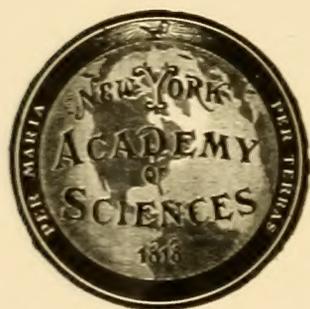


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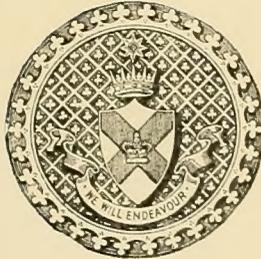
PROCEEDINGS

OF THE

ROYAL IRISH ACADEMY

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VOLUME XXXIV



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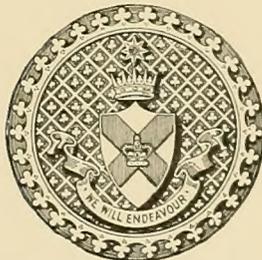
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SECTION A.—MATHEMATICAL, ASTRONOMICAL, AND
PHYSICAL SCIENCE.



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PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY

PAPERS READ BEFORE THE ACADEMY

I.

ON THE SIMULTANEOUS FORMULATION OF TWO LINEAR VECTOR FUNCTIONS.

BY FRANK L. HITCHCOCK, PH.D., Massachusetts Institute of Technology.

[Read JANUARY 22. Published MAY 25, 1917.]

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1. *Introduction.*—In his valuable appendix to Hamilton's "Elements of Quaternions" the late Prof. C. J. Joly exhibited, in a very elegant manner, some of the properties of the most general pair of linear vector functions. He pointed out that two such functions $\phi\rho$ and $\theta\rho$ may, in the general case, be simultaneously expressed in the form

$$\phi\rho = \lambda S a\rho + \mu S \beta\rho + \nu S \gamma\rho; \theta\rho = a\lambda S a\rho + b\mu S \beta\rho + c\nu S \gamma\rho, \quad (1)$$

where the three vectors a, β, γ are the axes of $\theta'\phi'^{-1}$, while λ, μ, ν are the axes, and a, b, c are the latent roots of $\phi\theta^{-1}$.

These function-pairs are important in many ways, and appear frequently in Joly's writings. In the above formulation we note that he has expressed

ϕ and θ in terms of those vectors whose directions are similarly altered by the two functions. Sometimes, as in his paper* on "Scalar Invariants of Two Linear Vector Functions," he finds it more convenient to express ϕ in terms of its own axes, and then to formulate θ in terms of ϕ . Two of his invariants will be useful in the present investigation.

On the purely analytical side, the problem of the present paper is analogous to that presented by the classification of pairs of bilinear forms, or of pairs of collineations.† To the worker in quaternions, however, a purely scalar treatment is unsatisfactory, first because the physical and geometrical significance of the results is pretty thoroughly concealed by the method of presentation, also because relations of singular and non-singular forms to each other and to the invariants of the system, cannot be, or at least has not been, clearly brought out by ordinary algebra. A singular bilinear form (or a singular collineation) corresponds to a linear vector function one of whose latent roots is zero. It will appear below that either or both of the given forms may be singular without altering the typical properties of the system: in fact, it is only when the occurrence of simultaneous vanishing roots is accompanied by the vanishing of two of Joly's invariants that the system falls into a more special type.

To mention a problem of another sort in which Joly's formulas for ϕ and θ prove to be of great assistance: the general *quadratic* vector function of ρ can be written

$$V\phi\rho\theta\rho + \rho S\delta\rho, \quad (2)$$

where δ is a constant vector—a fact bearing on the theory of certain functions defined by differential equations.‡ In factorizing a quadratic vector in this way, simple methods for the simultaneous formulation of ϕ and θ are necessary.

Again, to take a problem from geometry, if a curve of the fourth order in space be given by the intersection of two quadric surfaces, the equations of the curve may conveniently be written

$$\left. \begin{aligned} S\rho\phi\rho + S\alpha\rho + a &= 0, \\ S\rho\theta\rho + S\beta\rho + b &= 0, \end{aligned} \right\} \quad (3)$$

where ϕ and θ are *aff-symmetric* linear vector functions, α and β are constant vectors, and a and b are constant scalars. Many of the properties of the curve appear most clearly when ϕ and θ are expressed by formulas analogous to (1).

* *Trans. R. I. A.* 30 (July, 1895), p. 709.

† For a short account in English of this aspect of the matter, see Bocher and Duval's "Introduction to Higher Algebra," chap. xxi.

‡ For a sketch of this theory see "A Classification of Quadratic Vector Functions," *Proc. Nat. Acad. of Sciences* (Washington), vol. i, No. 3 (March, 1915), p. 177.

2. *Possibility of the reduction to form (1).*—In all these problems we are concerned with the properties of a pencil of functions $\phi + t\theta$. That is to say, in studying the curve (3), or in forming the vector product $V\phi\rho\theta\rho$, or in calculating Joly's invariants, we may replace a given ϕ or θ by any other functions of the pencil. The general problem is, then, to determine what types of function-pairs may occur.

In writing ϕ and θ in the form (1), Joly assumes the possibility of the reduction. To see on what the possibility depends we note, first, that $V\beta\gamma$, $V\gamma\alpha$, and $V\alpha\beta$ are the axes of $\phi^{-1}\theta$. A necessary condition for reduction to the form (1) is, therefore, the existence of three distinct axes for $\phi^{-1}\theta$.

Second, if ϕ has a vanishing root, so that $\phi^{-1}\theta$ does not exist, we may suppose ϕ replaced by a different function of the pencil. But it may happen that no function of the pencil possesses an inverse. The reduction (1) is impossible in this case also. We have therefore to examine two cases:—

I. The function $\phi^{-1}\theta$ exists, but has a double or a triple axis.

II. The function $\phi^{-1}\theta$ cannot exist, i.e. no function of the pencil $\phi + t\theta$ possesses an inverse.

3. *Typical form of ϕ and θ when $\phi^{-1}\theta$ has a double axis.* Suppose $\phi^{-1}\theta$ to have a double root. As I have shown in a former paper,* we may then write, as the most general form of $\phi^{-1}\theta$,

$$\phi^{-1}\theta = g\rho + c\beta S\beta\beta_1\rho + c_1\beta_1 S\alpha\beta\rho, \tag{4}$$

where g is the double root of the cubic in $\phi^{-1}\theta$, and may vanish.

The double axis is β . It is assumed that c , c_1 , and $S\alpha\beta\beta_1$ are all different from zero. To express ϕ and θ in a simple manner we have now merely to operate by ϕ on the three diplanar vectors α , β , β_1 . Let the results be denoted by λ , μ , ν , respectively; and these three vectors are also diplanar, because, by hypothesis, ϕ has an inverse. Expanding ϕ in terms of λ , μ , ν we have

$$\phi\rho \cdot S\alpha\beta\beta_1 = \lambda S\beta\beta_1\rho + \mu S\beta_1\alpha\rho + \nu S\alpha\beta\rho, \tag{5}$$

and by operating with ϕ on both sides of (4) we have

$$\theta\rho = g\phi\rho + c\mu S\beta\beta_1\rho + c_1\nu S\alpha\beta\rho \tag{5_1}$$

These expressions actually differ little from (1). To bring out the analogy we first note that (5₁) is equivalent to the three equations

$$\theta\alpha = g\lambda + c\mu S\alpha\beta\beta_1, \quad \theta\beta = g\mu, \quad \theta\beta_1 = (g + c_1 S\alpha\beta\beta_1)\nu,$$

* Proc. Royal Soc. Edinburgh, vol. xxxv, Part II (No. 17, June, 1915), p. 172.

so that if we agree to write

$$c\mathcal{S}a\beta\beta_1 = c_2 \quad \text{and} \quad g + c_1\mathcal{S}a\beta\beta_1 = g_1,$$

we may rewrite θ in terms of its effect on a , β , and β_1 , thus—

$$\theta\rho \cdot \mathcal{S}a\beta\beta_1 = (g\lambda + c_2\mu)\mathcal{S}\beta\beta_1\rho + g\mu\mathcal{S}\beta_1a\rho + g_1\nu\mathcal{S}a\beta\rho, \quad (5_2)$$

where the analogy with (1) is more obvious, g and g_1 being the two roots of the cubic in $\phi^{-1}\theta$. To complete the formulation, put

$$a_2\mathcal{S}a\beta\beta_1 = V\beta\beta_1, \quad \beta_2\mathcal{S}a\beta\beta_1 = V\beta_1a, \quad \gamma_2\mathcal{S}a\beta\beta_1 = Va\beta,$$

whence (5) and (5₂) become

$$\left. \begin{aligned} \phi\rho &= \lambda\mathcal{S}a_2\rho + \mu\mathcal{S}\beta_2\rho + \nu\mathcal{S}\gamma_2\rho, \\ \theta\rho &= (g\lambda + c_2\mu)\mathcal{S}a_2\rho + g\mu\mathcal{S}\beta_2\rho + g_1\nu\mathcal{S}\gamma_2\rho \end{aligned} \right\} \quad (6)$$

It is clear that the form of ϕ is as in (1), while θ differs only in its effect on a .

4. *Geometrical applications.*—If equations of a curve are given as in (3), we write down the conditions for self-conjugation from (5) and (5₁)—

$$V\lambda V\beta\beta_1 + V\mu V\beta_1a + V\nu Va\beta = 0, \quad Vc_1\mu V\beta\beta_1 + Vc_1\nu Va\beta = 0,$$

which (by Hamilton's *Elements*, Art. 294) are equivalent to the six scalar equations

$$\left. \begin{aligned} \mathcal{S}\beta_1\mu &= \mathcal{S}\beta\nu, & \mathcal{S}a\nu &= \mathcal{S}\beta_1\lambda, & \mathcal{S}\beta\lambda &= \mathcal{S}a\mu, \\ c_1\mathcal{S}\beta\nu &= 0, & c_1\mathcal{S}a\nu &= c\mathcal{S}\beta_1\mu, & c\mathcal{S}\beta\mu &= 0. \end{aligned} \right\}$$

To solve, regarding a , β and β_1 as known vectors, we note first that c and c_1 are by hypothesis different from zero. The six equations thus reduce at once to

$$\mathcal{S}\beta\mu = 0, \quad \mathcal{S}\beta_1\mu = 0, \quad \mathcal{S}a\nu = 0, \quad \mathcal{S}\beta\nu = 0; \quad \mathcal{S}\beta_1\lambda = 0, \quad \text{and} \quad \mathcal{S}\beta\lambda = \mathcal{S}a\mu$$

Hence μ , being perpendicular to both β and β_1 , has the form $pV\beta\beta_1$, where p is some constant scalar. Similarly ν has the form $qVa\beta$, and λ has the form $rV\beta\beta_1 + r'V\beta_1a$, where r and r' are two more constant scalars. Collecting results, (5) and (5₁) become

$$\left. \begin{aligned} \phi\rho \cdot \mathcal{S}a\beta\beta_1 &= (cV\beta\beta_1 + r'V\beta_1a)\mathcal{S}\beta\beta_1\rho + pV\beta\beta_1 \cdot \mathcal{S}\beta_1a\rho + qVa\beta \cdot \mathcal{S}a\beta\rho, \\ \theta\rho &= g\phi\rho + cpV\beta\beta_1\mathcal{S}\beta\beta_1\rho + c_1qVa\beta\mathcal{S}a\beta\rho. \end{aligned} \right\} \quad (7)$$

The self-conjugate character of these two linear vector functions is evident from their form. And since, in the geometrical problem, any multiple of one of the quadratic expressions (3) may be added to the other without altering the curve of intersection of the two quadric surfaces, we may take $g = 0$ in (7). If we now operate on (7) by $\mathcal{S}\rho$ and introduce a set of oblique coordinates defined by the equations

$$x\mathcal{S}a\beta\beta_1 = \mathcal{S}\beta\beta_1\rho, \quad y\mathcal{S}a\beta\beta_1 = \mathcal{S}\beta_1a\rho, \quad z\mathcal{S}a\beta\beta_1 = \mathcal{S}a\beta\rho,$$

we shall find the scalar products $S\rho\phi\rho$ and $S\rho\theta\rho$ to be proportional to the quadratic expressions

$$rx^2 + 2pxy + qz^2 \quad \text{and} \quad cpx^2 + c_1qz^2;$$

If we now combine the two equations so as to eliminate z^2 from the former, we may obtain the terms of the second degree as

$$ax^2 + 2pxy \quad \text{and} \quad p_1x^2 + q_1z^2,$$

where a , p_1 , and q_1 are constants. The form of the result shows that the curve has a double point at infinity.

5. *Typical form of ϕ and θ when $\phi^{-1}\theta$ has a triple axis.*—Suppose $\phi^{-1}\theta$ to have a triple root. The most general form of $\phi^{-1}\theta$ is*

$$\phi^{-1}\theta\rho = g\rho + c\beta S\beta\gamma\rho + c_1\gamma S\gamma a\rho, \tag{8}$$

where g is the triple root, and may vanish. It is assumed that c , c_1 , and $Sa\beta\gamma$ are all different from zero. As before, we regard a , β , and γ as known, operate on them by ϕ , and call the results λ , μ , and ν . Whence

$$\phi\rho \cdot Sa\beta\gamma = \lambda S\beta\gamma\rho + \mu S\gamma a\rho + \nu Sa\beta\rho, \tag{9}$$

and by operating with ϕ on both sides of (8),

$$\theta\rho = g\phi\rho + c\mu S\beta\gamma\rho + c_1\nu S\gamma a\rho. \tag{9_1}$$

This is, perhaps, the most convenient form of θ , but we may, if we wish, bring out the analogy with (1) and (6) by writing

$c_2 = cSa\beta\gamma$, $c_3 = c_1Sa\beta\gamma$, $a_3Sa\beta\gamma = V\beta\gamma$, $\beta_3Sa\beta\gamma = V\beta\gamma$, and $\gamma_3Sa\beta\gamma = Va\beta$, when we shall obtain

$$\left. \begin{aligned} \phi\rho &= \lambda Sa_3\rho + \mu S\beta_3\rho + \nu S\gamma_3\rho, \\ \theta\rho &= (g\lambda + c_2\mu)Sa_3\rho + (g\mu + c_3\nu)S\beta_3\rho + g\nu S\gamma_3\rho. \end{aligned} \right\} \tag{10}$$

It is clear that θ differs from (1) in its effect on a and on β . The only direction similarly altered by ϕ and θ is γ , the triple axis of $\phi^{-1}\theta$.

6. *Restriction to self-conjugate functions.*—If, as in Art. 4, we require that ϕ and θ shall be self-conjugate, we have by (9) and (9₁)

$$V\lambda V\beta\gamma + V\mu V\gamma a + V\nu Va\beta = 0; \quad Vc\mu V\beta\gamma + Vc_1\nu V\gamma a = 0,$$

which, c and c_1 not being zero, are equivalent to

$$S\beta\nu = 0, \quad S\gamma\nu = 0, \quad S\gamma\mu = 0, \quad Sav = S\gamma\lambda, \quad S\beta\lambda = Sa\mu, \quad \text{and} \quad cS\beta\mu = c_1Sav.$$

Solving for λ , μ , and ν we have

$$\lambda = rV\beta\gamma + qV\gamma a + cpVa\beta, \quad \mu = qV\beta\gamma + c_1pV\gamma a, \quad \nu = cpV\beta\gamma,$$

* *Loc. cit.*, p. 174, equation (24).

where p, q, r are three arbitrary constants. If we substitute these values of λ, u, v , in (9) and (9'), the self-conjugate character of ϕ and θ is evident.

7. *Typical form of ϕ and θ when $\phi^{-1}\theta$ has an infinite number of axes.*—It may also happen that $\phi^{-1}\theta$, whether possessing a double axis or not, has an infinite number of axes. The most general form of $\phi^{-1}\theta$ is then*

$$\phi^{-1}\theta\rho = g\rho + \gamma S\varepsilon\rho, \quad (11)$$

where g is a double root of the cubic in $\phi^{-1}\theta$ (not necessarily corresponding to a double axis), and γ and ε are constant vectors. Let α and β be two vectors which, with γ , form a triplanar system. Call $\phi\alpha, \phi\beta$, and $\phi\gamma$, as before, λ, u , and v , respectively. Expanding $\phi\rho$ we have

$$\phi\rho \cdot S\alpha\beta\gamma = \lambda S\beta\gamma\rho + \mu S\gamma\alpha\rho + \nu S\alpha\beta\rho, \quad (12)$$

and by acting on (11) by ϕ ,

$$\theta\rho = g\phi\rho + \nu S\varepsilon\rho. \quad (12')$$

It thus appears that ϕ and θ differ in the same way the direction of γ , and also that of any vector perpendicular to ε . If γ is itself perpendicular to ε , the function $\phi^{-1}\theta$ becomes a "shear," and γ becomes a double axis.

If we require ϕ and θ to be self-conjugate we may take ϕ any self-conjugate linear vector function whatever, and must have ε parallel to v . Operating by $S\phi$, and setting $\rho = \theta$ in (12'), we see that $S\phi\theta\rho$ is a perfect square, or may be made so by a proper choice of quantities from the pencil.

We may, if we wish, regard various special cases of (12) and (12') as being merely limiting forms of the function-pairs (1), (6), and (10). For example, if either c or l vanishes (8) falls into the form (11), and θ may be written as in (12).

