such on the Ordnance Map, and *none* of the other structures; and that of the twenty-three place-names<sup>1</sup> in the square mile of country mapped in Plate X, only nine (the seven townland names and two others, all in phonetic spelling) are recorded. Nothing could more clearly indicate the absolute necessity, for scientific or historical purposes, of a thorough re-survey, under expert superintendence, of the archaeology and the fast-corrupting place-names of the country.

We now proceed to a description of the structures.

#### 1.-The Carns,

The typical carns are conical mounds of stone, erected on a base more or less circular. They are composed entirely of the limestone native to the spot, save for occasional fragments of calcite, or of the erratic blocks of sandstone that are strewn about in the neighbourhood. The only earth in the carns is a little peat which has evidently been blown over them as dust, and then been washed by rain into the interstices between the stones. Except in the case of two or three of the carns, very little vegetation has found root upon them.

The internal structure, as will be seen from the detailed description that follows, is not uniform. In the concluding summary the various types are enumerated. As at Brugh na Bóinne,<sup>2</sup> the chambers are never centred exactly

<sup>&</sup>lt;sup>1</sup> Counting alternative names for one place as one only.

<sup>&</sup>lt;sup>2</sup> It is devoutly to be wished that the pointless modern label of this structure ("New Grange") should be abandoned in favour of its ancient Irish name.

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in the heart of the mound, but are rather to one side. Once for all we may here state that although we searched for sculptured ornament, such as is to be seen at Brugh na Bóinne, with the most scrupulous care, not a single decorated stone came to light anywhere, either outside or inside the carns.

The carns are denoted by letters in order from A to P (excluding the letters I, J, which are inconveniently apt to be confused with numerals): they are taken from north to south on each of the ridges in turn, beginning with the most westerly.

## Tulach (" Tully ") Townland.

A.—A small grass-grown carn, about 6 to 8 feet high, and 40 feet in diameter. It appears to be a cenotaph, there being no room for any internal structure. The greater part of its bulk consists of two natural knobs or bosses of rock which have been utilized in its construction. There are traces of a kerb surrounding the base. There is an Ordnance Survey beacon erected on the carn, the height of which is given as 821 feet, but the carn itself is not recorded. It is possible that this structure, which, though small, is prominent, owing to its commanding position, gives its name to the townland.

### Trian Scrábach ("Treanscrabbagh") Townland.

B.—This fine carn stands near the northern extremity of the bold, cliffwalled spur overlooking, on its eastern side, Lough Availe. The commanding situation of the carn is well shown in Plate XI, fig 2. The carn itself is the largest and best-formed of the entire series, with the exception of F. Its appearance, after the opening of the entrance, is shown in Plate XI, fig. 3. The entrance faces north, and was completely concealed : no trace or indication was visible before the excavation began, and in search for it we cut a trench completely round the carn. Even then it was only discovered afterwards almost by chance.

The structure measures 21 feet in height (15 feet if measured from the south side, as there the surface of the ground rises), and the diameter of the base is about 74 feet. The top is slightly flattened, and an Ordnance Survey beacon was erected upon it, the height of which is given as 936 feet. It is passing strange that the carn itself, though an object so conspicuous and striking, is not recorded on the map as an ancient monument.

The entrance, which is shown in Plate XI, fig. 4, is unusually high up on the side of the mound. It gives access to the chamber by a low passage, to which additional head-room is given by a drop in the floor, about a couple of feet in from the threshold. The chamber itself expands inward like a wedge

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in breadth, and to a lesser degree in height: the total length, measured from the back wall to the inner face of the sill at the entrance, is 9 feet 8 inches; the maximum height of the chamber is 5 feet 3 inches. The construction is very rough, and altogether unworthy of the fine external appearance of the carn: the massive boulders of which the walls and roof of the chamber are made are less carefully selected than in some other carns of the series.

At the left-hand side of the chamber, at its inner end, is erected a cist, open at the side, in shape almost like a rude altar. This will be seen in the plans and sections of the structure (Plate XVII). It measures 3 feet 6 inches long, 2 feet broad, and 2 feet 2 inches high. Very probably it was intended originally as the burial-place proper, but as the interments increased in number it was found impossible to restrict them to this part of the structure : in point of fact, they were found actually to cover the floor of the whole chamber.

Round the outside of the carn there seems to have been a kerb of boulders a little larger than those of which the heap of stones itself is composed. From the disposition of the kerb-stones that remain (which will be understood from the plan of the carn on Plate XVII) we may perhaps infer that the present diameter is rather wider than the original intention of the builders. Round the south-west side, for nearly half the circumference of the carn, there runs a vertical joint in the stone-heap, with a truly formed face about 2 feet to 2 feet 6 inches in height. The position of this face is marked on the plan by heavier lines. It seems as though this had been erected as a retaining wall, and the stones piled behind it, a covering shell by which it was concealed being added later.

On the south-east side, close to the end of this masonry-face, two subsidiary cists were found, just under the surface of the mound. There can be little doubt that these were secondary interments, perhaps long subsequent to the original erection of the carn. They were small boxes formed of stone slabs about 3 inches thick. The northern cist measured 1 foot 7 inches by 8 inches by 1 foot 4 inches high. The southern cist was smaller, and was much dilapidated. They contained nothing but a handful of burnt bone-dust. These cists, and the masonry face above described, were found in cutting the trench in search of the entrance.

## Ceathramhadh Caol (" Carrowkeel") Townland.

C.—This structure is much ruined, having evidently been despoiled of stones to provide material for the field-fence that runs alongside of it. The chamber has apparently been wilfully destroyed, and the large stones of

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which it was composed are thrown about in confusion. It appears, however, to have been of the cruciform type, of which G and K, described below, are the most conspicuous examples now surviving in the group. But it is so injured that it is impossible to be certain about its original form. The Ordnance map, which omits nearly all the more conspicuous carns of the series, has recorded this comparatively insignificant example.

This carn has the distinction of being, so far as we could learn, the only structure of the group which has a distinctive name. This is English, "The Leprechaun's house." The name seems to indicate that it stood open, and fairly complete, so suggesting the idea of a "house," till it was wrecked by the fence-builders.

D.—This carn is about 50 feet to the south of C. It is ruined to its foundations. There are traces of a kerb of large stones, standing on end, and of a passage in the south-east face, running in a north-westerly direction into the carn, and ending in a cist. The carn, accordingly, seems to have affinities with H; but, being so ruined, satisfactory measurements cannot be taken, nor can it be planned with certainty.

E.-This remarkable structure is quite different from all the other carns of the series, though the general appearance of the building, and the scanty remains found within it, forbid our referring it definitely to a different stratum of civilisation, as we were at first inclined to do. It is a long, low mound (see Plate XII, fig. 1), 120 feet in length, and 35 feet in maximum breadth. The height is about 8 feet in the middle, but it decreases at each end. The long axis lies about N.N.W. and S.S.E. (the compass-bearing is 160°). Traces of a kerb exist at the sides, as will appear from the plan (Plate XVII). At the S.S.E. end is an arrangement of large slabs on end, the disposition of which can scarcely be described in words. A glance at the plan will, however, convey to the reader a good idea of the arrangement. The large slab at the inner end is 12 feet long, 9 inches thick, and stands about 3 feet high. It is difficult to explain this structure: it is not like a ruined cist or chamber, but looks as though it had been intended to represent a large porch. The horned long barrows, of which that at Uley is the typical example, are also distinctly recalled by this curious part of the carn. In any case, the "porch," if such it be, is blind, and the greater part of the carn consists simply of piled stones, as we proved by cutting several trenches across the mound. Just behind the porch, on the eastern slope of the carn, is a flagstone, 4 feet by 5 feet 6 inches, with some other stones underneath it, which has the appearance of being the cover-slab of a cist. This we raised, but found no construction or deposit below. Only at the N.N.W. end there is a small group of cists. This had long been open, and had fallen into ruin Plate XII, fig. 2, represents it in the state in which we found it.