8. *A special case of self-conjugation.*—The foregoing function-pairs have been built up by assigning particular forms to $\phi^{-1}\theta$. Various interesting special cases may be obtained by assigning some special form to ϕ . As an illustration, important in the theory of curves of constant torsion, let ϕ be required to have a double axis and to be self-conjugate. It is clear that ϕ cannot be real, since a real self-conjugate linear vector function has three distinct mutually perpendicular axes. In fact, if we write ϕ in the form of the right member of (4), which is the most general form of a linear vector function having two coincident axes, viz. :—

$$\phi\rho = g\rho + c\beta S\gamma\beta_1\rho + c_1\beta_1 S\alpha\beta\rho,$$

the condition for self-conjugation is

$$cV\beta V\beta_1 + c_1V\beta_1 V\alpha\beta = 0,$$

* *Loc. cit.*, p. 175, equation (28).

equivalent to the three scalar equations

$$c_1 S\beta\beta_1 = 0, \quad c_1 S\alpha\beta_1 - cS\beta\beta_1 = 0, \quad c\beta^2 = 0.$$

If c and c_1 are different from zero, these reduce to

$$S\beta\beta_1 = 0, \quad S\alpha\beta_1 = 0, \quad \beta^2 = 0,$$

whence β must be a vector whose square is zero, i.e. a minimal vector. An example of such a vector is $i + j\sqrt{-1}$. We may satisfy the conditions by taking $\beta_1 = k$, and $\alpha = i$, with c and c_1 any constants. We shall then have

$$\phi\rho = g\rho + c(i + j\sqrt{-1})S(-j + i\sqrt{-1})\rho + c_1 k S k \rho.$$

Here i, j, k are any three unit vectors forming a rectangular system, ϕ is self-conjugate, and has the two axes k and $i + j\sqrt{-1}$, the latter being a double axis.

When $\phi\rho$ has been developed in this or any other manner, a second function $\theta\rho$ may be formulated, following Joly, by expanding θ in terms of three vector constituents of ϕ . Thereby θ is determined by means of nine constants, and it is in terms of these constants that Joly expresses a large number of invariants (cf. note 1).

9. *Typical form of ϕ and θ when no function of the pencil has an inverse.*—The function-pairs (1), (6), (10), and (12) include all possible cases except when no function of the pencil possesses an inverse. In this latter case, the cubic in $\phi + t\theta$ must have a vanishing root for all values of t . Now the constant term in this cubic, as was pointed out by Joly, may be written

$$m_3' + tl_3' + t^2l_3 + t^3m_3,$$

where m_3' and m_3 are the third invariants of ϕ and θ respectively, and l_3' and l_3 are Joly's new invariants given by

$$l_3 = \frac{S(\phi\alpha\theta\beta\theta\gamma + \phi\beta\theta\gamma\theta\alpha + \phi\gamma\theta\alpha\theta\beta)}{S\alpha\beta\gamma}, \quad l_3' = \frac{S(\theta\alpha\phi\beta\phi\gamma + \theta\beta\phi\gamma\phi\alpha + \theta\gamma\phi\alpha\phi\beta)}{S\alpha\beta\gamma}.$$

The invariants m_3' and m_3 vanish by hypothesis. If, and only if, l_3' and l_3 also vanish, we shall have no function of the pencil possessing an inverse.

These quantities are invariant in the sense that their values are independent of our choice of the three vectors α, β, γ , provided they are diplanar. Let α be chosen to be the direction annulled by ϕ , that is $\phi\alpha = 0$. We shall have two sub-cases, according as $\theta\alpha$ is, or is not, zero. If $\theta\alpha = 0$, it is evident that α is zero for every function of the pencil. If $\theta\alpha$ is not zero, let β be chosen to be the direction annulled by θ , i.e. $\theta\beta = 0$. Let γ be any vector not coplanar with α and β . Joly's invariants now become

$$l_3 = \frac{S\phi\beta\theta\gamma\theta\alpha}{S\alpha\beta\gamma} \quad \text{and} \quad l_3' = \frac{S\theta\alpha\phi\beta\phi\gamma}{S\alpha\beta\gamma}.$$

If these are both zero, we shall therefore have simultaneously

$$S\gamma\theta'V\theta a\phi\beta = 0 \quad \text{and} \quad S\gamma\phi'V\theta a\phi\beta = 0.$$

But γ was an arbitrary vector, hence these equations imply

$$\theta'V\theta a\phi\beta = 0 \quad \text{and} \quad \phi'V\theta a\phi\beta = 0.$$

that is, the vector $V\theta a\phi\beta$ is a zero for both of the conjugates ϕ' and θ' . This direction will then be a zero for the conjugate of any function of the pencil.

The two sub-cases may accordingly be characterized as follows:—

1. ϕ and θ have a common zero. This implies that the conjugates $\phi'\rho$ and $\theta'\rho$ lie in a common fixed plane for all values of ρ .

2. ϕ' and θ' have a common zero. This implies that $\phi\rho$ and $\theta\rho$ lie in a common fixed plane for all values of ρ .

The second case is easy to formulate. Since the common fixed plane is known when ϕ and θ are known, we may choose ϵ and η any two perpendicular unit vectors in that plane, and expand ϕ and θ in terms of them, when the two functions necessarily appear in the form

$$\phi\rho = iS\alpha\epsilon\rho + jS\alpha\eta\rho, \quad \theta\rho = iS\beta\lambda\rho + jS\beta\mu\rho, \quad (13)$$

where ϵ , η , λ and μ are four constant vectors: for, by hypothesis, $\phi a = 0$ and $\theta\beta = 0$. To find ϵ we have $-S\epsilon\phi\rho = -S\rho\phi'\epsilon = S\rho V\alpha\epsilon$, whence, ρ being any vector, we must have $V\alpha\epsilon = -\phi'$; therefore ϵ may be any vector at right angles to ϕ' , distinct in direction from a , the tensors of a and of ϵ being selected to satisfy this equation. In a similar manner we may find values for η , λ , and μ .

In the other sub-case $\phi'\rho$ and $\theta'\rho$ lie in a common fixed plane. Hence they must be in form, the conjugates of the right members of (13) or some equivalent. That is, we may write for this case

$$\phi\rho = V\alpha\epsilon S i\rho + V\alpha\eta S j\rho, \quad \theta\rho = V\beta\lambda S i\rho + V\beta\mu S j\rho, \quad (14)$$

where ϵ , η , λ and μ are to be found by treating the conjugates as ϕ and θ were treated in (13), i and j are taken in the plane of the conjugates, l is the common zero of ϕ and θ , and a and β are the directions annihilated by the conjugates, ϕ' and θ' , respectively.

The forms (13) and (14), from their method of formation, cover all function-pairs such that no function of the pencil has an inverse.

10. *Application to quadratic vector functions.*—In conclusion I shall prove

a theorem, which, as I have elsewhere shown,* is fundamental in the theory of quadratic vector functions.

Theorem: The locus of the IRREDUCIBLE† vector $V\phi\rho\theta\rho$ cannot be a fixed plane.

To prove the theorem, we note that by the preceding investigation all possible function-pairs may be written in one or the other of the six cases, (1), (6), (10), (12), (13), or (14).

Forming the product $V\phi\rho\theta\rho$ from (1), we have

$$V\phi\rho\theta\rho = (c - b)V_{\mu\nu}S\beta\rho S\gamma\rho + (b - a)V_{\lambda\mu}S\alpha\rho S\beta\rho + (a - c)V_{\nu\lambda}S\gamma\rho S\alpha\rho, \quad (15)$$

where λ , μ , and ν were by hypothesis diplanar, since ϕ has an inverse. Hence $V_{\mu\nu}$, $V_{\nu\lambda}$, and $V_{\lambda\mu}$ are also diplanar. Furthermore, a , b , and c are unequal, since, in this case, $\phi^{-1}\theta$ has distinct roots. And α , β , γ are diplanar for the same reason. Hence the locus of (15) cannot be a fixed plane, and the theorem is proved for this case.

Forming the product $V\phi\rho\theta\rho$ from (6), we have

$$V\phi\rho\theta\rho = (g_1 - g)V_{\mu\nu}S\beta\rho S\gamma\rho + (g - g_1)V_{\nu\lambda}S\gamma\rho S\alpha\rho + e_2[V_{\lambda\mu}S^2\alpha\rho - V_{\mu\nu}S\gamma\rho S\alpha\rho], \quad (16)$$

where similar reasoning holds, viz., λ , μ , and ν are diplanar because ϕ has an inverse: hence the vectors $V_{\mu\nu}$, $V_{\nu\lambda}$, and $V_{\lambda\mu}$ are diplanar; $g - g_1$ is not zero, since $\phi^{-1}\theta$ has two unequal roots; e_2 was by hypothesis not zero; and, finally, the scalars $S\alpha\rho$, $S\beta\rho$, and $S\gamma\rho$ cannot be multiples one of another, since α , β , and γ are diplanar. Hence the locus of (16) cannot be a fixed plane.

Forming the product $V\phi\rho\theta\rho$ from (10), we have

$$V\phi\rho\theta\rho = c_1[V_{\mu\nu}S^2\gamma\rho - V_{\nu\lambda}S\beta\gamma\rho S\gamma\rho] + c[V_{\lambda\mu}S^2\beta\gamma\rho - V_{\mu\nu}S\beta\gamma\rho S\gamma\rho]. \quad (17)$$

Here neither c nor c_1 can be zero under the hypothesis for this case. The rest of the reasoning is as before. Hence the locus of (17) is not a fixed plane.

Passing to (12), which is equivalent to removing the restrictive hypotheses on the c 's and g 's of the former cases, it is evident that we have $V\phi\rho\theta\rho$ divisible by $S\epsilon\rho$, hence reducible.

From (13) we have $V\phi\rho\theta\rho$ parallel to k , and so divisible by a quadratic scalar, that is reducible.

* Proc. Nat. Acad. Sci., *loc. cit.* For a more detailed study of quadratic vectors see "A Classification of Quadratic Vectors." Proc. American Acad. of Arts and Sciences, 52-7 (January, 1917), p. 369.

† An irreducible vector is one which cannot be factored into a variable scalar and a vector of lower degree,—a term of the form ρt being added to the vector if necessary. As an equivalent definition we may say that a vector $F\rho$ is reducible when, and only when, the vector product $V_\rho F\rho$ is divisible by a scalar variable.

Finally, from (14), forming the product $V\phi\rho\theta\rho$ we have

$$V\phi\rho\theta\rho = S^2i\rho VV\alpha\epsilon V\beta\lambda - S^2j\rho S^2j\rho[VV\alpha\epsilon V\beta\mu + VV\alpha\eta V\beta\lambda] + S^2j\rho VV\alpha\eta V\beta\mu. \quad (18)$$

Since i and j are at right angles, it is only needful to show that coplanarity of the vector coefficients entails the reducibility of the expression; in fact, to show that whenever we have

$$S.VV\alpha\epsilon V\beta\lambda[VV\alpha\epsilon V\beta\mu + VV\alpha\eta V\beta\lambda]VV\alpha\eta V\beta\mu = 0, \quad (19)$$

we also have the right member of (18) divisible by a scalar factor. The scalar product may be expanded as

$$-S.V\alpha\epsilon V\beta\lambda V\beta\mu S.V\alpha\epsilon V\alpha\eta V\beta\mu - S.V\alpha\epsilon V\beta\lambda V\alpha\eta S.V\beta\lambda V\alpha\eta V\beta\mu, \quad (20)$$

by applying the identity

$$S.V\rho_1\rho_2 V\rho_2\rho_1 V\rho_3\rho_6 = S\rho_1\rho_2\rho_3 S\rho_4\rho_5\rho_6 - S\rho_1\rho_2\rho_4 S\rho_3\rho_5\rho_6$$

in which we write $\rho_1 = V\alpha\epsilon$, $\rho_2 = V\beta\lambda$, &c. Expanding again in a similar manner (20) may be written

$$-S\alpha\epsilon\beta S\lambda\beta\mu . (-S\alpha\epsilon\eta S\alpha\beta\mu) + S\alpha\epsilon\eta S\alpha\beta\lambda . S\beta\lambda\mu S\alpha\eta\beta. \quad (21)$$

Now if $S\lambda\beta\mu = 0$, the direction of $\theta\rho$ in (14) is constant, hence $\theta\rho$ is divisible by a linear scalar and (18) is reducible. Similarly, if $S\alpha\epsilon\eta = 0$, $\theta\rho$ is reducible. Rejecting these factors from (21) we have

$$S\alpha\epsilon\beta S\alpha\beta\mu - S\alpha\beta\lambda S\alpha\eta\beta = 0, \quad (22)$$

as the only remaining possibility. But this is the condition that $\phi'\beta$ shall be parallel to θa ; for, remembering that (13) is the conjugate of the present case, we have

$$\phi'\beta = iS\alpha\epsilon\beta + jS\alpha\eta\beta, \quad \theta'a = iS\beta\lambda a + jS\beta\mu a; \quad (23)$$

the condition that the coefficients of i and j shall be in proportion is equivalent to (22). Write accordingly $\theta'a = r\phi'\beta$ and take γ any vector not coplanar with a and β . Identically

$$\rho S\alpha\beta\gamma = aS\beta\gamma\rho + \beta S\gamma a\rho + \gamma S\alpha\beta\rho,$$

whence, operating with ϕ' and θ' , and remembering $\phi'u = \theta'\beta = 0$,

$$\phi'\rho S\alpha\beta\gamma = \phi'\beta S\gamma a\rho + \phi'\gamma S\alpha\beta\rho, \quad \theta'\rho S\alpha\beta\gamma = r\phi'\beta S\beta\gamma\rho + \theta'\gamma S\alpha\beta\rho.$$

By taking conjugates of both sides

$$\phi\rho S\alpha\beta\gamma = V\gamma a S\phi'\gamma\rho + V\alpha\beta S\phi'\gamma\rho, \quad \theta\rho S\alpha\beta\gamma = rV\beta\gamma S\phi'\beta\rho + V\alpha\beta S\theta'\gamma\rho.$$

Forming the vector product we have

$$V\phi\rho\theta . S^2\alpha\beta\gamma$$

$$= S\phi'\gamma\rho [rVV\gamma a V\beta\gamma S\phi'\gamma\rho + VV\gamma a V\alpha\beta S\theta'\gamma\rho + rVV\alpha\beta V\beta\gamma S\phi'\gamma\rho]$$

which contains the factor $S\phi'\beta\rho$, hence is reducible. The theorem is therefore proved.

II.

ON TWO-DIMENSIONAL FLUID MOTION, WITH FREE STREAM-LINES, PAST AN OBSTACLE OF CURVED OUTLINE.

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INTRODUCTION.

1. There is already a considerable amount of literature on the subject of the two-dimensional flow of infinite liquid, with free stream-lines, past a fixed obstacle of curvilinear outline, or, what comes to the same thing, the motion of such an obstacle through liquid which is "at rest at infinity." The following papers are those which seem most relevant to the present discussion; they are arranged in chronological order, and reference will be made to them by quoting the prefixed capital letters:—

A. T. LEVI-CIVITA. *Scie e Leggi di Resistenza*, Rendiconti del Circolo Matematico di Palermo, xxiii, 1907.

B. U. CISOTTI. *Vene Fluenti*, Rendiconti del Circolo Matematico di Palermo, xxv, 1908.

C. H. VILLAT. *Sur la résistance des fluides*, Annales de l'École Normale Supérieure, 3me série, xxviii, 1911.

D. J. G. LEATHEM. *Some applications of conformal transformation to problems in hydrodynamics*, Phil. Trans. Royal Society, A, cexiv, 1915.

E. H. LEVY. *Discontinuous fluid motion past a curved boundary*, Proc. Royal Society, A, xcii, March, 1916.

F. J. G. LEATHEM. *On two-dimensional fields of flow, with logarithmic singularities and free boundaries*, Philosophical Magazine, xxxi, March, 1916.

G. J. G. LEATHEM. *Theorems on conformal transformation*, Proc. Lond. Math. Soc. xvi, 1917.

In these researches there have been three distinct objectives:—

(i) A mathematical formulation, in terms of somewhat general functions.

for any motion bounded partly by fixed and partly by free boundaries; (ii) The exact or approximate adaptation of such a general formula to the case of an obstacle of arbitrarily assigned outline; (iii) The choice of such forms of obstacle as shall correspond to liquid motions that can be precisely specified.

The exact adaptation of a general formulation to the case of an assigned obstacle seems bound to depend upon difficult functional equations upon whose solution further progress must wait; and it is doubtful whether any sufficiently practical and general method of approximation has yet been demonstrated. For this one may find some consolation in the reflection that the question is mainly of academic interest, since in practically important applications to problems of design the form of the fixed boundary is the *quaesitum*, not the *datum*.

The primary objective of a comprehensive formulation remains of fundamental importance, since such may well be the only possible point of departure for further progress in general theory. The papers in the above list present several different types of mathematical formulation, and yet plainly leave room for possible alternatives.

The present paper offers a general formulation in terms of conformal curve-factors—functions whose properties the writer has discussed in previous papers. The method leads to expressions in terms of a definite integral involving a single arbitrary function of a real variable, and it is believed that in this form the properties of the relation between the fundamental variables are exhibited as simply as possible. From this formulation as starting-point it has proved feasible to make a certain advance in knowledge, for there are obtained formulae which specify the most forward points at which free stream-lines can break away from an obstacle with smoothly curved sides. Attention is called to a probable connection between the positions of these points and the resistance which the obstacle offers to the stream when there are no free stream-lines but the “wake” is in rotational motion; and a principle is defined which may have important bearing on the problem of designing cylinders of small resistance as for example struts for aeroplanes.

Notation and Formulation.

2. The material configuration is represented in the plane of a complex variable $z = x + iy$. The obstacle is supposed to be at rest, and the liquid to be streaming past with a steady velocity whose limit, for infinite remoteness from the obstacle, is V parallel to the positive direction of the axis of x .

The obstacle is of finite dimensions, and is assumed generally to have a pointed prow or vertex, and smoothly curved sides. The type of the configuration is represented in figure 1. A stream-line divides at the vertex,

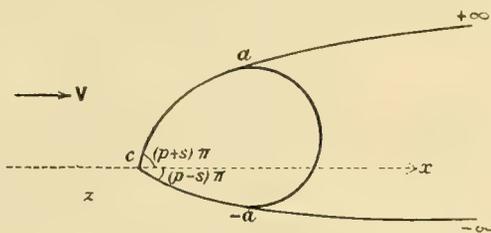


FIG. 1.

and each branch follows the contour of the obstacle for a certain distance and then breaks away as a free stream-line, which tends to ultimate parallelism with the axis of x . Between the free stream-lines, and partially bounded by the hinder surface of the obstacle, there is a semi-infinite region occupied by liquid at rest, the "wake."

The angles which the tangents to the two sides of the obstacle, just at the vertex, make with the axis of x may be denoted by $(p + s)\pi$ and $-(p - s)\pi$ respectively.

The relevant region in the z plane is the region of flow, whose boundary is made up of the two free stream-lines and part of the surface of the obstacle, including the vertex.

The field of flow is formally specified by the complex variable $w = \phi + i\psi$, such that, if (u, v) be the velocity,

$$d\phi = u dx + v dy, \quad d\psi = u dy - v dx.$$

A knowledge of the functional relation between w and z is what is required for a definite specification of the motion. Such a relation must give a conformal representation of the relevant region in the z plane upon a relevant region in the w plane, consisting, namely, of the whole of the w plane bounded only by the two sides of a cut made along the axis of ϕ from $\phi = 0$

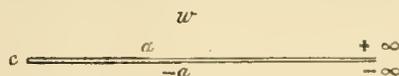


FIG. 2.

to $\phi = +\infty$, as indicated in figure 2. It is assumed that $w = 0$ at the vertex.

It is found convenient to introduce an intermediate variable $\zeta = \xi + i\eta$ which is so related to z that the relevant region in the z plane is conformally

represented upon the half-plane $\eta > 0$. This implies a relation between w and ζ such that the relevant region in the w plane is also conformally represented upon the half-plane $\eta > 0$. Thus there are two functional relations, the "geometrical relation" between z and ζ , and the "field relation" between w and ζ . Figure 3 represents the ζ diagram, and it is convenient



FIG. 3.

to specify points of interest in the other diagrams by the values assigned to ζ at these points, namely c at the prow, $-a$ and a at the points of departure of the free stream-lines, and $-\infty$ and $+\infty$ for infinite remoteness along these stream-lines.

A suitable form for the field relation is

$$w = \frac{1}{2} V (\zeta - c)^2; \quad (1)$$

the main problem is to find a geometrical relation which shall satisfy not only the geometrical data but also the special requirements of free stream-lines. When this problem is dealt with by the method of curve-factors no variables are required but those above specified.

3. If the obstacle is symmetrical about a line parallel to the ultimate stream, the distribution of flow is symmetrical about the same line. Such a configuration is typified in figure 4. In this case it is convenient to adopt a

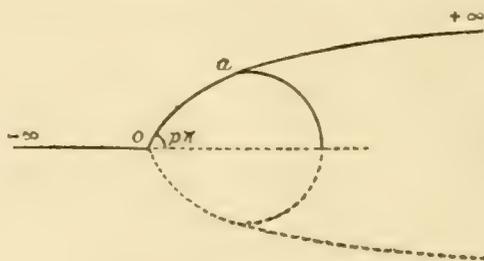


FIG. 4.

different formulation and to regard half the field of flow as constituting the relevant region in the z plane, the boundary being completed by the straight stream-line in the line of symmetry. The corresponding region in the w plane is the half-plane on the positive side of the real axis, so that the intermediate variable ζ is not required, ζ and w being equal. The value assigned to ζ or w at the prow is now zero, and the value at the point of departure of the free stream-line is a .

4. It is convenient to put $u + iv = q \exp(i\varpi)$, so that q is the resultant velocity and ϖ its direction-angle, and to notice that $dw/dz = u - iv$. The characteristic of a stream-line that is free is that, along it, the resultant velocity q or $|dw/dz|$ is constant.

If the geometrical relation be

$$dz = \mathcal{C}_0(\zeta) d\zeta, \quad (2)$$

where $\mathcal{C}_0(\zeta)$ is a curve-factor, the constancy of q involves that of $|\mathcal{C}_0(\zeta) d\zeta dw|$, so that, if $w = \frac{1}{2}V(\zeta - c)^2$, $|\mathcal{C}_0(\zeta)/(\zeta - c)|$ is constant. Along a free stream-line which extends to infinity the constant value of q must be V , and therefore the constant value of $|\mathcal{C}_0(\zeta)/(\zeta - c)|$ is unity.

If, as in the case of symmetry, $w = \zeta$, then $|\mathcal{C}_0(\zeta)|$ is constant along a free stream-line.

GENERAL FORMULAE.

5. A field relation and a geometrical relation of the forms of equations (1) and (2) respectively having been assumed, the problem of formulation is reduced to that of finding a suitable general formula for $\mathcal{C}_0(\zeta)$.

The requirements which $\mathcal{C}_0(\zeta)$ has to satisfy are:—(i) that it shall give a conformal relation between the relevant regions of the planes of z and ζ , which is equivalent to saying that it must be a curve-factor, not necessarily pure (G , § 1), whose angular range is π , and (ii) that all along the parts of the boundary corresponding to free stream-lines, namely the parts where ζ is real and $\zeta^2 > a^2$, the modulus of $\mathcal{C}_0(\zeta)/(\zeta - c)$ shall be unity.

In the case of symmetry there is a single relation, say

$$dz = \mathcal{C}'_0(w) dw, \quad (3)$$

and what is required of $\mathcal{C}'_0(w)$ is that it shall be a curve-factor of zero angular range, whose linear range is the part of the real axis of w in which w is positive, and such that the modulus of $\mathcal{C}'_0(w)$ is constant for w real and greater than a .

Whether for $\mathcal{C}_0(\zeta)$ or $\mathcal{C}'_0(\zeta)$, the general formula is a product or limit of a product of curve-factors of suitable type and possibly also Schwarzian corner-factors. But there is a considerable range of choice of the type of sub-factor. In the case of a limit of a product it is convenient to represent \mathcal{C}_0 or \mathcal{C}'_0 as the exponential of a definite integral, making use of equalities of the type

$$\text{Lim}_{\kappa = a}^{\kappa = b} \prod \{\theta(\kappa)\}^{f(\kappa) \delta\kappa} = \text{Exp} \int_a^b f(\kappa) \log \{\theta(\kappa)\} d\kappa.$$

6. In passing it is worth while to refer to possible types of sub-factor other than that which it is proposed to adopt.

Adverting to the case of symmetry, it is known (D, § 37) that, when κ is a real parameter, that branch of

$$\{i\kappa + (w - \kappa)^{\frac{1}{2}}\}/w^{\frac{1}{2}},$$

in the relevant region of the plane of w , which $\rightarrow 1$ for $w \rightarrow +\infty$ is a curve-factor of zero angular range, representing a straight boundary for w real and $0 < w < \kappa$, and a curved boundary for $w > \kappa$, and having constant modulus on the curved boundary. Hence

$$\mathcal{C}'_0(w) = \text{Exp} \int_0^a \log [\{i\kappa + (w - \kappa)^{\frac{1}{2}}\}/w^{\frac{1}{2}}] f(\kappa) d\kappa, \quad (4)$$

where f is any function of the real variable κ , is a form of \mathcal{C}'_0 which satisfies the special requirements. Save for slight changes of notation and sign-convention, this is the same as $w^{-p}\mathcal{C}_0(w)$ as defined in D, § 40. It is mentioned here because, if Mr. Levy's analysis (paper E) were replaced by an equivalent analysis in terms of curve-factors, it would prove to correspond, in the case of symmetry, to using a form of $\mathcal{C}_0(\zeta)$ which differs from the above only as the product of a definite number of factors with definite indices differs from the exponential of a definite integral, which is its limit when the number of factors becomes great without limit and the index of each factor infinitesimal.

Similarly, Mr. Levy's treatment of the asymmetrical case would correspond to the use of powers of sub-factors of the type

$$\mathcal{C}_{12}(\zeta) = i \left\{ \frac{(\beta - a - 2c)(\zeta - c)}{2(a + c)^{\frac{1}{2}}(\beta - c)^{\frac{1}{2}}} - a + c \right\} (\beta - c)^{\frac{1}{2}} \left\{ (\zeta - a)^{\frac{1}{2}} \zeta - \beta \right\}^{\frac{1}{2}}, \quad (5)$$

which is a particular case of \mathcal{C}_{12} and \mathcal{C}_{23} as defined in F, § 8. The index would ultimately be a function of a and β , while these parameters would take values respectively between $-c$ and a , and between c and a .

Some reason for doubting the complete generality of \mathcal{C}'_0 as given by formula (4) is suggested in Article 18 below.

When Prof. Levi-Civita's analysis (paper A) is replaced by a parallel analysis in terms of curve-factors, it is found to be essentially equivalent to representing $\mathcal{C}_0(\zeta)$ as the product of a single factor

$$\{\mathcal{C}_{12}(\zeta) (\zeta - c)\}^{2p},$$

in which $a = \beta = a$, and a number of sub-factors of the type

$$\mathcal{C}_n(\zeta) = \text{Exp} [-ic_n a^{-n} \{ -\zeta + (\zeta^2 - a^2)^{\frac{1}{2}} \}^n], \quad (6)$$

n taking integral values. On comparison with D, § 43, it will be recognized

that C'_n belongs to the type of C'_s , but is closely akin to C'_m and has zero order at infinity.

Still another type of sub-factor is the foundation of the formula of G, § 59. It is believed, however, that the one now to be discussed is simpler and more useful for developing general theory.

7. Suggestion is found in the obvious device of taking the fixed curved boundary of the obstacle as the limit of a rectilinear polygon, for which latter type of obstacle the solution of the hydrodynamical problem is, in one form or another, well known. With very different analysis Cisotti (paper B) has dealt with a polygonal obstacle, and Villat (paper C) with a curved obstacle as the limit of a polygon. In paper D, § 38, the present writer has outlined the formulation of this process in terms of curve-factors, for the particular case of symmetry, but without such demonstration of the generality of the formula as is necessary if further theory is to be built upon it.

Beginning with the asymmetrical case, it is convenient to replace $C'_a(\zeta)$ by $(\zeta - c) C(\zeta)$, so that the geometrical relation is

$$dz = (\zeta - c) C(\zeta) d\zeta. \quad (7)$$

Then, since $\zeta - c$ has angular range π , what is required of $C(\zeta)$, besides generality, is that it be a curve-factor of angular range zero, such that for all real values of ζ greater than a or less than $-a$ the modulus of $C(\zeta)$ is unity. Lest the ultimate parallelism of the free stream-lines should be regarded as an unjustified assumption, it may be recalled in passing that the angular range of a curve-factor is always π times the order at infinity (D, § 5), so that the constancy of $|C(\zeta)|$ for $\zeta \rightarrow \infty$ is not compatible with any angular range for $C(\zeta)$ other than zero.

Now if in $C_{72}(\zeta)$, as defined in equation (5), $\alpha = \beta = a$, and c is replaced by a real parameter κ intermediate in value between $-a$ and a , there results a curve-factor

$$C_{72}(\kappa, \zeta) = -i(\kappa\zeta - a^2)(a^2 - \kappa^2)^{-\frac{1}{2}} + (\zeta^2 - a^2)^{\frac{1}{2}}, \quad (8)$$

whose angular range is π and whose modulus, for ζ real and $\zeta^2 > a^2$, is

$$a(a^2 - \kappa^2)^{-\frac{1}{2}} |\zeta - \kappa|.$$

Hence $C_{72}(\kappa, \zeta) (\zeta - \kappa)$ is a curve-factor which, if multiplied by a suitable complex constant, satisfies the particular requirements of $C(\zeta)$; and any power of this expression is equally suitable. Further, for ζ real and $\zeta^2 > a^2$, the vector angle of the expression is constant, save for abrupt change in passing through the value $\zeta = \kappa$.

If, therefore, a succession of values κ_r be taken for κ , all lying between $-a$ and a , and if to $\mathcal{C}(\zeta)$ be assigned the form

$$\mathcal{C}(\zeta) = K' \prod_r \{ \mathcal{C}_{72}(\kappa_r, \zeta) / (\zeta - \kappa_r) \}^{\lambda_r}, \tag{9}$$

where K' is a complex constant, the relation (7) will represent upon the relevant half-plane of ζ the region bounded internally partly by an open rectilinear polygon having corners at κ_1, κ_2 , etc. and c , and partly by curved lines extending to infinity: and when the field relation is employed it specifies a field of flow in which the polygon represents the obstacle, and the curved boundary the free stream-lines.

Since $\mathcal{C}_{72}(\kappa, \zeta)$ is a pure curve factor, that is such as would if employed singly give a boundary free from corners, the corner-factors in $\mathcal{C}(\zeta)$ are simply those which appear explicitly in formula (9): to these, in formula (7), must be added the corner-factor $\zeta - c$. Hence the angles of the polygon, measured on the side of the moving liquid, are 2π at $\zeta = c$, $(1 - \lambda_1)\pi$ at $\zeta = \kappa_1$, $(1 - \lambda_2)\pi$ at $\zeta = \kappa_2$, etc., as indicated in figure 5. It is, of course, permissible

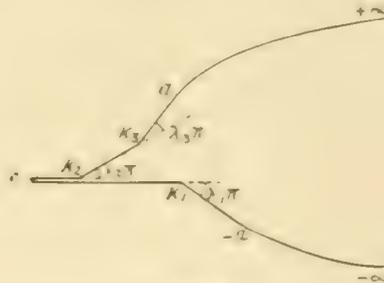


FIG. 5

to take one of the values of λ to be $\frac{1}{2}$, and if this be associated with a power λ' the angle at the vertex will be $(2 - \lambda')\pi$ instead of 2π .

The form of that part of the boundary of the obstacle which is in dead water is, at this stage, irrelevant.

An obstacle of the type represented in figure 1 may be regarded as the limit of a polygonal obstacle of the type represented in figure 5, as the sides of the polygon become indefinitely numerous and indefinitely small. If the obstacle is to be smooth everywhere save at the vertex, each angle of the type $\lambda\pi$ becomes infinitesimal and therefore also each index λ , with the sole exception of λ' ; such infinitesimal index may be represented by $p\lambda$. In order to get a vertical angle $2p\pi$ it is necessary to put $\lambda' = 2p$.

The passage to limit yields the formula

$$\begin{aligned}
 \mathcal{C}'(\zeta) &= K' \left\{ \frac{\mathcal{C}'_{72}(c, \zeta)}{\zeta - c} \right\}^{2p} \text{Lim}_{\kappa = -a}^{\kappa = a} \prod_{\kappa = -a}^{\kappa = a} \left\{ \frac{\mathcal{C}'_{72}(\kappa, \zeta)}{\zeta - \kappa} \right\}^{\delta\lambda}, \\
 &= K' \left\{ \frac{\mathcal{C}'_{72}(c, \zeta)}{\zeta - c} \right\}^{2p} \text{Exp} \int_{\kappa = -a}^{\kappa = a} \log \left\{ \frac{\mathcal{C}'_{72}(\kappa, \zeta)}{\zeta - \kappa} \right\} d\lambda. \tag{10}
 \end{aligned}$$

The integral in the second line is not, of course, definite until assumption is made of a functional relation between κ and λ , that is between the integrated flow up to a point of the boundary and the direction of the tangent at that point. The form of this function and the form of the fixed boundary are interdependent, so that if either is assigned the other is determinate.

The corresponding geometrical relation is

$$\frac{dz}{d\zeta} = K'(\zeta - c) \left\{ \frac{\mathcal{C}'_{72}(c, \zeta)}{\zeta - c} \right\}^{2p} \text{Exp} \int_{\kappa = -a}^{\kappa = a} \log \left\{ \frac{\mathcal{C}'_{72}(\kappa, \zeta)}{\zeta - \kappa} \right\} d\lambda, \tag{11}$$

and this, together with the field relation, with the hypothesis of an adjustable functional relation between κ and λ , constitutes the general formulation of the hydrodynamical problem. But the generality of the formulation has yet to be proved, and this must now be done.

DEMONSTRATION OF GENERALITY.

8. The corner of angle $2p\pi$ at the vertex being assumed to be the only corner on the obstacle, though others could easily be allowed for if necessary, the theorem to be proved is this:—Any curve-factor whatever, $\mathcal{C}'(\zeta)$, which has the property that its modulus is constant over those parts of the real axis of ζ for which $\zeta^2 > a^2$, and which has no zeros or infinities on that axis save an infinity at c of the form $(\zeta - c)^{-2p}$, is capable of being expressed as in formula (10). Without any real loss of generality, one may postulate further that $\mathcal{C}'(\zeta)$ tends to a real limit, K , for $\zeta \rightarrow +\infty$.

It is convenient to introduce a new function defined by the relation

$$\begin{aligned}
 F(\kappa, \zeta) &= \left\{ 1 - \frac{i\kappa}{(a^2 - \kappa^2)^{\frac{1}{2}}} \right\} \frac{\zeta - \kappa}{\mathcal{C}'_{72}(\kappa, \zeta)}, \\
 &= \frac{(\zeta - \kappa)^{\frac{1}{2}} - \kappa - i(a^2 - \kappa^2)^{\frac{1}{2}}}{-\kappa\zeta + a^2 - i(a^2 - \kappa^2)^{\frac{1}{2}}(\zeta^2 - a^2)^{\frac{1}{2}}}, \tag{12}
 \end{aligned}$$

which, for κ real and $|\kappa| < a$, is a curve-factor in ζ whose limit value for $\zeta \rightarrow \infty$ is unity, with constant modulus (unity) over the proper ranges of

ζ real. It is to be understood that the branch points $\zeta = \pm a$ are excluded by infinitesimal cavities from the relevant half plane of ζ for which the function is defined.

If $dz/d\zeta$ be equal to a product of powers of functions of this type multiplied by a real positive constant, the asymptotic directions of the curve corresponding to ζ real will be parallel to the real axis of z .

Now let a fixed value ζ_0 be assigned to ζ , corresponding to any point in the relevant half-plane, and let a complex variable ζ be substituted for κ . There results a function

$$F(\zeta, \zeta_0) = \frac{(\zeta_0 - \zeta) \{-\zeta - i(a^2 - \zeta^2)^{\frac{1}{2}}\}}{-\zeta\zeta_0 + a^2 - i(a^2 - \zeta^2)^{\frac{1}{2}}(\zeta_0^2 - a^2)^{\frac{1}{2}}}, \quad (13)$$

and if this also be considered only in the relevant half-plane of ζ its definition can be cleared of ambiguity by postulating that the continuation of the function from real values of ζ between the branch-points $\pm a$ shall be by paths confined to the positive half plane with these branch-points excluded as before.

It is important to notice that $F(\zeta, \zeta_0)$, regarded as a function of ζ , has no infinity or zero in the relevant half-plane save the obvious zero at ζ_0 .

It is proposed to show that, if $\ell'(\zeta)$ be any curve-factor complying with the conditions set out in the first paragraph of the present article, then $\ell'(\zeta_0)$ can always be expressed as a product or limit-product of factors which are powers of $F(\kappa, \zeta_0)$, where κ takes real values from $-a$ to a .