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At first sight this looked a hopeless complication of débris, promising neither instructive remains nor even a satisfactory plan. But when we proceeded to clear out the floor, and then re-erected a couple of the side stones of the passage which had fallen forward, we had the satisfaction of recovering completely the original design, except at the entrance, where stones have apparently been removed (Plate XII, fig. 3). A bed of peat, several feet thick, covered some parts of the existing entrance. This had evidently accumulated after the structure had fallen into the condition of ruin in which we found it.

There may have here been a porch-like structure of large slabs or stones, resembling that at the other end. The stones that seem to suggest this are represented on the enlarged plan on Plate XVII. The chamber proper (which has lost all its cover-slabs) is a narrow passage, just under 12 feet long, and of irregular width, averaging about 3 feet. It is bounded by slabs of lime-stone set on edge, four on one side, six (one of small size) on the other. The floor is divided by sill-stones, 6 to 8 inches high, into four compartments of unequal size, all of which contained the débris of interments. The side-slabs are between 4 and 5 feet in height.

On each side, at the second floor-compartment, is a small cist, formed, like the main passage, of slabs on end—though smaller than the slabs in the passage—and each covered with a large more or less rectangular slab, which still remains intact. These cists also contained bone débris, lying in each case on a large floor-slab. They are pentagonal in shape, the dimensions every way being about 3 feet.

The plan of a very similar structure, at Highwood, to the north of Lough Arrow, will be found in Wood-Martin's "Rude Stone Monuments of Ireland," page 181.

F.—This structure was in some respects the most important of the entire series. As the photograph 'Plate XII, fig. 4) shows, it is of large size, and beautifully regular. It is indicated only by an indefinite symbol, not as an ancient monument, on the Ordnance map, though it is perhaps the most conspicuous of the whole series. It is 87 feet in diameter, and about 25 feet in height. The structure is built of stones rather smaller than are the other carns. The top is slightly hollowed, possibly as a result of the collapse of the chamber. A plan and section of the carn will be seen in Plate XIX.

The entrance, as in the others, is toward the north. It is of a much more monumental character than the small creep-holes which give admission to the other carns, being 4 feet 7 inches high, and lined by massive jamb-stones supporting lintels, one of which is 7 feet in length. Plate XIII, fig. 1, shows this doorway.

The chamber into which this doorway gives admittance is quite different

in plan from any of the chambers in the other carns. It is in the form of a passage, 12 feet long and at the entrance 2 feet broad, but widening inwards, terminating in a square recess, marked off by a sill-stone, 7 inches high, and having two similar recesses, with splayed sides, on either hand.

The plan of the chamber was marked all round by massive slabs of limestone, roughly brought to a square shape, and set on edge. These slabs were carefully selected, being all from one quarry-bed. Above these were laid either long stones or horizontal slabs. In the upper courses large slabs only were used, which gradually oversailed till they approximated close enough to bear cover-slabs roofing the whole chamber. These oversailing slabs were not horizontal. Packing of small stones was inserted over each, the face of the packing being flush with the edge of the slab below. This packing acted as a wedge tilting the slab backwards, so that rain-water that percolated between the small stones of the carn was shed off by the slabs and prevented from penetrating into the chamber. See the Plan and Sections, Plate XVIII.

The labour of erecting this chamber must have been enormous. The much simpler work of excavating it and removing the broken stones that had fallen into it was no light task; the manipulation of the gigantic slabs of which the building was formed could not have been carried out at all except by a community much more highly organized than we might have expected to find in the middle of the Bronze Age. The constructional skill displayed is beyond all praise. The use of squinch-stones (slabs running diagonally in the corners), by which the length of the space to be spanned is reduced, is specially noteworthy. Similar squinches occur in the roof of Brugh na Bóinne, but on a The top-stone of the chamber was a great massive slab, 9 feet smaller scale. by 6 feet 6 inches by 1 foot thick-weighing, roughly speaking, about four tons. This stone is seen in Plate XIII, fig. 1, marked by a walking-stick lying upon it. The doorway of the carn is there shown in the foreground. In order to get this stone out of the way, we had no alternative but to break it up. To have attempted to move it would have been a dangerous and expensive undertaking, and probably the doorway underneath would have suffered serious injury.

The architect who carried out the work of constructing this chamber had made one unfortunate miscalculation. A huge slab, 9 feet 3 inches in length, which he had inserted close to the inner end of the western side, had not been equal to supporting the cross-strain put upon it. It had split into two, and, in falling, brought down all the upper part of the roof. An avalanche of small stones from the outer shell of the carn had rushed into and filled up the chamber : on the top of these the cap-stone above described lay misplaced, in the position in which it is shown in the photograph. This was taken after we had cleared out the small stones from the chamber, as much as we could without disturbing the large slab. The accident is most deplorable, as it ruined what it is no exaggeration to call one of the most impressive and interesting ancient structures remaining in Ireland.

The plan and sections on Plate XVIII show without need of further description the design of the structure and the relative sizes of its parts. It will be seen that it can also be fairly described as consisting of two chambers separated by a narrow doorway, with two grave-recesses in the outer and three in the inner. The interments had not been confined to the grave-recesses : bone dust, much trampled, was found in places on the floor. The sill of the grave-recess on the left-hand side, within the entrance, was missing : it is restored in dotted lines on the plan. We suspect that by an oversight it was removed by ourselves in clearing out the débris of large and small stones that filled the chamber.

The perspective view on Plate XIX is designed to illustrate more clearly the elaborate and ingenious construction of this carn. But to prepare a satisfactory view was found extremely difficult. The narrow doorway in the middle of the chamber makes it next to impossible to find a point of view from which enough of the construction can be seen in one *coup d'ail* to be at all informing. Plate XIII, figs. 2-4, shows portions of the building that display the masonry. Fig. 2 is the north-west corner of the western grave-recess in the outer chamber; fig. 3 is the south-east corner of the eastern grave-recess in the inner chamber; fig. 4 shows the central grave-recess,<sup>1</sup> and also the most interesting and suggestive detail of this monument, which it is now time to describe.

This is a standing stone, 5 feet high, with a fairly uniform thickness of  $7\frac{1}{2}$  inches east to west, and 9 inches north to south. It cannot have served any constructional purpose: not only is it too slender, but it seems never to have stood quite upright, so could not have borne any other stone or stones. The roof of the chamber vertically over this stone must have been well-nigh 16 feet above the ground, or 11 feet above the top of the pillar. The stone had been snapped across 15 inches above the ground; in falling, it cracked the sill-stone of the central recess behind it, across which it was found lying. The fractured surfaces, however, are both intact and fit exactly. The broken part, however, will not stand on its base without support: a little Portland

<sup>&</sup>lt;sup>1</sup> The oversailing lintels seen in the sections on Plate XVIII above the lintel shown in this photograph were *in situ* when the excavation began, and appear in Plate XIV, fig. 1. After measuring, we were obliged to remove them, as the top lintel (supported by a wooden prop in the photograph) was loose, and the second was cracked longitudinally, and neither could have stood without the support of the small stones which had filled the chamber completely, and which, of course, we had to clear out. The great slab whose failure caused the collapse of the building is seen on the righthand side of this photograph, under the foot of the wooden prop.

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cement, and probably a metal clamp, would be necessary if haply this interesting building be ever restored, as one likes to hope may some time be the case. The accident, whatever it was, which broke the stone, was not the same as the catastrophe that brought the roof down. For after the stone had fallen, the ashes of a burnt human body were laid on the butt end of the prostrate part. It is possible that the resting-place was chosen on account of some special sanctity attaching to the stone; for after much discussion we can find no satisfactory alternative to regarding it as a religious emblem. This being assumed, the question presents itself whether we may not have here something more than a mere burial-place. May we not have some sort of temple? The grandiose scale of the architecture, the large entrance doorway, the peculiar ground-plan, and, above all, the standing stone, all mark this carn out conspicuously from the rest.

At the foot of the stone, on the eastern side, is lying another, 1 foot broad, 9 inches thick, and 3 feet long. Bone débris in plenty lay under it. A third stone, 2 feet 6 inches long, 6 inches thick,  $9\frac{1}{2}$  inches broad at one end and  $5\frac{1}{2}$  inches broad at the other, lies at the northern end of the south-western grave-recess. The position of both these stones is marked in the plan. There is no evidence that they ever stood upright, but that they had been placed with intention where they were found seems undeniable.

The last point to notice about this important carn is the use of the erratic blocks of silicified sandstone which are frequent in the neighbourhood. Those used in the buildings are shaped rather like cheeses, with convex sides and flattened top and bottom. One such will be seen in the photograph, fig. 3 on Plate XIII—the inner stone of the topmost course in the corner opposite that in which the man is leaning. Here it is merely used as an ordinary buildingstone: but in another place the sandstone is used probably because it was found by experiment that it was capable of bearing a heavier crushing strain than was the limestone. This was on the jambs of the central doorway : on the top of each was a sandstone block-indeed, on the eastern jamb there were two, one on the other like the drums of a column. Evidently at these two points, in the middle of the two long sides, the weight of the massive roof was expected to be concentrated; and it increases our respect for the mind that planned this fine building when we see that he had the discrimination to choose an especially hard stone for just this part of the structure. The same foresight is displayed by the builder of the first of the two dolmenlike structures, described below.

G.—This carn is about the same size as B-21 feet high and 68 feet to 70 feet in diameter at the base. There may be a kerb, but if so it is completely concealed by the turf which has grown up round the margin of

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the heap of stones, to such an extent that the floor of the chamber is some 2 feet below the present average level of the base of the mound. The entrance faces north-west by north (compass bearings 328°). It is a small hole, confined between a lintel and a threshold very close together; but it gives access to a chamber of considerable size, which is by far the best piece of construction in the whole series. A plan and sections of the carn are given in Plate XXII, and of the chamber on Plate XX. Well-selected standing stones of a maximum height of 6 feet support a system of lintels and cross-beams of stone, which, rising by oversailing courses, form a chamber very similar to Brugh na Bóinne both in plan and construction. The roofing-slabs, as in Carn F, slope downwards to the outside. The main chamber is more or less circular, and three small cells, of lesser heights and separated by high sills from the main chamber, give a cruciform shape to the plan of the structure. These cells are the receptacles for the interments. Each is floored with a large flagstone, and a similar flagstone occupies the floor of the central chamber. These flagstones were raised, but nothing was found underneath them. Plate XIV, fig. 2, illustrates the construction of the inside of the chamber: but it is impossible to secure a photograph that does justice to the building, which, though it may seem an exaggeration to say so, is beyond all praise as a veritable work of art. The builders aimed not merely at a building which should remain standing: they evidently took a pride in erecting a neat and symmetrical chamber. In one or two cases we suspected that a single block had been split in two, in order to secure as nearly as possible identical stones for corresponding positions on opposite sides of the chamber. The fourth standing stone on the right hand side of the entrance did not reach the roof, and inserting the hand behind it we found that there was here a sort of shelf or pocket in the wall, which contained the bones of children. Its outline is indicated by dotted lines in the plan. The space was just under the roofing-slab, and measured 2 feet 6 inches parallel to the chamber by 2 feet at right angles to it. The floor of this "shelf" is on a level 4 feet 4 inches above the floor of the main chamber, and the height of the clear space is about 1 foot 9 inches. A similar pocket was also found behind two of the stones in the left-hand recess. In each of the inner corners of the right-hand recess there is a block of stone about 8 inches square and 1 foot 3 inches high, set on end. On the western side of this carn, half buried in the turf, a slab is lying which may possibly have been intended for the construction but left over. It is 1 foot 3 inches thick, 7 feet 3 inches long, 3 feet broad at one end, 5 feet broad at the other.

H.—The entrance of this structure was found open, unlike all the other perfect carns of the series, and had evidently been open for a very consider-

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able period, if indeed it had ever been closed. It was, however, impossible to make use of it as a means of access to the chamber, as a slip of one of the side-stones of the passage had narrowed it too much to admit of a person creeping through. We were accordingly obliged to cut down through the middle of the carn, and to get into the central chamber through the roof. It proved to be merely a square cist, 5 feet long, 3 feet 3 inches broad at the inner end, and 2 feet 10 inches high, approached by a narrow and awkward creep-passage, roughly built, widening just inside the door, though nowhere high enough to permit one to stand upright. The passage (exclusive of the 5-foot length of the cist) is 22 feet 3 inches long; the width ranges from 3 feet 6 inches to 1 foot; the maximum height is 2 feet 10 inches. The accident must have happened while the carn was still in use, as interments were found both inside and outside the spot where the stone had slipped-the latter having presumably been deposited after the blocking of the passage barred the entrance to the central cist. This is the only carn of the series with a double row of kerb-stones surrounding its base. There is a space of 5 to 7 feet between the two rows. The inner kerb is composed of larger stones, which are about sixty in number. The diameter of the carn at the base is about 100 feet, its height about 20 feet. The plan and section of this carn and of the entrance passage and chamber will be found on Plate XXII; Plate XIV, fig. 3, shows the carn (with Carn G in the distance); Plate XIV, fig. 4, shows the entrance. This photograph was taken after we had cut down on the lintels.

K.-In design this fine carn resembles G, but, though rather larger, is, from the point of view both of construction and artistic finish, vastly its inferior. A poor, rotten stone has been used, and all the lintels are in consequence cracked: some of the side-stones have also settled. It is, indeed, rather surprising that the whole chamber has not collapsed. The chamber is much higher in K than in G, though it is in this respect less than the great ruined chamber in F: the maximum height is 12 feet 2 inches. The mound itself is about 20 feet in height and 71 feet in diameter. The total length of the chamber, from the entrance to the back of the central recess, is 22 feet 10 inches: the maximum breadth through the two side recesses is 15 feet The entrance faces almost due north (compass bearings 355°). 9 inches. There is an Ordnance beacon on the carn, the height of which is given as 1,062 feet; but the carn itself is not recorded as an ancient monument. Plans and sections of the carn will be found on Plate XXII, and of the chamber on Plate XXI. Plate XV, fig. 1, is a good view of the carn after the door was opened; Plate XV, fig. 2, shows the interior, looking inwards, and Plate XV fig. 3, shows the entrance passage, looking outwards.

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L.-This carn is much ruined by the depredations of rabbit-hunters. Unlike the other carns, it is almost entirely overgrown with peat. After several examinations we decided that it would not repay investigation.

## CARRAIG NA HEORNA ("CARRICKNAHORNA") TOWNLAND.

M.—A small dilapidated carn ruined to the base, which consists of standing stones about 3 feet high. The diameter is 25 feet: at the north-east face is a passage 10 feet in length, leading to a cist 4 feet square, with two *cellac* at the side and one at the back. It was evidently a cruciform structure like G and K, but of much smaller size.

N.—Is similar to M, and in similar condition. It was about 20 feet in diameter. Three jamb-stones remain on the east side of the entrance, which faced the north. The chamber seems to have been cruciform. It is probable that the stones which originally covered these two carns were removed for building boundary walls.

## DUN NA BHFIORADH ("DOONAVEERAGH") TOWNLAND.

O.—A small carn, about 17 feet high and 58 feet in diameter at base, roughly built of stones rather larger than are used elsewhere in the series. Near the top, on the southern side, was a small pentagonal cist, about 3 feet 6 inches high and 4 feet in maximum length, covered with a single slab of stone. It was entered through an opening 10 inches wide from a manhole, also pentagonal, and covered with two slabs. The floor of the cist was quite irregular and was heaped up with discs of sandstone, bone, and ashes. The height is given on the O. S. map as 890 feet above sea-level. A plan and section of the carn, with an enlarged plan of the cist, are shown on Plate XXII; and Plate XV, fig. 4, shows the top of the manhole and the narrow entrance into the cist.

P.—A beautifully built conical carn, about 12 feet high, and 33 feet in diameter at the base. The Ordnance map gives 138 feet as its height above sea-level. The most careful examination of this carn failed to reveal any cist, chamber, or interment; it is a cenotaph, like Carn A. Four large boulders of rock had been laid on the site chosen for the carn, and the stones were heaped on these.