For real values of ζ it is convenient to put $\ell'(\zeta) = \tau \exp(i\beta)$.

The integral

$$\int \pi^{-1} \log F(\zeta, \zeta_0) d \log \ell'(\zeta), \quad (14)$$

taken round any contour in the relevant half-plane of ζ , will vanish if the contour does not surround an infinity or branch-point of the subject of integration. Consider a contour consisting mainly of a semicircle with centre at the origin and large radius R , together with its diameter in the real axis, with a semicircular detour of infinite small radius ϵ round the point c . At ζ_0 , which is assumed within this contour, $\log F(\zeta, \zeta_0)$ has a singularity of the type $\log(\zeta_0 - \zeta)$; in order to exclude this a circular cavity of infinitesimal radius ϵ' is made round ζ_0 , and a cut from this across to the semicircular boundary. This gives a complete contour which includes the two sides of the cut and the circumference of the cavity, and inside this contour the subject of integration has no singularities. Limit formulae are sought for ϵ and ϵ' vanishing and $R \rightarrow \infty$. It is convenient to make the cut to the negative end of the diameter, as in figure 6.

The logarithm is so defined that, as ζ traverses the real axis from $-\infty$ to ∞ , the imaginary part of $\log(\zeta_0 - \zeta)$ increases from zero to π .

If ζ made a complete circuit round ζ_0 in the positive sense, $\log F(\zeta, \zeta_0)$ would increase by $2i\pi$; hence the values of the logarithm at corresponding

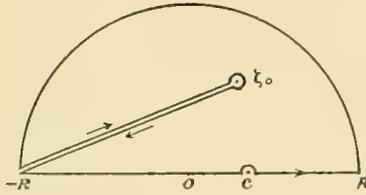


FIG. 6.

points on opposite edges of the cut differ by this amount, and the integrations along the two edges combine to give

$$2i \int_{-R}^{\zeta_0} d \log \mathcal{C}(\zeta)$$

or $2i \{ \log \mathcal{C}(\zeta_0) - \log \mathcal{C}(-R) \}$, whose limit is $2i \{ \log \mathcal{C}(\zeta_0) - \log K \}$.

The integral round the circumference of the cavity is of the order of $\epsilon' \log \epsilon'$, and so has its limit value zero.

On the infinitesimal semicircle round c the integral has the same limit as

$$\pi^{-1} \log F(c, \zeta_0) \int d \log (\zeta - c)^{-2p},$$

namely $2ip \log F(c, \zeta_0)$.

On the semicircle of radius R , for $R \rightarrow \infty$, $\log F(\zeta, \zeta_0) \sim \log \zeta$; and if $\zeta = R \exp i\theta$, $d\zeta = i\zeta d\theta$. If $\mathcal{C}(\zeta) = K \{ 1 + f(\zeta) \}$, where $f(\zeta) \rightarrow 0$, then $d \log \mathcal{C}(\zeta) \sim i\zeta f'(\zeta) d\theta$. Hence, if it be assumed that the order of smallness of $f'(\zeta)$, for R or $|\zeta|$ great, is such that $R \log R f'(\zeta) \rightarrow 0$, the integral round the great semicircle has zero limit. The assumption is justified if $f(\zeta)$ be of the order of smallness of any negative power of ζ , as, for example, if $\mathcal{C}(\zeta)$ be regular at infinity.

The real axis contributes a line-integral in which ζ , being real, may be replaced by ξ . This integral would generally be semi-convergent as regards the infinity at c , but the semi-circular detour leads to the Cauchy principal value. It will therefore be understood in what follows that derived integrals which appear to be semi-convergent have then Cauchy principal values.

The collection of all parts of the contour integral and the equation of their sum to zero yields the equality

$$2i\{\log \mathcal{C}(\zeta_0) - \log K\} + 2ip \log F(c, \zeta_0) + \int_{\xi=-\infty}^{\xi=\infty} \pi^{-1} \log F(\xi, \zeta_0) d \log \mathcal{C}(\xi) = 0,$$

which may also be written

$$2i\{\log \mathcal{C}(\zeta_0) - \log K\} + 2ip \log F(c, \zeta_0) + \int_{\xi=-\infty}^{\xi=\infty} \pi^{-1} \log F(\xi, \zeta_0) d \log \tau + i \int_{\xi=-\infty}^{\xi=\infty} \pi^{-1} \log F(\xi, \zeta_0) d\mathfrak{S} = 0. \quad (16)$$

9. Let ζ_0' be the complex conjugate to ζ_0 , and let a function $G(\zeta, \zeta_0')$ be defined by the equation

$$G(\zeta, \zeta_0') = \frac{(\zeta_0' - \zeta)\{ -\zeta + i(a^2 - \zeta^2)^{\frac{1}{2}}\}}{-\zeta\zeta_0' + a^2 + i(a^2 - \zeta^2)^{\frac{1}{2}}(\zeta_0'^2 - a^2)^{\frac{1}{2}}}, \quad (17)$$

this being the form appropriate when ζ is real and $\zeta^2 < a^2$; and let the function be defined on the half-plane on the positive side of the real axis of ζ so that the continuation from the above form shall be by paths which never cross the axis and never quite pass through the points $\pm a$. Then the form appropriate to ζ real and $\zeta^2 > a^2$ is

$$G(\zeta, \zeta_0') = \frac{(\zeta_0' - \zeta)\{ -\zeta + (\zeta^2 - a^2)^{\frac{1}{2}}\}}{-\zeta\zeta_0' + a^2 + (\zeta^2 - a^2)^{\frac{1}{2}}(\zeta_0'^2 - a^2)^{\frac{1}{2}}}. \quad (18)$$

This function $G(\zeta, \zeta_0')$ has important relations to the function $F(\zeta, \zeta_0)$ in the particular case when ξ is real. When ξ is real and $\xi^2 < a^2$, the complex conjugate to $G(\zeta, \zeta_0')$ is $F(\xi, \zeta_0)$. When ξ is real and $\xi^2 > a^2$, the complex conjugate to $G(\zeta, \zeta_0')$ is $1/F(\xi, \zeta_0)$.

$G(\zeta, \zeta_0')$ has no zeros, infinities or branchings in the relevant half-plane (ξ being on the irrelevant side of the real axis) and so $\log G(\zeta, \zeta_0')$ has no branchings or infinities in the relevant half-plane. Therefore the integral

$$\int \pi^{-1} \log G(\zeta, \zeta_0') d \log \mathcal{C}(\zeta) \quad (19)$$

must have the value zero when taken round a contour differing from that shown in figure 6 only by the omission of the now unnecessary cavity and cut.

Just as in the case considered in the preceding article, the contribution to the integral made by the great semicircle has zero limit, and the infinitesimal semicircle round c gives $2ip \log G(c, \zeta_0')$. Thus the result of the contour integration, in its limit form, is

$$2ip \log G(c, \zeta_0') + \int_{\xi=-\infty}^{\xi=\infty} \pi^{-1} \log G(\xi, \zeta_0') d \log \mathcal{C}(\xi) = 0. \quad (20)$$

10. The equality of formula (20) must remain true if every term in it is replaced by its conjugate complex. The conjugate complex of the G function has already been specified; that of $\log \mathcal{C}(\xi)$ is $\log \tau - i d\mathfrak{S}$. Thus the new formula is

$$\begin{aligned}
 & -2ip \log F(c, \zeta_0) + \int_{\xi=-a}^{\xi=a} \frac{1}{\pi} \log F(\xi, \zeta_0) (d \log \tau - i d\mathfrak{S}) \\
 & - \left\{ \int_{\xi=-\infty}^{\xi=-a} + \int_{\xi=a}^{\xi=\infty} \right\} \frac{1}{\pi} \log F(\xi, \zeta_0) (d \log \tau - i d\mathfrak{S}) = 0. \quad (21)
 \end{aligned}$$

Since, by hypothesis, $\tau = K$ for $\xi^2 > a^2$, $d \log \tau = 0$ over these ranges. Hence formulae (16) and (21) can be simplified, and are respectively equivalent to

$$\begin{aligned}
 \log \left\{ \frac{\mathcal{C}(\zeta)}{K} \right\} &= -p \log F(c, \zeta_0) \\
 &+ \frac{i}{2\pi} \int_{\xi=-a}^{\xi=a} \log F(\xi, \zeta_0) d \log \tau - \frac{1}{2\pi} \int_{\xi=-\infty}^{\xi=\infty} \log F(\xi, \zeta_0) d\mathfrak{S}, \quad (22)
 \end{aligned}$$

$$\begin{aligned}
 0 &= -p \log F(c, \zeta_0) - \frac{i}{2\pi} \int_{\xi=-a}^{\xi=a} \log F(\xi, \zeta_0) d \log \tau \\
 &+ \frac{1}{2\pi} \left\{ \int_{\xi=-\infty}^{\xi=-a} + \int_{\xi=a}^{\xi=\infty} - \int_{\xi=-a}^{\xi=-a} \right\} \log F(\xi, \zeta_0) d\mathfrak{S}. \quad (23)
 \end{aligned}$$

Addition of corresponding sides of these equations gives

$$\log \left\{ \frac{\mathcal{C}(\zeta)}{K} \right\} = -2p \log F(c, \zeta_0) - \frac{1}{\pi} \int_{\xi=-a}^{\xi=a} \log F(\xi, \zeta_0) d\mathfrak{S}, \quad (24)$$

so that

$$\mathcal{C}(\zeta_0) = K \{F(c, \zeta_0)\}^{-2p} \text{Exp} \left\{ -\frac{1}{\pi} \int_{\xi=-a}^{\xi=a} \log F(\xi, \zeta_0) d\mathfrak{S} \right\}. \quad (25)$$

It being remembered that there is necessarily a functional relation between \mathfrak{S} and ξ , this formula is recognized as an expression of $\mathcal{C}(\zeta_0)$ in the form of the limit of a product of the character discussed in article 7, above.

Thus the generality of the synthesis of $\mathcal{C}(\zeta_0)$ by factors of the type of $F(\xi, \zeta_0)$ is demonstrated. The form (25) is preferable to the form (10) since K is always real while K' is complex. In the hydrodynamical application it may be convenient to take K to be unity.

The significance of the functional relation between ϑ and ξ becomes clearer if the vector angle of $dz/d\zeta$ on the boundary is denoted by χ and it is noticed that, for $\xi > c$, $\vartheta = \chi$, while, for $\xi < c$, $\vartheta = \chi - \pi$. Thus along the curved sides of the obstacle $d\vartheta = d\chi$, and $d\chi$ may be substituted for $d\vartheta$ in formula (25). It is of course to be understood that

$$\int_{-a}^a \quad \text{means} \quad \int_{-a}^c + \int_c^a,$$

all sudden change of ϑ or χ in passage through c being accounted for in the factor

$$\{F(c, \zeta_0)\}^{-2p}.$$

χ is the angle which the tangent to the boundary, drawn in the direction of ξ increasing, makes with the axis of x . From the relations (1) and (7) it is seen that $\vartheta = \pi$ all along the boundary.

11. The case of symmetrical flow, as typified in figure 4, lends itself to similar treatment and leads to a result of the same character but simpler form.

If the geometrical relation be written

$$dz = \mathcal{C}(\zeta) d\zeta, \quad (26)$$

and be associated with a field relation $z = \zeta$, the problem is to find a convenient and general form for the function $\mathcal{C}(\zeta)$. What is required of $\mathcal{C}(\zeta)$ in this case is that it be a curve-factor of zero angular range, giving the proper corner at $\zeta = 0$, and such that (i) it is real for ζ real and negative; (ii) its modulus is a constant, say K , for ζ real and greater than a .

It can be shown that every $\mathcal{C}(\zeta)$, satisfying these conditions and regular at infinity can be expressed as the limit of a product of powers of $f(\kappa, \zeta)$, where

$$f(\kappa, \zeta) = \frac{\{a - \kappa\}^{\frac{1}{2}} - i(\zeta - a)^{\frac{1}{2}}\}^2}{\kappa - \zeta} = - \frac{(a - \kappa)^{\frac{1}{2}} - i(\zeta - a)^{\frac{1}{2}}}{(a - \kappa)^{\frac{1}{2}} + i(\zeta - a)^{\frac{1}{2}}}. \quad (27)$$

The proof of this follows so closely the method of articles 8 to 10 that only the outline need be given. An arbitrarily selected value of ζ in the relevant half-plane is denoted by ζ_0 , and its conjugate complex by ζ'_0 . An auxiliary function $g(\zeta, \zeta'_0)$ is defined by the equation

$$g(\zeta, \zeta'_0) = - \frac{(a - \zeta)^{\frac{1}{2}} + i(\zeta'_0 - a)^{\frac{1}{2}}}{(a - \zeta)^{\frac{1}{2}} - i(\zeta'_0 - a)^{\frac{1}{2}}}; \quad (28)$$

and it is noticed that the complex conjugate to $g(\xi, \xi'_0)$ is $f(\xi, \xi'_0)$ for $\xi < a$, while for $\xi > a$ it is $1/f(\xi, \xi'_0)$. Contours in the relevant half-plane

of ζ are taken the same as in articles 8 and 9, save only that the infinity of $\mathcal{C}(\zeta)$ is taken at the origin and as of the type ζ^{-p} . The integrals

$$\int \pi^{-1} \log f(\zeta, \zeta_0) d \log \mathcal{C}(\zeta) \quad \text{and} \quad \int \pi^{-1} \log g(\zeta, \zeta'_0) d \log \mathcal{C}(\zeta)$$

are evaluated round their respective contours, it being known that the result in each case is zero. The results are

$$-2i \log \{ \mathcal{C}(\zeta_0)/K \} + ip \log f(0, \zeta_0) + \int_{-\infty}^{\infty} \frac{1}{\pi} \log f(\xi, \zeta_0) (d \log q + id\chi) = 0, \tag{29}$$

$$ip \log g(0, \zeta'_0) + \int_{-\infty}^{\infty} \frac{1}{\pi} \log g(\xi, \zeta'_0) (d \log q + id\chi) = 0. \tag{30}$$

In the latter formula every complex is replaced by its conjugate, and it is remembered that in both formulae $d\chi = 0$ for $\xi < 0$, and $d \log q = 0$ for $\xi > a$. Then the elimination between the two results of the part of the integral which involves $d \log q$ gives

$$\log \{ \mathcal{C}(\zeta_0)/K \} = p \log f(0, \zeta_0) + \int_{\xi=0}^{\xi=a} \frac{d\chi}{\pi} \log f(\xi, \zeta_0), \tag{31}$$

which is equivalent to

$$\mathcal{C}(\zeta_0) = K \left\{ - \frac{a^{\frac{1}{2}} - i(\zeta_0 - a)^{\frac{1}{2}}}{a^{\frac{1}{2}} + i(\zeta_0 - a)^{\frac{1}{2}}} \right\}^p \text{Exp.} \int_{\xi=0}^{\xi=a} \frac{d\chi}{\pi} \log \left\{ - \frac{(a - \xi)^{\frac{1}{2}} - i(\zeta_0 - a)^{\frac{1}{2}}}{(a - \xi)^{\frac{1}{2}} + i(\zeta_0 - a)^{\frac{1}{2}}} \right\}, \tag{32}$$

the integral being definite in virtue of the functional relation between χ and ξ which subsists at the fixed boundary.

Formula (32) is the general formula for $\mathcal{C}(\zeta)$ which has been aimed at, and its generality is now demonstrated. It is to be noticed that, for ζ real and $a > \kappa > 0$, $\{f(\kappa, \zeta)\}^n$ has the following properties: (i) for $\zeta > a$ the modulus is constant, being equal to unity; (ii) for $a > \zeta > \kappa$ the vector angle is constant, being $n\pi$; (iii) for $\zeta < \kappa$ the vector angle is zero. Formula (32) is equivalent to formula (94) of paper D, § 38, and represents a passage from a rectilineal polygonal obstacle to a smoothly curved obstacle as a limit.

12. If attempt were made to approximate to the definite integrals of formula (25) or (32), for an assigned form of smoothly curved obstacle, by replacing the integral by a series, the resulting specification would be that of

a field of flow with a number of infinities in the boundary. For the substituted obstacle is polygonal, and gives rise to a field in which the velocity is infinite at every convex corner. No matter how numerous the corners, it is difficult to regard such a field as constituting an approximation to the flow past a smooth obstacle. It is not, therefore, as aids to approximation that the formulæ are considered; but it is hoped to show that they are useful in the exact theory.

DETERMINATION OF THE POINTS OF DEPARTURE OF FREE STREAM-LINES FROM A CURVED OBSTACLE.

13. In cases of liquid flow past a rectilinear polygonal obstacle it is usual to take for granted that the stream-line which follows the contour of the forward part of the obstacle on either side breaks away as a free stream-line at a corner of the obstacle. But the considerations which support this assumption do not apply to a smoothly curved obstacle, and the important problem of the determination of the points of departure in such a case calls for attention.

The question may be approached by considering the rate of change of the direction of the tangent to the free stream-line just at the point of departure. So far as the previous analytical formulation is concerned, any points on the obstacle may be assumed to be the points of departure of the free stream-lines. But if, after such an assumption has been made, the curve of the stream-line be traced and it be found that at the very outset it enters into space occupied by the solid obstacle, clearly the specified motion is physically impossible. Thus there suggests itself a rule to the effect that, unless the inward curvature of the free stream-line at the point of departure is less than that of the obstacle, the specified motion is impossible. This rule may, in a sense, stand; but its wording may prove misleading unless it is known and remembered that generally the free stream-line has not got a definite curvature or radius of curvature at its point of departure. This fact will be proved in the following article. For the sake both of practical utility and of keeping the main argument as free as possible from analytical complication, it is proposed to consider in the first instance the case of symmetrical flow.