### II. Dolmens.

1. A short distance south-east of Carn H is a massive block of limestone which, when sound, measured about 5 feet 7 inches by 4 feet by 1 foot 8 inches. It is now split into fragments. It had been placed on four round boulders of sandstone, now partly buried in the peat, which were

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arranged in a lozenge form and, roughly speaking, faced the cardinal points. Three limestone slabs set on edge are added, apparently placed with the intention of forming a cist. The use of sandstone erratics has already been commented upon in describing Carn F: it suggests that the builders appreciated the difference between the two kinds of stone, and recognized the greater strength of the sandstone blocks. Plate XVI, fig. 1, represents this structure, which is, however, an exceptionally difficult subject for the camera, on account of the collapse of the cover-stone, which gives it the indefinite appearance of a shapeless pile of stones.

2. A few paces east of Carn K is a square structure of large limestone slabs. There had originally been a cover, as we learned, which was, however, smashed up by rabbit-hunters. Fragments of this stone are lying about. Doubtless anything the cist may have held was then removed. The chamber measured about 6 feet by 4 feet 6 inches by 2 feet 5 inches high. There is no evidence that this cist was ever covered by a heap of stones. This structure is shown in Plate XVI, fig. 2. The length and breadth of the slabs, beginning with the large stone in the foreground and working round in order to the smallest stone, are respectively 7 feet by 1 foot 2 inches; 5 feet 2 inches by 1 foot 3 inches; 6 feet 5 inches by 1 foot 2 inches; 3 feet 3 inches by 6 inches.

On the eastern edge of the ridge called Carn Mór, and about midway between the two groups of Carns E, F and M, N, is a standing stone 7 feet 6 inches high, 5 feet wide at the base, but tapering to a point, and 2 feet thick. We came to the conclusion that it belongs to geology rather than to archaeology, showing no sign of having been erected artificially. Of course it may have been accepted by the carn-builders and used by them for whatever purposes standing stones were set up. There are no marks of any kind on the stone.

## III. Remains of a Settlement.

On the bare rocky platform to the north of the towering mass of Dún na bhFioradh, occupying almost the whole area between that hill and the Mullach Fearna mearing, is to be seen a very remarkable group of circular structures. The plan given (Plate XXIII) shows their disposition: the numeral with each represents the approximate diameter (ranging from 20 to 42 feet), as ascertained by pacing. The plan itself was made with the aid of a plane-table. Where enough of the structures remain to show details, they are seen to consist of two rings of upright slabs with small stone filling between, the walls thus made being about 3 feet thick. They are ruined so completely that it is impossible to say where the doorways may have been. The forty-seven recorded on the plan are all of which we could be sure: some other rude groups of stone here and there were possibly the remains of others, but it was impossible to be certain about this. There is no trace of internal divisions. These enclosures were probably protecting walls within which were erected dwellings of some temporary nature—tents or huts. It is not at all improbable that they were the dwelling-places of the carn-builders: if so, those interesting structures may fairly claim to be one of the oldest village sites in northern Europe.

On account of the extremely rocky nature of the space on which these structures stand, and the insignificant height and rough construction of the structures themselves, it proved impossible to obtain a photograph that shows any of them satisfactorily: the eye is unable to distinguish the circle of stones from the rocky background in which it is set. Several attempts were made, all, however, unsuccessful. An idea of the general appearance of the site is given by the two photographs (Plate XVI, figs. 3, 4). The first of these is taken across Upper Clár, from above Boithín an tSagairt, overlooking Dún na bhFioradh with its two carns on the summit; to the left of the ridge is the rock-surface, on which are the circles. The second view is taken from Dún na bhFioradh itself; and though not a very successful photograph, the circles can be clearly seen in it scattered among the rocks.

## 4. ACCOUNT OF THE OBJECTS DISCOVERED.

Carn B.—In order to discover an entrance to this carn a trench was cut all round it, and in the course of cutting this a small cist containing burnt bones was found, at compass bearing from the middle of the carn  $120^{\circ}$ ; a few feet further to the north a second similar cist was discovered. These two cists evidently represent secondary interments. The chamber in the carn itself was found to have a small cist on the left-hand side. Both cist and chamber contained burnt human bones. Three fragments of pottery were discovered—one roughly ornamented piece in the cist (Plate XXV, fig. 4), and two much detrited and hardly recognizable fragments in the chamber.

Carn E.—Both the side cists of this curiously shaped monument contained a few fragments of bones. The central chamber had been uncovered and exposed for a long period, and the third and fourth bays were empty. The porch contained a few fragments of bones; it was much dilapidated and was covered with about 18 inches of peat, which had grown since the destruction of the carn (see plan).

The first and second bays contained a quantity of bones in a very fragmentary state. Among these were found several small flat slabs of stone, which had apparently been used as trays in a manner similar to those to be noted in Carn G. In the first bay were found a minute fragment of pottery, the upper portions of two pins of bone with well-cut heads, and a boar's tusk (Plate XXIV, figs. 16, 23, and 25).

The discovery of the bone pins and the fragment of pottery in this monument is important, as establishing the fact that some at least of the interments are of the same date as those in the other carns. The shape of the structure would lead one to believe it to be of an earlier date, as monuments of somewhat similar shape in Scotland have been shown to belong to the Neolithic period. (See Dr. T. H. Bryce's account of the Cairns of Arran in the Proceedings of the Society of Antiquaries of Scotland, 3rd Ser., xii (1901-2), p. 74).

Carn F.-The collapse of this splendid structure cannot be too much deplored. The removal of the stones which had fallen into the chamber was carried out with the utmost care, but the contents must have been greatly damaged by the weight of the stones falling on them. The only archaeological remains obtained were found in the further left, end, and right recesses, and in the central chamber (see Plates XVIII, XIX). All of these contained burnt bone débris. This material was carefully sifted, and two broken beads and one small perfect bead were recovered. They were found in the right recess (Plate XXIV, fig. 27). These beads are of exactly the same type as those found in Carns G and K. In the central chamber two vertebrae of Bos longifrons were discovered; one had been placed just outside the sill-stone on the left recess near the entrance, and the other close to the opposite sill-stone of the right recess, but near the end recess, so that their position was almost a diagonal one. Their position is marked (plan, Plate XVIII) by the letter A. A number of pieces of quartz, split by the action of fire, were found among the remains in this carn. Eight water-worn, flattish lumps of limestone were also found. They are all illustrated in fig. 1, p. 334, and measure roughly, taking them from left to right in the figure,  $11\frac{1}{2}$  inches by  $5\frac{1}{4}$  inches; 14 inches by 8 inches;  $11\frac{1}{4}$  inches by 6 inches;  $11\frac{1}{2}$  inches by  $5\frac{1}{4}$  inches;  $6\frac{1}{2}$  inches in diameter by  $2\frac{3}{4}$  inches in thickness;  $9\frac{5}{8}$  inches by  $4\frac{1}{2}$  inches;  $11\frac{1}{2}$  inches by  $4\frac{1}{2}$  inches; and  $5\frac{3}{4}$  inches by 5 inches. They average from  $1\frac{1}{4}$  inches to  $3\frac{3}{4}$  inches in thickness. Their position is marked on the plan by the letter C.

One of these (the second on the left of the lower line) has been bored into by a marine bivalve, probably *Saxicava*. This must therefore have been brought from the sea-shore like the shell *Natica catena* found in Carn  $\mathbf{H}$ .<sup>1</sup>

<sup>&</sup>lt;sup>1</sup> Objects from the sea-shore are recorded as accompaniments of interments in the carns at Loughcrew. Conwell, describing the contents of Carn H, says :--In the chambers were obtained "upwards of 200 sea-shells, principally limpet and cockle shells, in a tolerably perfect state of preservation, and 110 other shells in a bloken state; eight varieties of small lustrous or shining

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The letter B on the plan shows where it was found. The exact purpose of these stones is not possible to determine, but their presence in this very remarkable carn and in the vicinity of the standing stone is of considerable interest and suggestiveness.



FIG 1.-WATER WORN STONES FROM CARN F.