14. In dealing with a configuration of the kind typified in figure 4, every case of flow can be specified by $d\zeta = \ell(\xi)d\xi$, where ℓ is expressible in the form set out in formula (32),

From this formula it is seen that, if ζ_0 have a real value ξ_0 greater than a , and if $\mathcal{C}(\xi_0) = K \exp(i\chi_0)$,

$$\chi_0 = p \left\{ \pi - 2 \tan^{-1} \frac{(\xi_0 - a)^{\frac{1}{2}}}{a^{\frac{1}{2}}} \right\} + \int_{\xi=0}^{\xi=a} \frac{d\chi}{\pi} \left\{ \pi - 2 \tan^{-1} \frac{(\xi_0 - a)^{\frac{1}{2}}}{(a - \xi)^{\frac{1}{2}}} \right\}, \quad (33)$$

so that

$$\chi_0(a) = p\pi + \int_{\xi=0}^{\xi=a} d\chi, \quad \text{and} \quad \chi_0(\infty) = 0,$$

as was to be expected.

If $\chi_0(a) + \delta\chi_0$ and $a + \epsilon$ be corresponding values of χ_0 and ξ_0 ,

$$\delta\chi_0 = -2p \tan^{-1} \left(\frac{\epsilon}{a} \right)^{\frac{1}{2}} - \frac{2}{\pi} \int_{\xi=0}^{\xi=a} \tan^{-1} \left(\frac{\epsilon}{a - \xi} \right)^{\frac{1}{2}} d\chi. \quad (34)$$

When ϵ is very small the first term of this formula can readily be replaced by a simpler approximately equivalent expression; but it is not obviously legitimate to substitute $\{\epsilon/(a - \xi)\}^{\frac{1}{2}}$ for $\tan^{-1}\{\epsilon/(a - \xi)\}^{\frac{1}{2}}$ under the integral sign, since there is a part of the range of integration in which $a - \xi$ is very small. If, however, $\epsilon = \eta^2$, the theorem of the mean, applied to the subject of integration regarded as a function of η , gives

$$\tan^{-1} \{ \eta / (a - \xi)^{\frac{1}{2}} \} = \eta (a - \xi)^{\frac{1}{2}} / (a - \xi + \eta'^2),$$

where $\eta > \eta' > 0$. Thus

$$\delta\chi_0 = -2p \tan^{-1} \left(\frac{\epsilon}{a} \right)^{\frac{1}{2}} - \frac{2\epsilon^{\frac{1}{2}}}{\pi} \int_{\xi=0}^{\xi=a} \frac{(a - \xi)^{\frac{1}{2}} d\chi}{a - \xi + \epsilon'}, \quad (35)$$

where $\epsilon > \epsilon' > 0$. The last integral has a definite limit value for $\epsilon \rightarrow 0$ (which involves $\epsilon' \rightarrow 0$), and therefore the equation

$$-\delta\chi_0 = \epsilon^{\frac{1}{2}} \left[2pa^{-\frac{1}{2}} + \frac{2}{\pi} \int_{\xi=0}^{\xi=a} \frac{d\chi}{(a - \xi)^{\frac{1}{2}}} \right] \quad (36)$$

is a valid first approximation to formula (34). Thus $\delta\chi_0$ is generally of the order of smallness of $\epsilon^{\frac{1}{2}}$. Of course a higher order of smallness is possible in particular cases.

If δs be the corresponding element of arc of the free stream-line, $\delta s = |\mathcal{C}'(\zeta)| \epsilon = K\epsilon$. Hence generally $\delta\chi_0/\delta s \rightarrow \infty$.

It must be noticed that the above argument has tacitly assumed the definiteness of $d\chi/d\xi$ for $\xi = a$. It may be taken that, throughout the present discussion, the hypothesis is that the sides of the obstacle are

smoothly curved, with definite curvature at every point except the vertex. This guarantees definiteness of $d\chi/d\xi$.

15. It is useful to test this result by seeing how it applies to some of the particular examples most easily available, namely \mathcal{C}_{21} , \mathcal{C}_{31} and \mathcal{C}_{32} as defined in paper D, §§ 39 and 40.

In the case of \mathcal{C}_{21} it is readily seen that $\delta\chi$ is of the order of smallness of $\epsilon^{\frac{1}{2}} \log \epsilon$, but then $\chi(\xi) - \chi(a) = \lambda(a - \xi)^{\frac{1}{2}}$, and so $d\chi/d\xi$ is not definite for $\xi = a$. It is not therefore to be expected that \mathcal{C}_{21} should come under the theorem of the preceding article.

If $\mathcal{C}'(\xi) = \frac{1}{2}i\epsilon_{23}(a - \xi)\xi^{\frac{1}{2} + \pi}$, then $\chi(\xi) = p\frac{1}{2}\pi - 2(\xi a)^{\frac{1}{2} + \pi}$, and $\delta\chi_0$ is found to be small of the order of ϵ . This is not contrary to the general theorem; it merely means that $\chi(\xi)$ is such as to make the coefficient of $\epsilon^{\frac{1}{2}}$ zero. This may be confirmed by substitution of the particular form of $\chi(\xi)$ in formula 36).

If $d\chi/d\xi = -\lambda$, where λ is a constant, the coefficient of $\epsilon^{\frac{1}{2}}$ is $2a^{-\frac{1}{2}}(p - 2a\lambda/\pi)$, which is zero if $\lambda = p\pi/2a$. This is just the value of λ which corresponds to $\mathcal{C} = \frac{1}{2}i\epsilon_{23}(a - \xi)\xi^{\frac{1}{2} + \pi}$, and this explains the fact that for this particular curve-station $\delta\chi_0$ is shown by the formulae of D, § 40, to be of the order of smallness of ϵ .

16. The possibility and the importance of the vanishing of the coefficient of $\epsilon^{\frac{1}{2}}$ in the expansion of $\delta\chi$ render it desirable to carry the expansion a stage further by determining the coefficient of the term in ϵ .

To this end, consider

$$H = \int_0^a \frac{\chi(\xi) - \chi(a)}{(a - \xi)^{\frac{1}{2}}(a + \epsilon - \xi)} d\xi - \int_0^a \frac{\chi(\xi) - \chi(a)}{(a - \xi)^{\frac{1}{2}}} d\xi - \int_0^a \frac{\chi(a + \epsilon) - \chi(a)}{(a - \xi)^{\frac{1}{2}}(a + \epsilon - \xi)} d\xi, \\ = \int_0^a \frac{(a - \xi)\{\chi(a) - \chi(a + \epsilon)\} + \epsilon\{\chi(a) - \chi(\xi)\}}{(a - \xi)^{\frac{1}{2}}(a - \xi + \epsilon)} d\xi, \quad (37)$$

noting that the possible indeterminateness of $d\chi/d\xi$ is a security against divergence of the second integral at $\xi = a$.

By the theorem of the mean the numerator equals

$$(a - \xi)\epsilon\{\chi'(\xi'') - \chi'(a + \epsilon')\},$$

where $a + \xi' = \xi$ and $\epsilon + \epsilon' = 0$; and this again by the same theorem, equals

$$-(a - \xi)\epsilon\{\chi'(a + \epsilon') - \chi'(\xi'')\},$$

where $a + \epsilon' > \xi'' > \xi'$, so that $a + \epsilon > \xi'' > \xi$. Hence

$$H = -\epsilon \int_0^a \frac{\chi'(\xi'')(a + \epsilon' - \xi'')}{(a - \xi)^{\frac{1}{2}}(a + \epsilon - \xi)} d\xi. \quad (38)$$

It is clear that generally the integral in this formula is a continuous function of ϵ and has a definite limit for $\epsilon \rightarrow 0$, since $\epsilon \rightarrow 0$ involves $\epsilon' \rightarrow 0$, and $\xi \rightarrow a$ involves $\xi' \rightarrow a$. Of course the demonstration contains implicit assumptions as to the continuity of $\chi(\xi)$ and its first and second derivatives, on both sides of the value $\xi = a$.

Now

$$\begin{aligned} \int_0^a \frac{\chi(a+\epsilon) - \chi(a)}{(a-\xi)^{\frac{1}{2}}(a+\epsilon-\xi)} d\xi &\rightarrow \epsilon \chi'(a) \int_0^a \frac{d\xi}{(a-\xi)^{\frac{1}{2}}(a-\xi+\epsilon)}, \\ &= -2\epsilon^{\frac{1}{2}} \chi'(a) \left[\tan^{-1} \left\{ (a-\xi)^{\frac{1}{2}} / \epsilon^{\frac{1}{2}} \right\} \right]_0^a, \\ &= 2\epsilon^{\frac{1}{2}} \chi'(a) \left\{ \frac{1}{2}\pi - \tan^{-1}(\epsilon/a)^{\frac{1}{2}} \right\}, \rightarrow \pi \chi'(a) \epsilon^{\frac{1}{2}}. \end{aligned} \quad (39)$$

On substitution of this in H it is seen that (38) is equivalent to

$$J = \int_0^a \frac{\chi(\xi) - \chi(a)}{(a-\xi)^{\frac{1}{2}}(a-\xi+\epsilon)} d\xi = \int_0^a \frac{\chi(\xi) - \chi(a)}{(a-\xi)^{\frac{3}{2}}} d\xi + \epsilon^{\frac{1}{2}} \pi \chi'(a) + \omega, \quad (40)$$

where ω is small of the order of ϵ .

Now if the integral in formula (34) be integrated by parts, it being remembered that $\chi(0) = p\pi$, there results

$$-\delta\chi_0 = \frac{2}{\pi} \chi(a) \tan^{-1} \left(\frac{\epsilon}{a} \right)^{\frac{1}{2}} - \frac{\epsilon^{\frac{1}{2}}}{\pi} J; \quad (41)$$

and therefore, by (40), when ϵ is small

$$-\delta\chi_0 = \epsilon^{\frac{1}{2}} \left[\frac{2}{\pi} a^{-\frac{1}{2}} \chi(a) - \frac{1}{\pi} \int_0^a \frac{\chi(\xi) - \chi(a)}{(a-\xi)^{\frac{3}{2}}} d\xi \right] - \epsilon \chi'(a), \quad (42)$$

small quantities of the order $\epsilon^{\frac{3}{2}}$ or higher being neglected. Integration by parts within the square brackets leads to

$$-\delta\chi_0 = \epsilon^{\frac{1}{2}} \left[\frac{2p}{a^{\frac{1}{2}}} + \frac{2}{\pi} \int_0^a \frac{d\xi}{(a-\xi)^{\frac{3}{2}}} \right] - \epsilon \chi'(a). \quad (43)$$

This is the desired improved approximation. It will be convenient to denote the coefficient of $\epsilon^{\frac{1}{2}}$ in this formula by S .

A very important inference from equation (43) is that, if the coefficient of $\epsilon^{\frac{1}{2}}$ be zero, $-\delta\chi_0$ equals the angle of contingence of the fixed boundary for an element of arc $K\epsilon$. Thus in this case the free stream-line and the fixed boundary osculate at their point of separation.

17. When the sides of the obstacle are convex to the liquid, $d\chi$ is negative, and it is clear that if a be small the ratio of the second term to the first in the coefficient of $\epsilon^{\frac{1}{2}}$ is numerically small. Thus if the point P of departure of the free stream-line be supposed to take positions successively further and further from the vertex of the obstacle, $-\delta\chi_0 = \epsilon^{\frac{1}{2}}S$, where S begins by being positive but keeps getting smaller. So long as S is positive the free stream-line is curving sharply inwards into the obstacle, and so the motion is physically impossible.

But when a is so chosen that $S = 0$, $\delta\chi_0$ is small of the order of ϵ , and the free stream-line osculates the curve of the obstacle. The point of departure of the free stream-line in this case may be called P_0 . Without closer consideration of the form of the obstacle behind P_0 it is not safe to say that a free stream-line can actually depart from P_0 and be clear of the obstacle; but, so far as the shape between the vertex and P_0 is concerned, P_0 , determined by $S = 0$, may be described as the most forward point of the obstacle from which a free stream-line can break away.

If a greater value be assigned to a than that corresponding to $S = 0$, generally S may be expected to have become negative, so that $-\delta\chi_0$ is of the order of $\epsilon^{\frac{1}{2}}$ and is negative. This would indicate a free stream-line breaking away with a sharp concavity to the moving liquid. It may be thought that this is physically less probable than the smooth departure at P_0 ; but such an opinion is somewhat speculative. Anyhow the sharp outward turn gives increased chance of clearing the hinder part of the obstacle, so that if departure at P were impossible it might well be possible from a point very near to P_0 and behind it.

The theoretical importance of the point P is in any case obvious, and it is to be remembered that the corresponding value of a is determined by the relation

$$S = \frac{2a}{a^{\frac{1}{2}}} - \frac{2}{\pi} \int_0^{\pi} \frac{d\chi}{(a - \xi)^{\frac{1}{2}}} = 0. \quad (44)$$

18. It is interesting to note that there is available one rather comprehensive type of curve-factor into which the parameter a enters in such a way that the condition $S = 0$ is satisfied. This corresponds to C_{23} of D, § 40, and may be written

$$C_{23}(\xi) = \text{Exp.} \int_a^{\xi} \log \left\{ \frac{(\xi - \kappa)^{\frac{1}{2}} + i\kappa^{\frac{1}{2}}}{\xi^{\frac{1}{2}}} \right\} f'(\kappa) d\kappa, \quad (45)$$

where $f(\kappa)$ is an arbitrary function.

For a real value ξ of ζ , intermediate between 0 and a , the vector angle χ of this curve-factor is

$$\begin{aligned} \chi(\xi) &= \int_{\xi}^a \frac{1}{2} \pi f'(\kappa) d\kappa + \int_0^{\xi} \tan^{-1} \{ \kappa / (\xi - \kappa) \}^{\frac{1}{2}} f'(\kappa) d\kappa, \\ &= \frac{1}{2} \pi \int_0^a f'(\kappa) d\kappa - \int_0^{\xi} \tan^{-1} \{ (\xi - \kappa) / \kappa \}^{\frac{1}{2}} f'(\kappa) d\kappa; \end{aligned} \quad (46)$$

and from this

$$p\pi = \chi(0) = \frac{1}{2} \pi \{ f(a) - f(0) \}, \quad (47)$$

$$d\chi = - \frac{d\xi}{2\xi} \int_0^{\xi} \frac{\kappa^{\frac{1}{2}}}{(\xi - \kappa)^{\frac{1}{2}}} f'(\kappa) d\kappa. \quad (48)$$

On substitution of this value of $d\chi$

$$\int_{\xi=0}^{\xi=a} \frac{d\chi}{(a - \xi)^{\frac{1}{2}}} = - \int_{\xi=0}^{\xi=a} \frac{d\xi}{2\xi (a - \xi)^{\frac{1}{2}}} \int_{\kappa=0}^{\kappa=\xi} \frac{\kappa^{\frac{1}{2}} f'(\kappa) d\kappa}{(\xi - \kappa)^{\frac{1}{2}}}.$$

Though the subject of the double integration has an infinity for $\kappa = 0$, $\xi = 0$, this is not of sufficiently high order to preclude change of the order of integration. If this change be effected it appears that

$$\begin{aligned} \int_{\xi=0}^{\xi=a} \frac{d\chi}{(a - \xi)^{\frac{1}{2}}} &= - \int_{\kappa=0}^{\kappa=a} \frac{1}{2} \kappa^{\frac{1}{2}} f'(\kappa) d\kappa \int_{\xi=\kappa}^{\xi=a} \frac{d\xi}{\xi (a - \xi)^{\frac{1}{2}} (\xi - \kappa)^{\frac{1}{2}}}, \\ &= - \int_{\kappa=0}^{\kappa=a} \frac{1}{2} \kappa^{\frac{1}{2}} f'(\kappa) \left(\frac{\pi}{\kappa^{\frac{1}{2}} a^{\frac{1}{2}}} \right) d\kappa, \\ &= - \frac{1}{2} \pi a^{-\frac{1}{2}} \{ f(a) - f(0) \} = - p\pi a^{-\frac{1}{2}}. \end{aligned} \quad (49)$$

This shows that for all curve-factors of this particular class $S = 0$.

Formula (45) should be compared with formula (4) of article 6, above. It seems that formula (4) cannot be general, since it gives a curve-factor possessed of this very special property. This casts doubt likewise on the generality of formula (5), and suggests the possibility that Mr. Levy's method of approximation (paper E) may be less general than it seems.

POINTS OF DEPARTURE OF FREE STREAM-LINES IN ASYMMETRICAL FLOW.

19. It has been shown above (article 10) that every case of asymmetrical flow can be dealt with by the relation

$$\frac{dz}{d\zeta} = K(\zeta - c)^{2p} F(\zeta, \xi_0)^{-2p} \text{Exp} \left[-\frac{1}{\pi} \left\{ \int_{-a}^c + \int_c^a \right\} \log F(\xi, \zeta_0) d\chi \right],$$

where

$$F(\xi, \zeta_0) = (\zeta_0 - \xi) \left\{ \xi + i(a^2 - \xi^2)^{\frac{1}{2}} \right\} / i \xi \zeta_0 - a^2 + i(a^2 - \xi^2)^{\frac{1}{2}} (\zeta_0^2 - a^2)^{\frac{1}{2}},$$

and χ is a function of ξ . It follows that if χ_0 be the vector-angle of $dz/d\zeta$, corresponding to a real value ξ_0 of ζ_0 , and if $\xi_0^2 > a^2$,

$$\chi_0(\xi_0) = [\pi] - 2p \left\{ \cos^{-1} \frac{c}{a} - \cos^{-1} \frac{\xi_0 c - a^2}{a(\xi_0 - c)} \right\} - \frac{1}{\pi} \left\{ \int_{-a}^c + \int_c^a \right\} \left\{ \cos^{-1} \frac{\xi}{a} - \cos^{-1} \frac{\xi_0 \xi - a^2}{a(\xi_0 - \xi)} \right\} d\chi, \quad (52)$$

the term in the square brackets being omitted when $\xi_0 > a$, but retained when $\xi_0 < -a$.

Thus

$$\chi_0(a) - \chi_0(a + \eta^2) = 2p \cos^{-1} \left\{ \frac{a(a-c) - c\eta^2}{a(a-c) + a\eta^2} \right\} - \frac{1}{\pi} \left\{ \int_{-a}^c + \int_c^a \right\} \left\{ \cos^{-1} \left\{ \frac{a(a-\xi) - \xi\eta^2}{a(a-\xi) + a\eta^2} \right\} \right\} d\chi. \quad (53)$$

If the term in the mean brackets in the subject of integration, regarded as a function of η whose value is zero for η zero, the integral is seen to be equivalent to

$$\frac{2\eta}{\pi} \left\{ \int_{-a}^c + \int_c^a \right\} \frac{(a^2 - \xi^2)^{\frac{1}{2}} d\chi}{(2a + \eta^2)^{\frac{1}{2}} (a - \xi + \eta^2)^{\frac{1}{2}}},$$

where $\eta > \eta' > 0$. This latter integral tends to a definite limit for $\eta \rightarrow 0$, namely the term got by omitting η . Also when η is small, the first term of (53) approximates to $\{2(a+c)/a(a-c)\}^{\frac{1}{2}} \eta$. So, if $\eta^2 = \epsilon$ and is very small, formula (53) yields the approximation

$$\chi_0(a) - \chi_0(a + \epsilon) = \epsilon^{\frac{1}{2}} \left[2p \left\{ \frac{2(a+c)}{a(a-c)} \right\}^{\frac{1}{2}} - \frac{1}{\pi} \left\{ \int_{-a}^c + \int_c^a \right\} \left\{ \frac{2(a+\xi)}{a(a-\xi)} \right\}^{\frac{1}{2}} d\chi \right]. \quad (54)$$

Similarly

$$\chi_0(-a-\epsilon) - \chi_0(-a) = \epsilon^{\frac{1}{2}} \left[2p \left\{ \frac{2(a-c)}{a(a+c)} \right\}^{\frac{1}{2}} + \frac{1}{\pi} \left\{ \int_{-a}^c + \int_c^a \right\} \left\{ \frac{2(a-\xi)}{a(a+\xi)} \right\}^{\frac{1}{2}} d\chi \right]. \quad (55)$$

The same argument may be applied to this pair of formulae as has been employed in the case of a symmetrical obstacle; when the form of χ is assigned the simultaneous equations got by equating both coefficients of $\epsilon^{\frac{1}{2}}$ to zero determine values of a and c corresponding to the flow in which the two points of departure of free stream-lines are as far forward as is physically possible.

20. The approximation to $\chi_0(a) - \chi_0(a+\epsilon)$, when ϵ is small and positive may be carried a stage further as follows.

Since

$$\frac{d}{d\xi} \cos^{-1} \left\{ \frac{a(a-\xi) - \xi\epsilon}{a(a-\xi+\epsilon)} \right\} = \frac{\epsilon^{\frac{1}{2}}(2a+\epsilon)^{\frac{1}{2}}}{(a^2-\xi^2)^{\frac{1}{2}}(a-\xi+\epsilon)},$$

and since $\chi(c-) - \chi(c+) = (1-2p)\pi$, it appears, on integration by parts, that

$$\begin{aligned} & \chi_0(a) - \chi_0(a+\epsilon) \\ &= \cos^{-1} \left\{ \frac{a(a-c) - c\epsilon}{a(a-c+\epsilon)} \right\} - \frac{1}{\pi} \epsilon^{\frac{1}{2}} (2a+\epsilon)^{\frac{1}{2}} \left\{ \int_{-a}^c + \int_c^a \right\} \frac{\chi(\xi) - \chi(a)}{(a^2-\xi^2)^{\frac{1}{2}}(a-\xi+\epsilon)} d\xi. \end{aligned} \quad (56)$$

Also, by repeated use of the theorem of the mean,

$$\begin{aligned} H' &= \int \frac{\chi(\xi) - \chi(a)}{(a^2-\xi^2)^{\frac{1}{2}}(a-\xi+\epsilon)} d\xi - \int \frac{\chi(\xi) - \chi(a)}{(a^2-\xi^2)^{\frac{1}{2}}(a-\xi)} d\xi - \int \frac{\chi(a+\epsilon) - \chi(a)}{(a^2-\xi^2)^{\frac{1}{2}}(a-\xi+\epsilon)} d\xi \\ &= \int \frac{(a-\xi) \{ \chi(a) - \chi(a+\epsilon) \} + \epsilon \{ \chi(a) - \chi(\xi) \}}{(a^2-\xi^2)^{\frac{1}{2}}(a-\xi)(a-\xi+\epsilon)} d\xi \\ &= \int \frac{(a-\xi) \epsilon \{ \chi'(\xi') - \chi'(a+\epsilon') \}}{(a^2-\xi^2)^{\frac{1}{2}}(a-\xi)(a-\xi+\epsilon)} d\xi \\ &= -\epsilon \int \frac{\chi''(\xi'') (a+\epsilon' - \xi')}{(a^2-\xi^2)^{\frac{1}{2}}(a-\xi+\epsilon)} d\xi, \end{aligned} \quad (57)$$

where $a > \xi' > \xi$, $\epsilon > \epsilon' > 0$, $a+\epsilon' > \xi'' > \xi'$, and the integrations are from $-a$ to a . The last integral, if $\chi''(\xi)$ is assumed continuous, has a definite limit for $\epsilon \rightarrow 0$; for if $\epsilon \rightarrow 0$ then also $\epsilon' \rightarrow 0$, and if $\xi \rightarrow a$ then also $\xi' \rightarrow a$. Hence H' is small of the order of ϵ .

The third integral in H' depends on

$$\int_{-a}^a \frac{d\xi}{(a^2 - \xi^2)^{\frac{1}{2}} (a - \xi + \epsilon)} = \frac{1}{\epsilon^{\frac{1}{2}} (2a + \epsilon)^{\frac{1}{2}}} \left[\cos^{-1} \left\{ \frac{a(a - \xi) - \xi\epsilon}{a(a - \xi + \epsilon)} \right\} \right]_{-a}^a,$$

$$= \frac{\pi}{\epsilon^{\frac{1}{2}} (2a + \epsilon)^{\frac{1}{2}}}. \quad (58)$$

Therefore the smallness of H' makes formula (56) equivalent, when $\epsilon^{\frac{1}{2}}$ is neglected, to

$$\chi_0(a) - \chi_0(a + \epsilon) = \cos^{-1} \left\{ \frac{a(a - c) - c\epsilon}{a(a - c + \epsilon)} \right\} - \frac{1}{\pi} \epsilon^{\frac{1}{2}} (2a + \epsilon)^{\frac{1}{2}} \int_{-a}^a \frac{\chi(\xi) - \chi(a)}{(a^2 - \xi^2)^{\frac{1}{2}} (a - \xi)} d\xi \quad \chi(a + \epsilon) + \chi(a). \quad (59)$$

But

$$\int_{-a}^a \frac{\chi(\xi) - \chi(a)}{(a^2 - \xi^2)^{\frac{1}{2}} (a - \xi)} d\xi = \left[\chi(\xi) - \chi(a) \left\{ \frac{a + \xi}{a - \xi} \right\}^c \right]_{-a}^c + \dots + \left[\chi(a + \xi) - \chi(a) \left\{ \frac{a + \xi}{a - \xi} \right\}^c \right]_{-a}^c,$$

$$= (1 - 2p) \pi \left(\frac{a + c}{a - c} \right)^{\frac{1}{2}} - \int_{-a}^c \left[\chi(a + \xi) - \chi(a) \left\{ \frac{a + \xi}{a - \xi} \right\}^c \right] d\xi;$$

and therefore (59), when $\epsilon^{\frac{1}{2}}$ is neglected, reduces to

$$\chi_0(a) - \chi_0(a + \epsilon) = \left[2p \left\{ \frac{2(a + c)}{a - c} \right\}^{\frac{1}{2}} - \frac{1}{\pi} \int_{-a}^c \left\{ \frac{2(a + \xi)}{a - \xi} \right\}^{\frac{1}{2}} d\xi \right] \epsilon^{\frac{1}{2}} - \chi'(a) \epsilon. \quad (60)$$

This shows that, when the parameters are such that the coefficient of $\epsilon^{\frac{1}{2}}$ is zero, the angle of contingence of the free stream-line at its point of departure is the same as that of the obstacle, so that the two curves osculate.

INFLUENCE OF THE SHAPE OF THE OBSTACLE UPON THE DIVERGENCE OF THE FREE STREAM LINES AND THE RESISTANCE TO RELATIVE FLOW.

21. The theoretical considerations of the present paper have precise bearing only upon flow which is everywhere irrotational, with discontinuity at the free stream-lines. This may, for the moment, be called the "theoretical flow"; it is not realized in actual fact or experiment. What is realized seems generally to be a continuous flow which is not wholly irrotational, and this may be called the "actual flow." In the theoretical flow there is a dead-water or wake extending to infinity, in the actual flow there is a wake of limited extent within which the motion of the fluid is rotational.

For the same obstacle and the same limit velocity at infinity, the theoretical and the actual flow may be said to correspond. It is doubtful whether a good case has been made out* for believing that the resistance of the obstacle to the flow is the same in corresponding motions; nevertheless the correspondence may help towards estimating the resistance in the actual flow.

It seems to be established as an experimental fact that in actual flow the resistance is greater when the wake or region of rotational motion is extensive than when it is small. Thus, in such a problem as the designing of the cross-section of a strut for an aeroplane, attempt is made to secure a form such that the lateral spreading of the wake, and its area, shall be as restricted as possible. Now it may be argued with a certain degree of probability that, the less divergent are the free stream-lines at their points of departure in the theoretical flow, the less spreading will be the wake in the actual flow, and therefore the less will be the actual resistance. For different shapes of prow the capacity to produce divergence of the two branches of the divided stream is likely so to correspond in the theoretical and the actual flow that where it is relatively small in one it is also relatively small in the other. In both kinds of flow divergence of the wake is evidence of the capacity of the prow to screen the region behind it from the force of the adverse stream.

If this be true it is important to enquire how, in theoretical flow, the divergence of the free stream-lines can be made as small as possible. And it may be surmised that, in theoretical flow, the most probable points of departure of the free stream-lines are those points which (as discussed in articles 17 and 18, above) are the most forward points of the obstacle from which departure is possible; or, at least, that the degree of divergence for these most forward points of departure is relevant for purpose of comparison with the corresponding actual flow.

When the flow is symmetrical the most forward possible points of departure correspond to the value of a which satisfies the equation $S = 0$, that is

$$p\pi + a^{\frac{1}{2}} \int_{\xi=0}^{\xi=a} \frac{d\chi}{(a-\xi)^{\frac{1}{2}}} = 0, \quad (61)$$

where there is a functional relation between χ and ξ whose form determines or is determined by the shape of the obstacle. Assuming p to be assigned, the question of design with a view to minimizing the divergence of the wake

* See a foot-note near the beginning of paper A.

is simply this:—What kind of relation between χ and ξ will make the negative range of integration with respect to χ , that is from $\chi = p\pi$ to $\chi = \chi(a)$, as great as possible numerically, so that $\chi(a)$ may be as small as possible?

When the curved sides of the obstacle are convex to the stream $d\chi$ is negative throughout the range from $\xi = 0$ to $\xi = a$. And as $a^{\frac{1}{2}}(a - \xi)^{\frac{1}{2}}$ is greater than unity, the whole range must be numerically less than $p\pi$, so that $\chi(a)$ is necessarily positive. Thus the stream-lines must diverge; but the divergence may be kept small.

If formula (61) be written

$$p\pi = \text{Lim } \Sigma \{ a^{\frac{1}{2}}(a - \xi)^{\frac{1}{2}} \} (-\delta\chi), \quad (62)$$

it is clear that if the greatest values of $-\delta\chi$ be associated with the smallest values of $\{ a^{\frac{1}{2}}(a - \xi)^{\frac{1}{2}} \}$ they contribute less to the sum, and therefore a greater range of $-\delta\chi$ is required to bring the sum up to an assigned value. So the association of the greater values of $-\delta\chi$ with the smaller values of ξ diminishes the divergence of the wake. In other words, if the rate of turning of the tangent to the curved side of the obstacle be greatest near the prow, this configuration makes for reduction of the divergence of the wake.

22. It will be noticed that in the last sentence, where the word "curvature" suggests itself, a different phrase has been employed. This is because the argument has been founded on a functional relation between χ and ξ , and the "rate of turning of the tangent" which appears in the result is not $-d\chi/ds$, where s is the arc of the contour, but $-d\chi/d\xi$. If σ is the curvature of the obstacle,

$$\sigma = -d\chi/ds = -(d\chi/d\xi)q,$$

where q is the resultant velocity; and the theorem cannot be expressed in a purely geometrical form until it is ascertained how change in the value of $-d\chi/d\xi$ affects the value of q . It cannot be assumed a priori that $-d\chi/d\xi$ and σ increase or decrease together.

It will be advantageous to write $d\chi'$ for $-d\chi$, remembering that this is always positive on the convex obstacle.

If an addition $\delta\chi'$ be made to $d\chi'$, and if this be concentrated at a single point $\xi = \xi_0$ of the contour of the obstacle, a corner is created there, and q becomes either zero or infinite. It is therefore necessary to suppose $\delta\chi'$ to be spread over a range of ξ surrounding the point ξ_0 , say from $\xi_0 - \gamma$ to $\xi_0 + \gamma$; if $2\gamma = \delta\xi$, it will be assumed that $\delta\chi'$ and $\delta\xi$ are infinitesimals. If $\xi = \xi_0 + \lambda$, the addition to $d\chi'$ over the postulated range may be represented by $d\theta(\lambda)$, where θ is a function such that

$$\delta\chi' = \int_{-\gamma}^{\gamma} d\theta(\lambda) = \theta(\gamma) - \theta(-\gamma). \quad (63)$$

For ξ_0 real and $\alpha > \xi_0 > 0$,

$$C(\xi_0) = K \left\{ - \frac{\alpha^{\frac{1}{2}} + (\alpha - \xi_0)^{\frac{1}{2}}}{\alpha^{\frac{1}{2}} - (\alpha - \xi_0)^{\frac{1}{2}}} \right\}^p \text{Exp} \int_{\xi=0}^{\xi=\alpha} \frac{d\chi'}{\pi} \log \left\{ - \frac{(\alpha - \xi)^{\frac{1}{2}} - (\alpha - \xi_0)^{\frac{1}{2}}}{(\alpha - \xi)^{\frac{1}{2}} + (\alpha - \xi_0)^{\frac{1}{2}}} \right\},$$

and therefore, at ξ_0 , since $q = |1/C(\xi_0)|$,

$$- \log q = \log \left[K \left\{ \frac{\alpha^{\frac{1}{2}} + (\alpha - \xi_0)^{\frac{1}{2}}}{\alpha^{\frac{1}{2}} - (\alpha - \xi_0)^{\frac{1}{2}}} \right\}^p \right] + \int_{\xi=0}^{\xi=\alpha} \frac{d\chi'}{\pi} \left| \frac{(\alpha - \xi)^{\frac{1}{2}} - (\alpha - \xi_0)^{\frac{1}{2}}}{(\alpha - \xi)^{\frac{1}{2}} + (\alpha - \xi_0)^{\frac{1}{2}}} \right|. \quad (64)$$

If δq be the change in q due to the $\delta\chi'$ above specified, it follows from formula (64) that

$$- \frac{\delta q}{q} = \int_{\lambda=-\gamma}^{\lambda=\gamma} \frac{d\theta}{\pi} \log \left| \frac{(\alpha - \xi_0 - \lambda)^{\frac{1}{2}} - (\alpha - \xi_0)^{\frac{1}{2}}}{(\alpha - \xi_0 - \lambda)^{\frac{1}{2}} + (\alpha - \xi_0)^{\frac{1}{2}}} \right| = \int_{-\gamma}^{\gamma} \frac{d\theta(\lambda)}{\pi} \log \left| \frac{\lambda}{4(\alpha - \xi_0)} \right|,$$

the last equality being approximate, the second power of λ being neglected under the logarithmic sign. Thus

$$- \frac{\delta q}{q} = - \frac{1}{\pi} \log \{4(\alpha - \xi_0)\} \int_{-\gamma}^{\gamma} d\theta(\lambda) + \frac{1}{\pi} \int_{-\gamma}^{\gamma} \log |\lambda| d\theta(\lambda), \quad (65)$$

in which it is to be noticed that the first integral, by (63), equals $\delta\chi'$, and that the infinity at $\lambda = 0$ in the second integral is not sufficiently powerful to interfere with convergence.

It may be assumed that $\theta(\lambda)$ is expansible in the form $A + B\lambda + C\lambda^2 + \dots$, so that $d\theta = (B + 2C\lambda + \dots) d\lambda$; then

$$\int_{-\gamma}^{\gamma} \log |\lambda| d\theta = \int_{-\gamma}^{\gamma} (B + 2C\lambda) \log |\lambda| d\lambda, = 2B(\gamma \log \gamma - \gamma),$$

approximately. Also, by (63), $2\gamma B = \delta\chi'$ approximately. Therefore the second term of (65) equals $(\delta\chi'/\pi)(\log \gamma - 1)$, and

$$- \frac{\delta q}{q} = \frac{\delta\chi'}{\pi} \left\{ \log \left(\frac{1}{2} \delta\xi \right) - \log \{4(\alpha - \xi_0)\} - 1 \right\}. \quad (66)$$

This formula represents the change in q at a particular point due solely to a variation $\delta\chi'$ distributed in the immediate neighbourhood of that point. If account has to be taken at $\xi = \xi_0$ of a variation of $d\chi'$ elsewhere, say $\delta_1\chi'$ at $\xi = \xi_1$, there is a further variation of q , namely given by

$$- \frac{\delta_1 q}{q} = \frac{\delta_1 \chi'}{\pi} \log \left| \frac{(\alpha - \xi_1)^{\frac{1}{2}} - (\alpha - \xi_0)^{\frac{1}{2}}}{(\alpha - \xi_1)^{\frac{1}{2}} + (\alpha - \xi_0)^{\frac{1}{2}}} \right|. \quad (67)$$

As regards formula 66, what is contemplated is a variation of the rate of turning of the tangent at and about ξ , and if the mean of this variation over the range $\partial\xi$ be $\partial(d\chi'/d\xi)$, then $\partial\chi' = \partial(d\chi'/d\xi) \partial\xi$. Hence (66) is equivalent to

$$-\frac{\partial q}{q} = \frac{1}{\pi} \partial \left(\frac{d\chi'}{d\xi} \right) \partial\xi \left[\log \left| \frac{\partial\xi}{8(a - \xi)} \right| - 1 \right]. \quad (68)$$

Now, in spite of the greatness of $\log \partial\xi$, the product $\partial\xi \log \partial\xi \rightarrow 0$ as $\partial\xi \rightarrow 0$, and thus the formula shows that ∂q tends to vanishing smallness in comparison with $\partial(d\chi'/d\xi)$. A corresponding result holds for ∂q .