Carn G.—The flat floor of the left recess of Carn G was covered with burnt bone débris to a depth of about three inches, and on the top of this were lying seven smallish flat stones, which had apparently been used as trays

stones; and upwards of 100 white sea-pebbles." A portion of an intercostal bone from the skeleton of a whale was also found in this carn.—" Tomb of Ollamh Fodhla," pp. 51 and 52.

"A few sea-shells" were also found in the carn on Belmore Mountain.-Proc. R.I.A., 3rd ser., vol. iv, p. 663.

Sea-shells appear to have been frequently placed in the interments in the monuments at Carrowmore, Co. Sligo. See Wood-Martin, Rude Stone Monuments of Ireland, pp. 34, 36, 45, 48, 56, 57, &c.

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on which to carry the burnt bones into the chamber. The bone débris was all removed and carefully sifted through a fine riddle, and four pierced stone pendants and ten beads were found (Plate XXIV, fig. 39). About twelve fragments of pottery were also found; these were in a most friable state, and showed traces of burning. No attempted reconstruction of any of these fragments has been successful, nor is it possible to say to how many or to what type of urns they belonged.

The floor of the central recess was covered to a height of about five inches with burnt bone débris, mixed with stones. On the top of these in the centre was a pile of flattish stones, two of which were rounded intentionally (Plate XXV, figs. 9 and 10); the illustrations are one-sixth the actual size of the objects. There was also a piece of white calcite. These stones, like those in the left recess, appear to have been used as trays on which to carry the burnt bones into the recess. Careful riddling of the bone débris disclosed the following :—Three pointed bone implements (one being made from the tibia of a Red Deer), and a well-worked and finely pointed implement made of hard slate (Plate XXIV, figs. 8, 9, 10, and 11); a sandstone pebble (Plate XXIV, fig. 26), and numerous fragments of much detrited pottery. Three complete stone pendants, a broken one decorated with a spiral groove, six complete and one broken bead, and four small rounded pebbles were also found (Plate XXIV, figs. 29, 30, 24, 36, 37, and 38).

The right recess of this carn was built up to the level of the sill with stones, many of which were a foot long; on the top of these were smaller stones, and on them rested fragments of pottery. The layer of burnt bones was level with the sill stone. Four large pieces of calcite, about one foot in diameter, were removed from this recess; three of them were considerably rounded, probably by glacial action. Resting on the stones above the bones were fragments of pottery, the largest being about four inches by three inches. A partial reconstruction of these pieces has shown them to have belonged to an urn of larger size than the ordinary food-vessel type (Plate XXV, fig. 8).

Carn H.—As has been stated in the first portion of the report, the roof of Carn H had fallen in, and the passage and cist were blocked with débris. Both passage and cist contained burnt and unburnt bones; the only objects discovered with them were a small round stone ball and a sea-shell, *Natica catena* (Plate XXIV; figs. 34 and 21). The latter had been so much worn down on the under side as to make a hole, as shown in the illustration.

Carn K.—The floor of the chamber of this carn was covered with loose stones and small fragments of burnt bones. Three stone pendants and a stone ball were subsequently discovered here (Plate XXIV, figs 20 and 35). Resting

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on the floor, just at the junction of the central and right recesses, was an urn (Plate XXV, fig. 2). It is of the food-vessel type, and did not contain anything but a little bone dust. The figure shows its ornamentation.

The floor of the left recess was covered with large flat stones; under these was a layer of burnt bones, about one foot in depth. A large number of fragments of pottery were found among the bone débris. These, however, were so small that it has been impossible to reconstruct the urns in any way, or to determine their exact shape or number.

On the shelf in this recess a number of human bones, and the muchbroken portion of the upper part of a pin made of bone, were found (Plate XXIV, fig. 19).

There were a large number of stones in the central recess, some of them eighteen inches long. On the removal of these it could be seen that at the further end of this recess there were three compartments, separated by vertical stones about sixteen inches long, and nearly square; these and the larger compartment were filled with burnt bones. On these bones being riddled, two stone pendants, two small red beads, a small stone ball, and three broken bones, with the remains of a fourth, were found (Plate XXIV, figs. 28, 32, 4, 7, 14, and 15). Numerous fragments of pottery were also discovered; among these were pieces of the ornamented rims of two different urns (Plate XXV, figs. 6 and 7).

The surface of the floor of the right recess was covered with a large number of flat stones, under which was a layer of burnt bones. The flat stones appear to have been used as trays on which to carry the bones into the recess after burning. Careful sifting of the bone débris disclosed a number of very small fragments of pottery, two small stone balls, some portions of a bone pin, the heads of two bone needles, and a curious object made from the rib of some animal (Plate XXIV, figs. 1, 6, 18, 22, 31, and 33).

When sorting the human remains collected in this carn, Professor Alexander Macalister found a portion of the ornamented rim of an urn and two small fragments of pottery. The portion of the rim is figured (Plate XXV, fig. 5). He also discovered the heads of two bone pins, a pointed implement broken and pierced near the point, two other shaped bones, and another implement shaped from the leg bone of an ox, *Bos longifrons* (Plate XXIV, figs. 2, 3, 5, 12, 13, and 17).

Carn O.—The entrance to this carn was found on the south-east side, and disclosed a pentagonal cist, covered by one single stone, with a pentagonal anti-chamber of small size, covered by two stones. An urn was resting on the top of a pile of burnt and unburnt bones, intermixed with flat sandstone
slabs, about one foot in diameter (Plate XXV, fig. 1). No other pottery or fragments or any objects were discovered in this cist.

Description of the Implements.—No objects of metal were found in any of the carns, and the implements recovered, with the exception of the finely pointed object made from hard slate, and the sandstone pebble, consisted of worked animal bones. The absence of metal may be due to economy, for, though the carns as a whole may be dated well into the Bronze Age, metal, even in the advanced Bronze Age, may have been too valuable to be placed with the dead.

Dr. R. F. Scharff, Keeper of the Natural History Collections in the National Museum, has kindly examined the bone implements, and named those that could be identified.

They are very interesting, and are therefore all illustrated. The figures are reproduced to the scale of one-half. One of the larger implements is an exceedingly well-made object (Plate XXIV, fig. 11). It is formed out of the tibia of a Red Deer, which has been much reduced. It measures six and five-eighths inches in length. Hard bones of this kind make very good implements, and this object may have been used for boring skins. Another tool has its point broken (Plate XXIV, fig 10). It is made from the fibula of a Bear, and Dr. Scharff informs us that it is of much interest, as it is only the second specimen of remains of Bear being found with early man in Ireland, the other instance known being the finding of a worked Bear's tooth with human remains in Co. Clare.<sup>1</sup> This bone measures at present five and a quarter inches long. A third implement is broken at the point, and also higher up, and it is impossible to say what its original length was; it measures at present  $3\frac{1}{4}$  inches in length (Plate XXIV, fig. 8). It may also be made from the bone of a Bear, but it is not possible to be certain on this point. All these objects were found in Carn G.

Another well-shaped pointed implement was found in Carn K. It measures 7 inches in length, and greatly resembles the large implement found in Carn G. It is considerably flattened at the point, and may have been used for smoothing skins. It is made from the leg bone of an ox (*Bos longifrons*) (Plate XXIV, fig. 3).

The bones of *Bos longifrons* are common in the lake dwellings of Switzerland, which date from Neolithic times, and were abundant in Grime's Graves (England), also of Neolithic date. *Bos longifrons* appears to have been the ox

<sup>1</sup> Trans. R.I.A., vol. xxxiii, Sect. B, pp. 18 and 19.

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of the Bronze Age in the British Islands, and was probably domesticated in Ireland at the period of the interments in the Carrowkeel carns.<sup>1</sup>

The curiously shaped pointed implement is made of hard slate; the point is very sharp and the object has been carefully scraped or rubbed down to its present shape. It may have been used as a borer or for ornamenting pottery. (Plate XXIV, fig. 9).

The sandstone pebble appears to have been used as a hammer-stone. It is flattened on one side (Plate XXIV, fig. 26).

Six pins or pegs, with well-cut heads were found—four in Carn K (Plate XXIV, figs. 1, 12, 13, and 19), and two in Carn E (Plate XXIV, figs. 16 and 23). The largest (Plate XXIV, fig. 1) has been fractured down the centre (the lowest piece shown in the figure probably belongs to it, but it cannot be fitted on in any way, and certainty on the point is impossible).

These pins should be compared with the very similar bone pins found in excavations in the monuments at Carrowmore, Co. Sligo, figured by Wood-Martin,<sup>2</sup> and also with those found in Carn R 2 of the Loughcrew series by Mr. E. Crofton Rotheram.<sup>3</sup>

The heads of what were probably three bone needles found in Carn K are interesting (Plate XXIV, figs. 17, 18, and 22). They may be compared with what is described as the head of a bone pin discovered in the Carrowmore cromlechs, and figured by Wood-Martin.\* Among the other bones found, a curiously rounded rib bone may be noticed (Plate XXIV, fig. 6). It has been artificially rounded to such an extent that it is impossible to determine to what species it belonged. Its use is conjectural. The pointed end of a broken implement, what was probably the head of another from carn K, and also three curved bones are figured. These latter may have been used for some purpose. The boar's tusk found in Carn E is interesting as the first remains of boar found in this series of carns. It measures  $2\frac{1}{2}$  inches in length; (Plate XXIV, fig. 25). Boar's tusks are not uncommon accompaniments of early interments. Several were found in the carn on Belmore Mountain, Co. Fermanagh, excavated by Mr. Thomas Plunkett.<sup>5</sup> A boar's tusk, cut across and pierced in order to attach a string which had worn the hole, was found in the Edenvale Caves, Co. Clare.<sup>6</sup> They have also been found frequently in Crannogs in Ireland.<sup>7</sup> In England, boar's tusks perforated for suspension

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<sup>&</sup>lt;sup>1</sup> See McKenny Hughes, "On the more important Breeds of Cattle, &c." Archaeologia, vol. lv, pp. 133-135; also Wilde, Proc. R.I.A., vol. vii, p. 64.

<sup>&</sup>lt;sup>2</sup> Rude Stone Monuments of Ireland, pp. 21 and 29.

<sup>&</sup>lt;sup>3</sup> Journal Royal Society of Antiquaries of Ireland, vol. xxv, p. 313.

<sup>4</sup> Wood-Martin, op. cit., p. 33, fig. 17.

<sup>&</sup>lt;sup>5</sup> Proc. R.I.A., 3rd ser., vol iv, p. 663.

<sup>&</sup>lt;sup>6</sup> Trans. R.I.A., vol. xxxiii, Sect. B, p. 8 and Pl. V, fig. 6.

<sup>&</sup>lt;sup>7</sup> Wood-Martin, Lake Dwellings of Ireland, notes on pp. 168, 199, and 233.

have been found in interments dating from the Stone Age. They were probably worn as amulets. See Prof. W. Ridgeway on this point.<sup>1</sup>

Beads and Pendants.-Mr. T. Hallissy, of the Geological Survey of Ireland, has kindly examined the beads, pendants, and stone balls found in the carns, and illustrated in Plate XXIV to the scale of one-half. He states their composition is as follows :- The four pendants and nine of the beads found in the left recess of Carn G are made of steatite and serpentine. The ornamental broken bead from the central recess of Carn G is made of limestone; the other beads and pendants from this recess are composed of limestone, steatite, and serpentine. The largest pendant from the chamber of Carn K is limestone, the second in size is jasper, and the smallest serpentine. Two beads found in the central recess of Carn K are jasper, and the two pendants steatite. The perfect bead found in Carn F is jasper; and of the two broken specimens, one is steatite and the other is serpentine. The rounded stone balls found in the different carns are all limestone, with the exception of the two oblong specimens found in the central recess of Carn G, which are water-worn quartz pebbles. The jasper pendant and beads are well finished, and the method of boring such a hard substance as jasper at that time presents an interesting problem. They may possibly have been imported.

These beads and pendants are of much interest; they all belong to the same type, and all have been drawn so that the shapes can be well seen. Except for the incised line and cutting of the ends of the four pendants found in Carn G, left recess (Plate XXIV, fig. 39), the only ornamental example is the broken pendant with the small incised groove from Carn G, central recess (Plate XXIV, fig. 30).

The largest pendant was found in the chamber of Carn K. It is a brownish colour, is highly polished, and has a widely splayed hole (Plate XXIV, fig. 20).

The beads and pendants closely resemble those from the carn on Belmore Mountain, illustrated in Mr. Coffey's paper.<sup>2</sup> Comparison should also be made with the steatite beads found in the monuments at Carrowmore, and figured by Wood-Martin.<sup>3</sup> Very similar pendants and beads were found by Mr. Crofton Rotheram in Carn R 2 at Loughcrew. Some of these have been figured.<sup>4</sup> Mr. Rotheram kindly sent us a number of unpublished beads he found in Carn R 2, and also some he obtained from a small carn on Patrickstown Hill, Co. Meath, for comparison with the Carrowkeel beads; the similarity is most striking.

<sup>&</sup>lt;sup>1</sup> Journal Royal Anthropological Institute, vol. xxxviii, p. 253.

<sup>&</sup>lt;sup>2</sup> Proc. R.I.A., 3rd ser., vol. iv, p. 665.

<sup>&</sup>lt;sup>3</sup> Rude Stone Monuments of Ireland, p. 28.

<sup>&</sup>lt;sup>4</sup> Journal Royal Society of Antiquaries of Ireland, vol. xxv, p. 315.

The small round stone balls which were found in several of the carns are curious, and their use cannot be determined. The pieces of calcite that were found are also interesting; the custom of placing white stones in interments seems to have been common in prehistoric times, and has been frequently noted.<sup>1</sup> It is possible that the stones were believed to have some magical significance.

Pottery.—The complete urns and the portions of vessels illustrated are all reproduced to the scale of one-third. It is most unfortunate that the pottery was in so many cases discovered in such small fragments, and so much detrited. Many attempts at restoration have been made; but the fragments were so small and so much was missing that, except in one case, nothing of importance has been effected. However, two pieces of rim belonging to different urns were found among the débris from the central recess, Carn K; careful measurement, and following the recovered portion with a pair of compasses, have enabled the outline of the rims to be approximately drawn to scale and shown in the illustrations (Plate XXV, figs. 6 and 7). A third piece of rim was found by Professor Alexander Macalister when sorting out the bones from Carn K (Plate XXV, fig. 5).

In Carn G, right recess, the fragments found were slightly larger, and could be fitted together. The fitting together of these pieces has shown them to belong to a vessel of larger type than the ordinary food-vessel. Careful measurement has enabled the outline of the vessel to be drawn approximately (Plate XXV, fig. 8). It is most unfortunate that no portion of the rim was discovered, so that it is impossible to determine the height of the vessel or the exact type to which it belongs. All that can be stated with certainty is that it is larger than the ordinary food-vessels, and that it resembles the type known as cinerary urns more than these. The clay in the thickest portion recovered measures about three-quarters of an inch, and the pieces show considerable traces of blackening by fire. The decoration is of a simple character, and consists of punch marks, made with a pointed stick or bone. The portion of the rim found by Professor Alexander Macalister also appears to have belonged to a large urn. Measurements, and following the line of the rim with a pair of compasses, have enabled the outline to be approximately drawn to scale; and reference to the figure will show the probable size of the The fragment measures half an inch in thickness rim when complete. (Plate XXV, fig. 5).

In Ireland the pottery of Neolithic times appears to have consisted of smallish vessels with a round base. There is a specimen of this type preserved in the Royal Irish Academy's collection in the National Museum.

<sup>&</sup>lt;sup>1</sup> Wood-Martin, Rude Stone Monuments of Ireland, p. 34. Evans, The Ancient Stone Implements, Weapons, and Ornaments of Great Britain, 1872, pp. 419-422.

## MACALISTER, &C.—Bronze-Age Curns on Carrowkeel. 341

It was discovered in "a subterraneous cavern" near the town of Antrim, and a number of flint arrow-heads and a stone celt are stated to have been found with it.<sup>1</sup> The highly ornamented food-vessel of the Bronze Age was developed from this type.<sup>2</sup> The larger so-called cinerary urns belong to the later stages of the Bronze Age.