Thus it appears that infinitesimal variations of the rate of turning of the tangent at the keel contemplated, corresponding namely to alterations of curvature which are infinitesimal and do not introduce corners, may be regarded as leaving the velocity q unaffected. And therefore a variation which increases $d\chi'/d\xi$ increases the curvature, and conversely.

It is accordingly legitimate now to express in geometrical form the principle obtained in the preceding article, namely in the statement that the more the curvature of the sides of the obstacle is brought into the neighbourhood of the prow the less will be the divergence of the wake.

Of course complete concentration of curvature at the prow must be ruled out, for that would reduce the obstacle to a plane lamina edge-on to the stream. Other considerations that resistance to the flow have to be taken account of, and both q and the degree of concentration of curvature near the prow must be chosen, so as to give the obstacle as much breadth as it requires for strength or for any other purpose. But the present principle, if it is sound, furnishes a method of bringing the resistance question simply into the balance with the other relevant considerations.

23. The same principle may be established for an asymmetrical obstacle by considering the formulae got by equating to zero the coefficients of $\epsilon^{\frac{1}{2}}$ in formulae (54) and (55). Since $d\chi$ is negative for curves convex to the region of flow it will save confusion to put $-d\chi = d\chi'$. And the two integral signs may be replaced by a single one covering the whole range, provided it be agreed that the sudden change in the value of χ at $\xi = c$ is excluded from the integration. The equations determining the most forward points of departure may then be written

$$I_1 = \int_{\xi=-a}^{\xi=a} \left(\frac{a+\xi}{a-\xi} \right)^{\frac{1}{2}} d\chi' = 2p\pi \left(\frac{a+c}{a-c} \right)^{\frac{1}{2}}, \quad (69)$$

$$I_2 = \int_{\xi=-a}^{\xi=a} \left(\frac{a-\xi}{a+\xi} \right)^{\frac{1}{2}} d\chi' = 2p\pi \left(\frac{a-c}{a+c} \right)^{\frac{1}{2}}. \quad (70)$$

Though there is no loss of generality in dealing with an arbitrarily selected value of a , it is not permissible for the present purpose to keep the value of c fixed. So c must be eliminated. This gives

$$I_1 \cdot I_2 = \int_{-a}^a \left(\frac{a + \xi}{a - \xi}\right)^{\frac{1}{2}} d\chi' \int_{-a}^a \left(\frac{a - \xi}{a + \xi}\right)^{\frac{1}{2}} d'\chi = 4p^2\pi^2. \tag{71}$$

If, for one selected value of ξ , a small increment $\delta\chi'$ were made in $d\chi'$, the increment of $I_1 \cdot I_2$ would be $f(\xi) \delta\chi'$, where

$$\begin{aligned} f(\xi) &= I_2 \left(\frac{a + \xi}{a - \xi}\right)^{\frac{1}{2}} + I_1 \left(\frac{a - \xi}{a + \xi}\right)^{\frac{1}{2}}, \\ &= 2p\pi \left\{ \left(\frac{a - c}{a + c} \cdot \frac{a + \xi}{a - \xi}\right)^{\frac{1}{2}} + \left(\frac{a + c}{a - c} \cdot \frac{a - \xi}{a + \xi}\right)^{\frac{1}{2}} \right\}. \end{aligned} \tag{72}$$

Hence if two simultaneous increments of $d\chi'$, namely $\delta_1\chi'$ for $\xi = \xi_1$, and $\delta_2\chi'$ for $\xi = \xi_2$, be such that they leave the equality (71) still true, it is necessary that

$$f(\xi_1) \delta_1\chi' + f(\xi_2) \delta_2\chi' = 0. \tag{73}$$

Now, the two terms in $f(\xi)$ have a product independent of ξ , and are equal when $\xi = c$. Hence $f(\xi)$ has its minimum value for $\xi = c$, and increases as ξ varies from c towards either a or $-a$. And so, if $a > \xi_2 > \xi_1 > c$, or $c > \xi_1 > \xi_2 > -a$, then $f(\xi_2) > f(\xi_1)$, and therefore, by (73), $|\delta_1\chi'| > |\delta_2\chi'|$. Thus if $\delta_1\chi'$ is positive $\delta_2\chi'$ is negative, and $\delta_1\chi' + \delta_2\chi'$ is positive, so that there is a net increase in the whole range of χ' .

This means that any change in the functional form of χ which has the effect of bringing curvature nearer to the prow c increases the negative range of χ , and so makes the free stream-lines less divergent at their points of departure. The bearing of this principle on the resistance in a case of actual (as distinguished from theoretical) flow is the same as when the flow is symmetrical.

III.

ELECTRIFICATION BY FRICTION.

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THE work described in this paper may be looked upon as an attempt to study frictional electricity in an accurate and quantitative manner.

It has been found possible to overcome the well-known experimental difficulties of the subject to a sufficient extent to enable consistent results to be obtained. We have studied the effects of different pressures between the rubbing surfaces, different relative motions, changes of temperature and of the amount of moisture in the air, and finally we have carried out experiments in gases at greatly reduced pressures.

None of these subjects has been examined fully; we have in the first place made a general survey of some of the different factors which influence the rate of production of frictional electricity, with the object of deciding on the points most likely to repay fuller investigation.

The work described in this paper was carried out two years ago, but pressure of other work caused an interruption, and it was only recently that it has been possible to take up the detailed study of some of the points touched on in this paper.

Work on frictional electricity has been published in recent years by Morris Owen,¹ Morris Jones,² French,³ and Shaw,⁴ but there is not much direct overlapping in the case of our work with that of these authors.

APPARATUS.

After several attempts along different lines the following method of producing friction between surfaces was found to give satisfactory results.

¹ Phil. Mag., April, 1909.² Phil. Mag., Feb., 1915.³ French, Physical Review, vol. ix, No. 2, Feb. 1917.⁴ Shaw, P. E., Proc. Phys. Soc., vol. xxvii, April, 1915; Proc. Roy. Soc., vol. xciv, 1917.

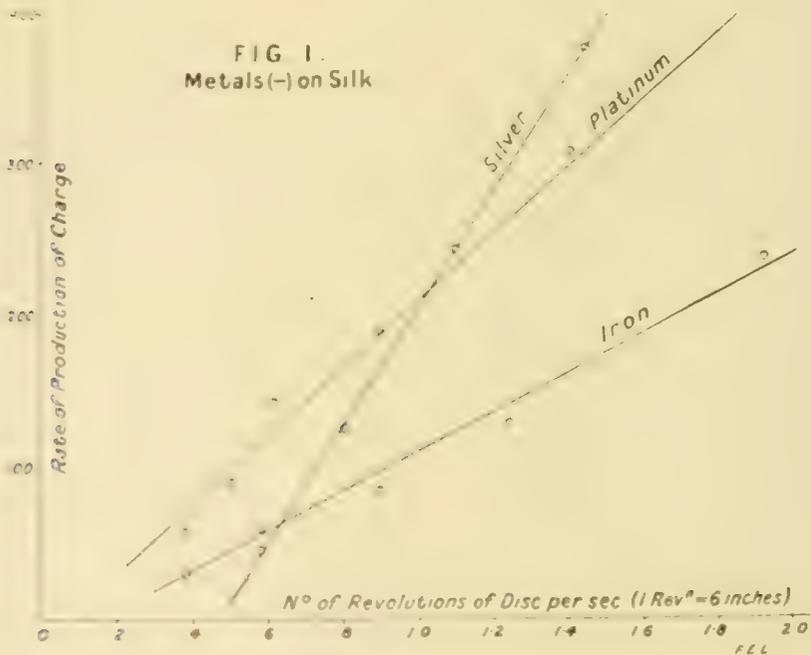
The apparatus was quite simple. A circular disc of wood was hollowed out on one face to a depth of about a quarter of an inch, leaving a circular rim around the edge. Silk—or linen—was stretched over the hollowed out face and bound firmly in position by wires fitting into shallow grooves on the circumference of the disc. The disc was fixed to an axis that could be revolved by a motor so that the silk rotated in its own plane and formed one of the rubbing surfaces. Discs of different sizes up to 14 inches diameter were used at different times, and a wide range of speed of rotation was available. The other rubbing surface was a metal, and different metals have been used. Small metal spherical caps of large radius of curvature were used. They could readily be attached to a simple lever arrangement that allowed them to be pressed against the silk surface with any desired pressure. The stem carrying the metal surface was insulated and joined to one pair of quadrants of an electrometer. The rate of production of charge on the metal surface was measured, either by observing the rate of charging of the electrometer, with a suitable capacity attached, when the motion of the silk surface was steady, or more often by connecting the metal to earth through a high resistance, and using the electrometer to measure the steady potential difference between the ends of the resistance.

This apparatus was modified for some of the experiments and especially for the work in gases at reduced pressures, but the general method remained the same.

It will be observed that in our method of working the metal cap which forms one of the rubbing surfaces is always either at zero potential or differs from it by only a fraction of a volt. On the other hand, the silk or linen which forms the other rubbing surface retains its charge to some extent, and we do not know the potential which it reaches. After some revolutions of the disc, that is in a very short time, the steady condition is no doubt reached when the leakage from the silk balances the rate of production, and it is the rate of charging of the metal surface under these conditions which we measure. No doubt there is uncertainty as to the extent to which the charging of the metal surface is influenced by coming in contact with silk electrified during the previous revolution of the disc, but we have used this method—at any rate up to the present—because of the steadiness of the results obtained by it. Besides, the difficulty referred to cannot be avoided completely by any method of experimenting. When two surfaces are electrified by friction, recombination of the charges will always take place at a rate depending on the conductivity of the bodies and on the relative velocity at the point of contact.

*Variation of rate of production of electricity with speed of moving surface,
and with pressure between surfaces.*

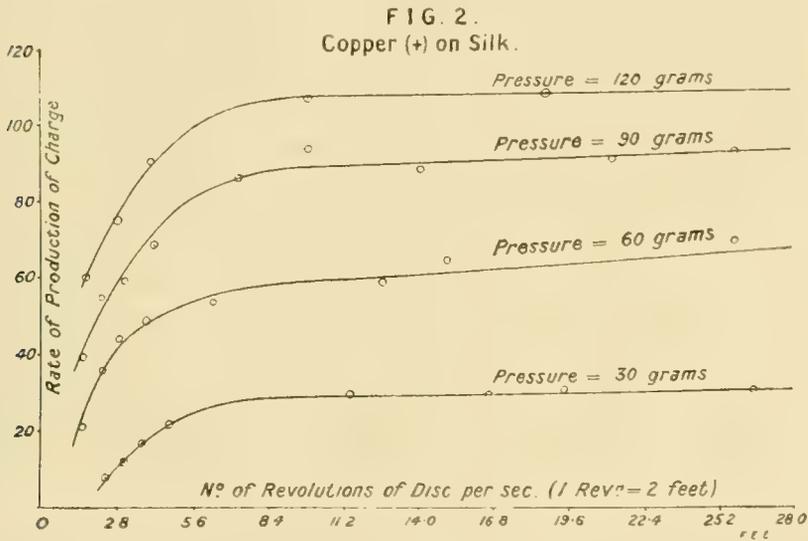
The first point investigated with the apparatus just described was the effect of the speed of the moving surface on the rate of production of electricity. Low speeds were first investigated, the metal cap being fixed so that it was rubbed by a length of 6 inches of silk in each revolution. The results with platinum, iron, and silver, rubbing on silk and getting in each case a negative charge, are shown on fig. 1.



It is clear from these curves and from others not reproduced in the paper, that for small speeds the rate of production is proportional to the excess of speed above a certain small value which differs for different metals. The relative rates of production for different metals under the same pressure would therefore differ according to the speed of the rubbing surface. The maximum speed represented on the curves in fig. 1 is only 12 inches per second.

Higher speeds were then dealt with. The circumference of the circle which the metal cap travelled over in one revolution was now 2 feet, and 28 revolutions per second could be obtained from the motor, giving a maximum speed of the rubbing surface of 56 feet per second. In stating the results we must distinguish between cases where the metal got a positive charge and cases

where the charge on the metal was negative, for the variation of production with speed is different in the two cases. As an example of the results when the metal is positive we give curves (fig. 2) for copper rubbing on silk, the different curves corresponding to different pressures between the copper and the silk. Somewhat similar curves were plotted for zinc and iron, the charge on the metal being positive in both cases.



As the speed of rubbing increases, the production increases to a certain point; a maximum rate of production is reached which is not altered by a further large increase of the speed. The maximum rate of production of a positive charge on copper was reached at a speed of about 20 feet per second, and no further increase of production took place when the speed was altered to 56 feet per second. The speed required to give the maximum rate of production of positive charge on zinc or iron was greater than in the case of copper, being about 30 feet per second.

The effects of different pressures between the metal and the silk are also shown by the curves on fig. 2, the production of electricity increasing with an increase of pressure whatever may be the speed of the rubbing surface. The maximum rates of production at different pressures are roughly proportional to the pressures.

In similar experiments with metal caps which got a negative charge, the results were less certain. Sometimes numbers would be measured which showed that the rate of production tended towards a maximum at high speed, and in other cases the rate of production increased even more rapidly than the speed.

We cannot fully explain the want of steadiness in the numbers for negative charge as compared with those for positive charge, but there is one factor which should make a decided difference in the form of the curves connecting production and speed according as the metal surface is positive or negative. Later work described below showed that an increase of temperature of the metal cap decreased the rate of charging, provided the charge was positive, but increased the rate of production of a negative charge on the metal. An increase of temperature tends to make the metal surface acquire a negative charge. As an increased speed of rubbing means an increase of temperature this effect would tend to flatten the curve and cause the production to reach a maximum when the metal was positive, while it would tend to cause a more and more rapid production at high speeds when the charge was negative.

In addition to this temperature effect we must remember that at high speeds the rapid return of the metal over the same silk surface brings it into contact with an oppositely electrified surface. This should flatten the curves connecting the rate of charging with the speed whether the charge on the metal is positive or negative. When the metal is charging positively, we have, therefore, two effects acting in the same direction and diminishing the observed rate of production of charge at high speeds, but acting in opposite directions when the metal is charging negatively.

This reasoning does not, however, explain the variable nature of the results we obtained when the metal was charging negatively. These measurements were among the first made and before we had learned some of the conditions necessary for very constant results.

To obtain a positive charge on the metal when rubbed with silk it is well to have the metal surface polished. When polished, some metals give a positive charge and behave very steadily. A clean surface of the same metal free from polish may charge negatively, and clearly inconsistent results may be obtained at a transition stage.

To return to the results with the metal surface charging positively, the curves would require correction for both the effects mentioned above in order to arrive at the true relation between rate of production and speed, but there is no doubt that the curves tend to a maximum as the speed is increased. To obtain similar curves for negative charges on the metal it will be necessary to prepare the surface in a standard way without actually polishing it.

We have tried some direct experiments with metal surfaces polished and then rubbed very slightly with emery paper. The result in most cases was that contact with the emery paper tended to make the metal charge negatively. If charging positively when polished, it gave either a smaller positive

charge or else a negative charge after the use of the emery paper. It is probable, we think, that when sufficient care is taken to keep the nature of the surface constant during the experiment, the curves for metals taking a negative charge will be of the same type as those given in fig. 2 when the metal is charging positively.

Variation of production of charge with temperature, speed of rubbing and pressure remaining constant.

We have tried a few preliminary experiments on how the rate of production of charge depended on the temperature of the metal surface. For this purpose we used a hollow metal cap with two tubes attached so that a stream of water could be passed through it. The vessels from and to which the water flowed were insulated, so that the rate of charging could be measured with or without the flow of water. Care was, of course, taken that the stream of water did not of itself produce any electrical effect. Small junctions soldered to the metal enabled the temperature of the rubbing surface to be estimated. By placing junctions close to and at greater distances from the rubbing surface we decided that the temperature of the surface in contact with the silk certainly did not reach 100° C. at the highest speeds used. We could assume, therefore, that the metal surface in contact with the silk was raised in temperature by passing steam through the cap, and lowered in temperature by passing a stream of water at the temperature of the room.

The results were similar in all the cases we examined. When the metal was charging positively, the stream of cold water increased the rate of charging, while the effect of steam was to decrease the rate or even to change the sign to negative. When the metal was charging negatively, the steam increased the rate of charging and the cold water decreased it or changed the sign to positive.

It is important to note that an increase of temperature produces the same effect as a slight roughening of the metal surface. When the metal surface is very slightly rough, the actual points of contact may be considerably raised in temperature, although the average temperature is not appreciably altered. The effects of changes of temperature will obviously be worth full investigation.

Variation of rate of production of charge with amount of moisture in the air.

To test how the rate of production of charge varied with the humidity of the surrounding air, the apparatus was slightly modified so that the humidity could be altered as desired. An extension of the axis of the motor, working

in a closely fitting tube, projected through the side of a box and carried the rotating disc, which was thus mounted with all its attachments inside the box. One side of the box could be removed to adjust the apparatus, and when replaced could quickly be made sufficiently air-tight. The necessary electrical connexions passed through insulating plugs in another side of the box.

To get observations at any humidity the method followed was to dry the air inside the box in the first place by phosphorus pentoxide, then shut off the vessel containing the phosphorus pentoxide, and start a slow stream of air saturated with moisture into the box, an exit for the air being opened. The air inside the box was thus slowly supplied with water-vapour, and during the change in humidity the observations were continued. Knowing the volume of the box, and the amount of air entering and leaving it per second, it is easy to calculate the humidity at any instant, assuming that complete mixing takes place, and this can be facilitated by means of the rotating disc.

Let the volume of the box be N c.c.s., and the volume of air entering and leaving it per second V c.c.s. Let p denote the water-vapour per c.c. in the box at any instant, and P the water-vapour per c.c. of the saturated air entering the box.

We have, therefore,

$$\frac{d}{dt}(pN) = V(P - p),$$

which gives

$$\text{Humidity} = \frac{p}{P} = 1 - c e^{-\frac{Vt}{N}}.$$

In practice we plotted the rate of production of charge against the time elapsed since the flow of saturated air into the box started. The humidity at any point of the curve can be obtained by substituting the corresponding value of t in the above expression.