The pottery remains from the carns are, as a whole, in such a fragmentary state that definite conclusions as to the number or type of urns cannot be safely drawn. The pieces found in Carn G, and the portion of rim recovered from Carn K, belong to vessels larger than the ordinary food-vessel type.

The perfect specimen from Carn K is finely decorated; it is comparatively large, and its mouldings are numerous and well-pronounced; it tapers to a small base, and belongs to the food-vessel type (Plate XXV, fig. 2).

The perfect urn from Carn O belongs to a type of food-vessel which appears to have lasted over a long period of the Bronze Age (Plate XXV, figs. 1 and 3). The sort of cruciform ornament on the base may be compared with that upon the base of the urn found in the carn on Belmore Mountain, Co. Fermanagh.<sup>3</sup> This carn, it may be noted, contained both burnt and unburnt burials, and the beads and pendants found resembled closely those discovered in the Carrowkeel series.

No Neolithic types of pottery appear to be present, and the carns so far examined may all be placed in the Bronze Age. The perfect urns are finely ornamented and well-shaped specimens, and hardly seem to belong to the earliest portion of the Bronze Age, while the presence of the remains of larger vessels points to a somewhat later period. The carns were, no doubt, used over a long period, and, considering the large number of persons buried, it cannot be doubted that many of the burials and objects placed with them must differ in date. As, however, the objects, with the exception of the two unbroken urns, were nearly all found among the burnt bones, it is impossible to do more than indicate this difficulty, which is another reason for exercising caution in attempting to date the carns. The carns themselves, and many of the objects they contained, present close analogies to the Loughcrew series; and it may be noted that this group of carns further resembles those at Loughcrew, in two of their number being cenotaphs. As far, therefore, as can be judged from the pottery, and making all reservations on account of the difficulty of forming conclusions as to the exact type of urns to which many of the fragments belonged, the contents of the carns must be placed in the Bronze Age.

<sup>&</sup>lt;sup>1</sup> Catalogue R.I.A. Coll., vol. i, p. 184.

<sup>&</sup>lt;sup>2</sup> For an excellent discussion of the development of the food-vessel see Mr. R. A. Smith's Paper on the Development of Neolithic Pottery, Archaeologia, vol. lxii, p. 340.

<sup>&</sup>lt;sup>3</sup> Proc. R.I.A., 3rd ser., vol. iv, p. 664.

## Proceedings of the Royal Irish Academy.

5. REPORT ON THE HUMAN REMAINS.

BY PROFESSOR A. MACALISTER, Cambridge.

The determination of the characters of the human remains was a matter of very great difficulty. The greater number had been thoroughly burnt and broken, and most of the fragments were, in consequence, quite unrecognizable. By a careful process of sorting of the fragments and counting the bones that were best preserved, it was possible to arrive at an estimate of the minimum number of individuals represented. In this manner I ascertained that there were bones representing thirty-one skeletons. These, however, constituted only a very small portion, and included only the least perfectly burnt. I think it is a safe conjecture to estimate the number as at least double that limit.

In my first examination I kept the remains from each carn and from each compartment separate, but after carefully reviewing them I found that they were so much alike I consider it unnecessary to describe the several fragments from each place.

In the determinable fragments males preponderated, but there were certainly twelve recognizable females, and probably more. In all carns I found fragments of infantile and foetal bones, but these were few.

There were no men of conspicuously tall stature. The measurements of such long bones as were sufficiently complete to give trustworthy results indicated one man of 5 feet 9 inches, but most of the others ranged from 5 feet 8 inches to 5 feet 5 inches, and the female bones from 5 feet 5 inches (?) to 5 feet. Ten femora and tibiae were sufficiently complete to give definite measurements, and as many more, whose ends were damaged, gave approximate results. The average stature deduced from these was for the males 5 feet 6<sup>1</sup>/<sub>2</sub> inches, and for the females about 5 feet 1 inch.

The femora were not unusually stout, and only one showed a slight amount of platymeria. Some, indeed, were proportionally slender. The tibiae were fairly strong, and about one-fourth showed a tendency to platycnemia; the others were distinctly eurycnemic. On three tibiae there were anterior marginal facets at the lower end, and on four astragali there were the companion facets, and a forward prolongation of the internal malleolar facet. These conditions have been correlated with a habitual use of the squatting posture common among Orientals. The fibulae were ridged and channelled with unusual sharpness. A few bones, especially some vertebrae, showed signs of rheumatoid disease at the joints. One fibula was very much curved. The humeri were in general much broken, but the fragments seem to indicate bones of considerable stoutness.

## MACALISTER, & C. Bronze-Age Carns on Carrowkeel. 343

From the number of bones which were not completely ossified at the extremities, it is evident that many of the people buried in the carns were under twenty-five years of age. None showed signs of senility.

The crania were megacephalic, but only five could be satisfactorily measured, and even these were incomplete; the capacity of the largest was about 1520 ccm. In point of shape they were pentagonoid, ovoid, and with cephalic index hovering on the limit between dolicho- and mesaticephaly, ranging from 73 to 76. From the general appearance of the curvatures of the unmeasurable fragments they seemed to have been of the same pattern. One was platybasic, as if rickety. The orbits were all megaseme and the nasal skeleton leptoprosopic. The muscular crests were fairly well marked, the teeth large and showing considerable wear, but only one or two showed signs of disease. The jaws were orthognathous, and the countenance long with moderately prominent cheek-bones. The chin was in some long and prominent, in others receding, and the angles of the jaws of two were prominently curved. Altogether the characters are practically those which are commonest among the people of the west of Ireland at the present day.

Attention has been directed of late by Keith to the shapes and sizes of teeth, as a criterion of date, those of Palaeolithic crania being supposed to be thicker-necked than those of later time. In these skulls the measurements were singularly uniform, the two lower molars having a proximo-distal crown measurement of 11, a labio-lingual of 11, and a crown height of 6. The neck was proximo-distally 9.5, labio-lingually 9, and the height 20. The other teeth were of a similar proportional size, showing that they correspond to the measurements of the teeth of the later crania and differ from those of the Mousterian age.

#### 6. SUMMARY AND CONCLUSIONS.

We may fairly claim that the investigation of the group of monuments described in the foregoing pages has given us a remarkably full picture of the life and customs of the Bronze Age in Ireland. It is true that no object of metal or stone witnessing to the high technical skill to which the people of this period are known to have attained came to light. It is also true that none of the carns showed any marks of the artistic influences which radiated from the civilization of the eastern Mediterranean, and which are so strikingly evidenced by the incised decoration of the analogous monuments in Meath.

In the remains of the settlements we find at least a hint of the nature of the dwellings of the Bronze-age people; and of the considerations that led them to a choice of site. In the imposing series of carns on the mountaintop and their contents, we find mirrored the physical character, social

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organization, and architectural skill of their builders: and, thanks to the happy circumstance that most of them were completely unrifled, we have gained a fuller insight into the burial ritual of the Bronze Age in Ireland than ever before. Even though the people did not indulge in incised ornament, the constructive skill displayed (notably in Carns F and G) shows that the ancient dwellers in county Sligo were on the same cultural level as their brethren in Meath; and the fact that their monuments remained undisturbed has enabled us, by their investigation, to fill in *lacunac* in our knowledge which were inevitable, owing to the plundered state of the typical monuments of Loughcrew and the Boyne.

When the Bronze Age settlement established itself on Carrowkeel Mountain, the physical aspect of the surrounding country was very different from what we see to-day. Much of the lower ground was covered by dense forests, in which ranged the Red Deer, the Wild Boar, and the Bear (as the bone deposits in the carns have shown), and no doubt such other species as are known to zoologists to have inhabited Ireland at that time. Very likely the stone walls round the dwellings served the important purpose of keeping out Wolves. Interspersed among the forests were extensive areas of swamp. The hill itself is extensive and isolated. It commands wide views in every direction, so that timely warning could be given of the approach of marauders. The spur on which the village is built could be converted into a fortress with but little trouble; by building walls at the tops of the fissures and "chimneys" that here and there break the continuity of its almost perpendicular walls of cliff, it could be made almost impregnable. Thus defined, the spur strongly resembles the site of many of the promontory forts with which the labours of Mr. Westropp have made us familiar. The tribe evidently belonged to the primitive dolichocephalic Neolithic stock which was spread over western and southern Europe, and now forms a leading element in the modern population of Ireland.

There is evidence in the two ox-bones in Carn F that this animal was domesticated. The fish of the lake and the game of the forest offered an abundant store of food to the inhabitants. There was no evidence as to whether they did or did not practise the arts of agriculture. The weak point of the village site is the scantiness of the water-supply. The springs of the hill are few and feeble; and there seems to be none within the immediate neighbourhood of the site.

The village consisted of some fifty circular hut-sites, more or less protected by the cliff-walls of the spur on which it stands. It may be as well to anticipate here an objection. We assume that this extensive colony is connected with the carus which surround it on three sides. The truth of this

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assumption cannot be demonstrated. On the bare, wind-swept, rain-washed rock surfaces, so far as we could see, not so much as a splinter of bone remains to tell of its former occupants or their mode of life. On the other hand, the assumption seems capable of justification by a process of exclusion. The buildings are not comparable with the Iron Age and Early Christian settlements of Fahan and elsewhere; nor are they of the same nature as the early medieval steadings whose remains are known as ring-forts. Though all these types of buildings are round, analogy ends there. The Carrowkeel community was distinguished from the others by its position in a strongly fortified situation, remote from any place where agriculture is possible; and by its organisation, in that it is close and compact, not spread widely in single huts over a large area of land. It is difficult to see to what period other than the Bronze Age this very primitive settlement can be assigned.

When we turn to the carns, our attention is immediately arrested by the variety which they display, both in design and in execution. Two of them, A and P, are completely blind, being apparently cenotaphs like Carn D at Loughcrew. Others, like H or O, have in their heart small cists, with or without passages leading to them. Others have elaborate and well-built chambers, comparable in excellence of structure with that in Brugh na Bóinne, though of course on a less grandiose scale. The plan of the carns is more or less round in all, but E is a marked exception to this rule. Again, the rude architecture of some, such as H and O, contrasts strikingly with the constructive and artistic skill displayed by others, such as F and G. Had the monuments been found rifled, we would have felt inevitably drawn to the conclusion that they represented widely different culture-strata; and indeed we long laboured under the impression that Carn F was Neolithic. But the absolute uniformity of the deposits shows clearly that all the carns were in use at one and the same period: the contents even of E were in all respects similar to those in its neighbours.

It has been pointed out in the foregoing pages that in the days of the carn-builders the hill was not covered with peat to the same extent as at present. Sub-aerial denudation, extending over a long period of time, must have resulted in the presence of a large number of blocks of limestone, lying loose on the surface. These were available for the builders. But in those carns which show a superiority of construction, it is evident that no mere haphazard choice of material was made. The symmetry of corresponding blocks, the absolute identity of appearance in groups of blocks—notably in the slabs facing the chambers in F, proving that they came from the same bed—show clearly that the architect who superintended the construction selected his materials carefully, if, indeed, he did not cause them to be specially quarried. The use of sandstone in places where a heavy weight had to be sustained is also an indication of architectural forethought and *design*.

That no metal objects were found may be accounted for on the ground of economy, bronze being too valuable to waste on tomb-deposits. The implements found with greatest frequency were pointed tools of bone or stone, sometimes perforated at the butt, and pegs or pins of bone with expanding heads. Similar objects are characteristic of the contemporaneous interments at Loughcrew. Possibly these pins had been used to fasten the bag of cloth into which the ashes from the funeral pyre were collected.

With regard to the religious ideas of the people, the first point to indicate is the great importance attached by them to sepulture. This is evidenced first by the extraordinary pains taken in the construction of the monuments; and, secondly, by the commanding sites chosen for them. The latter point is capable of two explanations, between which it is impossible to choose. It was intended either that the deceased tribesmen should overlook as wide an area of the clan territory as possible, or that the monuments themselves should be a centre upon which eyes could be turned from the remotest limits of the lands of the tribe.

The well-established fact that cremation and inhumation co-existed in the Bronze Age once more receives an illustration. For, while certain isolated unburnt bones might have escaped the fire accidentally, this cannot be said of the nearly complete skeletons found in the narrow passage of H, and in the cist of O. Burning evidently took place outside the carn, and the ashes were then placed either in an urn or (more frequently) on a flat stone—in the latter case possibly wrapped in a cloth—and then laid inside the chamber : as a rule, in the side *cellae*.

Once again we find evidence of the well-known, though inexplicable, custom of burying white stones with the deceased. Not only inside the carns but even inside the piles of stones covering the chamber were found numerous lumps of calcite, much rolled, which there is every reason to believe had been brought from a considerable distance. One remarkable collection of about a dozen of these stones lay just outside the doorway of K. Pebbles of white quartz, also foreign to the district, were likewise found. One of the rounded stones found in F was bored by the mollusk *Sawicava rugosa*. This and the shell of *Natica catena* from Carn H show that the people of the community penetrated as far as the sea-shore in their search for objects of religious or aesthetic value.

There seems every reason to assign a ritual purpose to the two ox vertebrae deposited in specific places in Carn F, especially when we bear in mind the sanctity attached to the ox in early religions, and when we consider that in the same chamber was a remarkable *menhir*, beside which, evidently of set purpose, were deposited eight carefully selected water-worn stones.

This menhir is the central point of interest in the whole series of structures. That it is constructional is absolutely out of the question. Its central position in the sanctum sanctorum of the most imposing of all the carns indicates that it had a peculiar importance. That it is a religious symbol is scarcely questionable; and here we have, therefore, some light on the general question of the age and use of the standing-stones that are so conspicuous among the prehistoric monuments of Ireland.

The growth of peat over the whole surface of the hill has greatly changed the appearance of the land since the carns were erected; the determination of the period of this growth is a not unimportant collateral result of the excavation. We have no means of knowing when this settlement came to an end, or what was its ultimate fate. But Irish archaeologists are to be congratulated on the fact that, save for some structural failures, and the minor depredations of boys, the chief monuments of the series have kept their main secrets intact during the centuries that have elapsed since the last interment was made within them.





PLATE X.







Carn



Fig. 1.-Characteristic rift, west of Doonaveeragh.







Fig. 3.-Carn B, after being opened.

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Fig 3.-Chamber of Carn E, after clearing.

MACALISTER, &c.--BRONZE AGE CARNS AT CARROWKEEL.

Fig. 4.—Carn F, before opening, showing the collapse.





Fig 1.- Carn F, before opening, showing the collapsed chamber and doorway



Fig. 2—Detail of structure, Carn F. (N.W. Corner, Outer Chamber),



Fig. 3 —Detail of structure, Carn F (S.E. Corner, Inner Chamber).



Fig. 4—Inner Chamber, Carn F (Shewing standing stone)

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Fig. L.-Carn F. during excavation



Fig. 2 -Interior of Carn G.



Fig. 3. Carns G (behind), and H (in front), showing general appearance.

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Fig. 3.-Entrance Passage, Carn K, from within, ·



PLATE XVI.



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CARN E















PLATE XX.












MACALISTER, &C .- BRONZE-AGE CARNS AT CARROWKEEL.





Macalister, &c.-Bronze-Age Carns at Carrowkiel.



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PLATE XXIV.



Implements, beads, pendants, etc.  $(\frac{1}{2})$ .

MACALISTER, &C .- BRONZE-AGE CARNS AT CARROWKFEL.



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PLATE XXV.



MACALISTER, &C.-BRONZE-AGE CARNS AT CARROWKEEL.

March, 1911 - THE REW YORK READENLY OF SULMORE,

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OF THE

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# VOLUME XXIX, SECTION A, NO. 1

# ARTHUR W. CONWAY

# **ON THE APPLICATION OF QUATERNIONS** TO SOME RECENT DEVELOPMENTS OF ELECTRICAL THEORY



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