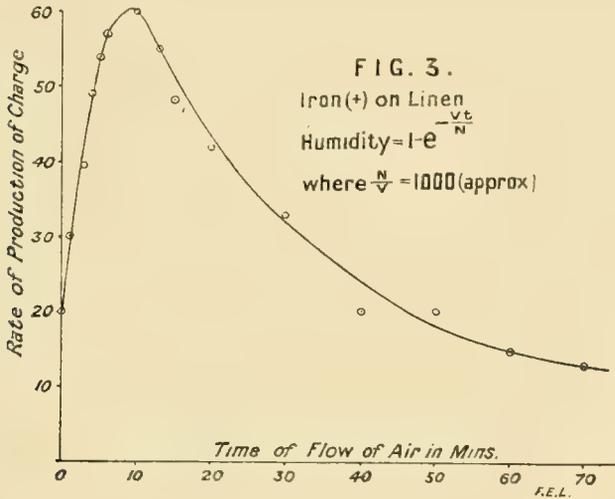
Having first thoroughly dried the air in the enclosure, saturated air was then passed in and curves taken with various metal caps, some of which charged negatively and some positively.

Fig. 3 is typical of those obtained when the metal knob charged positively. As moisture was gradually added the rate of production increased up to a certain point, and then decreased rapidly when more moisture was added.

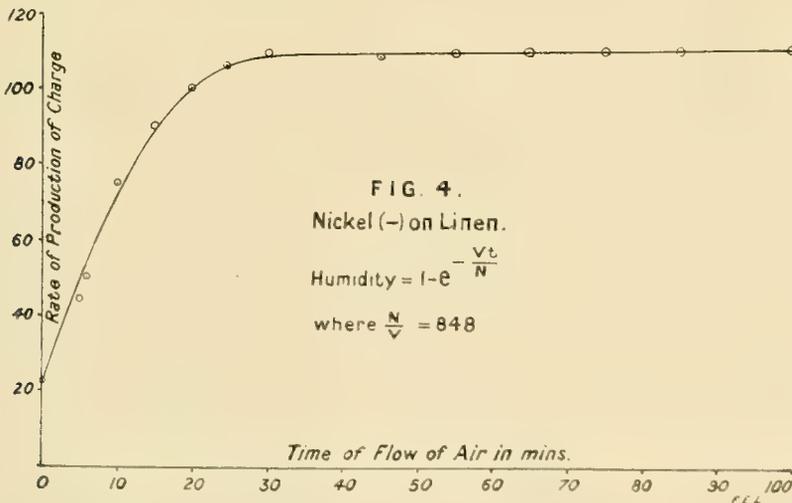
When the metal cap charged negatively the form of the curve was different. Fig. 4 is typical of those obtained in such a case. The surface rubbing

against the metal was in these experiments usually linen, but silk was sometimes used.

There is thus a marked difference in the form of the curves showing the variation of the rate of production of electrification with amount of moisture



present according as the metal surface is charging positively or negatively. There is one factor which we must remember in considering these curves, and which explains some of their features, but is not sufficient to account for the



difference between the two types. As the amount of moisture increases, the conductivity of the silk or linen also increases. The initial small rate of

production when the air is very dry is accounted for by the high insulation of the linen which thus gets charged oppositely to the metal, and this opposite charge leaks back to the metal on successive contacts. We tried the effect of placing a large number of sharp earth-connected points close to the surface of the linen, and found that when the metal was positive little effect was produced on the form of the curve, but when the metal was charging negatively the presence of the points increased its rate of charging in dry air. This is in agreement with the fact that the point discharge takes place more easily when the point is negative. The small apparent rate of production of charge in a very dry atmosphere may therefore be explained by the high insulation of the linen or silk.

The varying conductivity of the linen as the amount of moisture alters does not, however, explain the essential difference in the two types of curves. It does not explain why the apparent rate of production as we approach saturation falls off rapidly when the metal is positive and not when the metal is negative.

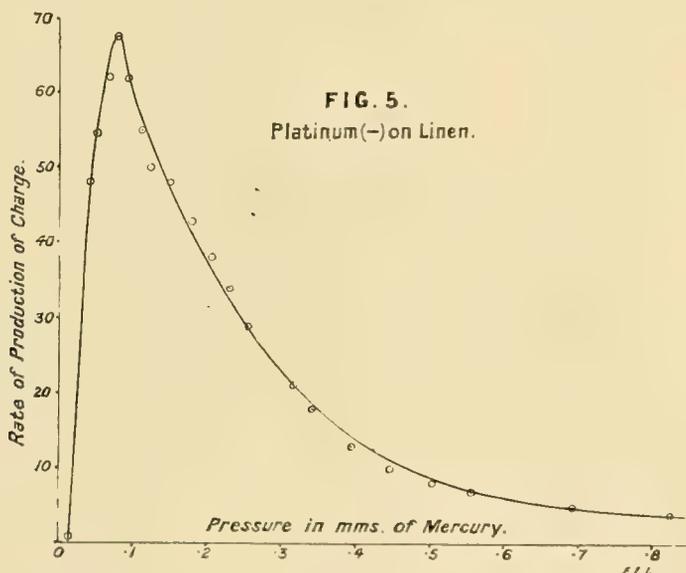
Experiments in Gases at reduced pressures.

We now proceeded to carry out experiments in air and other gases at reduced pressures.

A more elaborate apparatus was constructed, retaining, however, the same method of producing the friction and measuring the rate of production of charge. The closed space was formed by a bell-jar resting on a metal plate. An iron tube passed through a hole in the metal plate and projected below it to a length greater than the barometric height. The disc on which the silk or linen rubber was stretched was attached to an iron rod which passed down through the hemispherical tube and was rigidly fixed to a suitably shaped mercury reservoir which could be rotated by a motor. It was easy to arrange the reservoir so that no mercury was ejected even at high speeds. The necessary connexions were made through insulating plugs passing through the metal plate. With this apparatus the necessary adjustments could be made, the bell-jar put in position, made air-tight with wax, and a pressure of $\cdot 001$ mm. or lower reached by a rotating mercury pump in a short time. Liquid air was not available, and with an apparatus of this type it was not possible to reach much lower pressures without too much waste of time.

The usual method of working was to reduce the pressure as low as possible then set the motor working and take observations admitting gas in small quantities at intervals. A two way stop-cock allowed small quantities to be admitted when desired. The pressure was measured with a McLeod gauge.

Linen was used as the rubber, and curves were plotted for a number of metals all taking a negative charge. Fig. 5 refers to platinum, and the other curves were quite similar. At the lowest pressures reached the rate of production of charge was very small. As the pressure increased, the rate of production rose quickly to a maximum value which in all cases occurred at a pressure of about .08 mm. of mercury. The rate of production decreased as the pressure was further increased and became more or less steady about .5 mm.

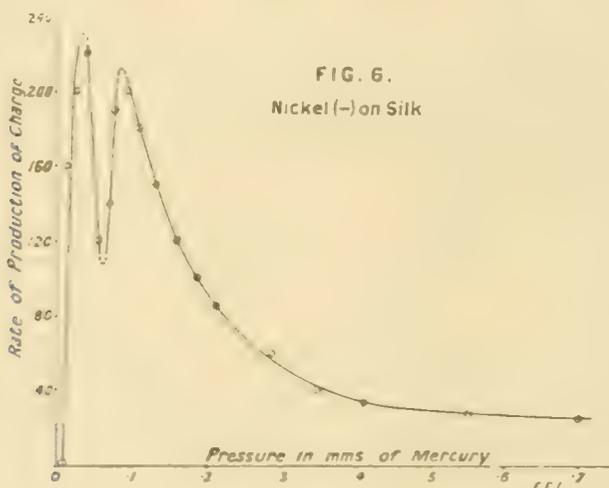


The remarkable feature of all the curves was the regularity with which the maximum occurred about the same pressure.

Similar experiments were next made using silk as the rubber. Fig. 6 refers to nickel which is again charging negatively. The curve shows two maxima, one at a pressure of .08 mm. and the other at .03 mm. We obtained the same type of curve showing the same maxima for platinum. Using a different sample of silk, the maximum at .08 mm. disappeared, and that at .03 mm. remained. The obvious suggestion is that the first sample of silk was not pure.

We now endeavoured to plot similar curves when the metal was charging positively. As mentioned frequently above, it was easy to get a well-polished metal surface charging positively with the rubbers we used; but in these experiments in air at low pressures it was only in the case of copper or iron rubbed with linen that we were able to get a positive charge on the metal. When these metals were charging positively, an increase in the rate of production took place as the pressure was increased from very low values, but

the rise was slower than in the case when the metal charged negatively, and the maximum occurred at a higher pressure. The pressure corresponding to maximum charging was also different for the two metals, being about .8 mm. for copper and 1.25 mm. for iron. From all these results it would appear that the pressure at which maximum production occurs is determined by the substance which is charging positively; thus different metals taking a negative charge gave the same point of maximum production when the same rubber was used, but a different point with another rubber. Again, copper and iron gave a maximum at different pressures when taking a positive charge.



In all the above experiments at low pressures the air was well dried with phosphorus pentoxide, and the effects of drying previously recorded must be borne in mind in interpreting the present results. The rubber no doubt insulates well when well dried and therefore retains the charge of opposite sign to that on the metal and if for any reason the rubber lost its charge more freely at a particular pressure, the form of the curves might be explained. But we do not think that a sufficient explanation can be found along those lines, and it would therefore appear that the actual rate of production of charge varies with the residual pressure of the gas as shown on the curves. This pressure effect is under further examination in the laboratory.

We do not propose at this stage to discuss the theory of the results contained in this paper. Indeed, the main object in publishing the results in their present form is to show that it is quite possible to make measurements on frictional electricity with such a degree of accuracy and consistency as to justify a complete study of the subject.

IV.

THE IONS PRODUCED BY BUBBLING AIR THROUGH
ALCOHOL.

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IN a previous paper¹ the nature of the ions produced by bubbling air through mercury was examined. Several different groups of ions were found, and with the view of obtaining further information on the nature of these ions we have undertaken similar experiments on the ionisation produced by bubbling air through alcohol. Alcohol was chosen for two reasons, (1) because the quantity of ionisation obtained with it is larger than with most liquids, and so enables us to make observations on the ions some time after formation; and (2) because alcohol is easily obtained comparatively pure.

Investigations bearing on the ionisation produced by breaking up alcohol have been made by De Broglie² and Eve.³ De Broglie showed that the electrification produced by bubbling air through alcohol increased very rapidly with the pressure inside the orifice through which the air issued when the pressure was over 8 cms. of mercury. He also showed that the electrification was the same with pure alcohol and with alcohol diluted with water down even to a strength of thirty per cent. alcohol. When the alcohol was diluted further, the electrification decreased. Eve sprayed a number of liquids and examined the quantity of positive and negative electrification given to the air. He found that alcohol was among the most active liquids, and that with alcohol the positive and negative electrifications were equal.

¹ Proc. Roy. Irish Acad., vol. xxxiii, Sec. A (1916).

² Le Radium, August, 1907.

³ Phil. Mag., vol. xiv (1907).

The experiments described in this paper were performed with the same method and the same style of apparatus as were used in the work on mercury. Air was forced by a pump through a fine nozzle, placed a few cms. below the surface of the alcohol. Before passing through the nozzle, the air was forced through a cotton-wool plug. In none of the experiments was the air in any way dried. A portion of the ionised air was then drawn off by means of a gasometer through the cylindrical tube designed to measure mobilities. The mobilities were determined by reading the current to the inner insulated terminal for various voltages on the outer tube, and thus plotting current-voltage curves. These curves were found to be similar to the curves obtained in the previous work; they were made up of a number of straight lines, showing that different types of ions were present. The mobilities of the different kinds of ions were calculated from the formula

$$u = \frac{Q \log \frac{b}{a}}{2\pi V l}$$

where Q is the volume of air passing through the tube per second, b and a the radii of the tube and inner terminal, and l the length of the terminal. V , the saturation voltage of a group of ions, is determined by the intersection of two straight lines on the curve. Examples of these curves were given in the last paper, so it is not thought necessary to give any examples of the present curves. The positive current is always practically the same as the negative under the same conditions. In all the types of ions given below (with one doubtful exception) the values of the mobilities for the positive and negative ions are the same. Accordingly, no distinction of sign has been made: about half the observations refer to positive and half to negative ions.

Preliminary Observations.

The results of preliminary experiments on the determination of mobilities are given in Table I.

TABLE I.

Mobilities in cms. per sec. under 1 volt per cm.

·017	·0083	·0042	·0024
·014	·0075	·0044	·0027
·012 ?	·0078	·0045	·0019
·017 ?	·0078	·0033	·0024 ?
·023 ?	·0077	·0036	·0025 ?
	·0080	·0043	
	·0069	·0035	
	·0087	·0042 ?	
	·0085 ?	·0042 ?	
	·0081 ?	·0053 ?	
	·0087 ?	·0039 ?	
	·0069 ?	·0035 ?	
	·0071 ?		
MEANS, ·015	·0078	·0040	·0023

All the values obtained are given. Those obtained from curves in which there was some doubt about the exact point of bending have been marked doubtful, and are not included in taking the mean. The ions can be divided into four definite classes. The justification for placing numbers like ·0033 (lowest in column 3) and ·0027 (highest in column 4) in different classes is that we get ·0033 and ·0019 on the same curve, and ·0042 and ·0027 on the same curve. This division is supported by much better numbers given further on. Most of these observations were taken before the importance of the pressure at which the bubbling takes place was fully recognized. The pressure is variable for these observations, and is not known with certainty. It is probably between 17 cms. and 21 cms. of mercury for most of them. It was found that the ion of mobility ·015 cm./sec. was present only when the pressure was reduced to about 17 cms. When the pressure was increased, the fastest ion that could be detected was that of mobility ·0078 cm./sec. A further increase in the pressure of bubbling caused the disappearance of this ion. Experiments were, accordingly, conducted on the effect of pressure.

Variation with Pressure.

A mercury manometer was placed between the cotton-wool plug by which the air was filtered and the bubbling nozzle so as to give the excess pressure inside the nozzle over the atmospheric pressure. The values given in

Table II*a* were obtained working at a pressure of 7 cms. of mercury, and those in Table II*b* with a pressure of 11 cms.

TABLE II*a*.

·049	·020	·0074
·056	·020	·0076
·050	·014	·0067 ?
·055	·014 ?	·0071
·040 ?	·015 ?	
MEANS, ·052	·018	·0074

TABLE II*b*.

·043	·016	·0072	·0032
·053	·018	·0071	·0040
·043 ?	·015 ?		·0037
MEANS, ·048	·017	·0072	·0036

A few curves with a pressure of 4 cms. of mercury were taken, and the presence of an ion of mobility = ·12 cm./sec. was observed.

From these results it is seen that the division into types of ions is further justified, and that change of pressure does not change the mobility of any of these ions. Increasing the pressure causes the appearance of types of ions of lower mobility and the disappearance of the faster ions.

The total ionisation, as de Broglie has found, increases as the pressure increases. From these measurements of mobilities at different pressures, it appears that this increased electrification is due to the increased production of slower ions. The disappearance of the faster ions may be only apparent. They may be present at the higher pressures in much the same quantity as at the lower pressure, but the large increase in the total quantity of ionisation may conceal them. It is difficult to decide on this point. With this method of measuring mobilities, especially when there are so many classes of ions, it is difficult to determine accurately the fraction of any particular class present. The fraction of the ionisation due to any particular ion is got by producing the two straight lines on the current-voltage curve, whose intersection determines the saturation voltage of the ion, to meet the current axis. The length intercepted by these lines on the current axis is the current due to the

ion. Variations in the numbers, which will not seriously affect the bending point, often change slightly the slopes of the lines. Thus curves which give the same mobility will sometimes give a different fraction of the ionisation as due to the particular ion, although the total quantity of ionisation is the same. This error is all the more serious if the straight lines are short. These straight lines are short, comparatively speaking, in the present work because there are so many classes of ions, and the saturation voltages are not very widely spaced.

Effect of Time.

In the case of the ions derived from air bubbled through mercury, it was found that the mobilities observed depended on the time-interval between the bubbling and the measurement of the mobility. We have examined this effect fully in the present paper in the case of the ions in air that has bubbled through alcohol. The time-interval can be varied in two ways: by interposing lengths of tubing between the alcohol and the measuring tube, or by varying the rate of flow of the air into the gasometer from the alcohol vessel. Both methods were used, and measurements were made with a number of widely different time-intervals. The tables numbered Table III (a), (b), (c), (d), (e), give all the numbers observed in the series of experiments performed with the object of investigating the time-effect. The pressure of air was generally between 7.4 and 9.6 cms. of mercury. On a few occasions it was as high as 11 cms.

TABLE III.

(a) Time—43 secs.

—	—	—	—	·0013	
·016 ?	·0066 ?	·0041	·0024	·0015	
·016	·0080	·0040	·0023	·0014	·0006 ?
—	—	—	—	·0016 ?	
MEANS,	·016	·0080	·0041	·0024	·0014
					·0006 ?

(b) Time—85 secs.

	—	—	—	—	·00066	·00037
	·0088	·0044	·0024 ?	·0015	·00070	
	·0074 ?	·0044	·0025	·0015	·00074	·00035
	—	—	—	—	·00073	
MEANS,	·0088	·0044	·0025	·0015	·00071	·00036

(c) Time—182 secs.

	—	—	—	·00035
	·0023	·0015	·00071	·00037
	·0023	·0015	·00065	·00034
	—	—	—	·00034
MEANS,	·0023	·0015	·00068	·00035

(d) Time—409 secs.

	—	—	·00031
	·0012	·00048	·00030
	·0010	·00052	·00026
	·0012	·00047	·00028
MEANS,	·0011	·00049	·00029

(e) Time—900 secs.

	—	—	—	·00015
	·0015	·00068	·00031	·00014
	—	—	·00031	·00014
	—	·00055	·00032	·00015
	—	—	—	·00014
MEANS,	·0015	·00062	·00031	·00014

From the numbers given in Table III we get further confirmation of the system of division of the ions into classes. Each class has a definite mobility, and in this series of experiments with widely different conditions, no ion is observed which cannot be classified.

It will be noticed in Table III that for the time 409 seconds the mobility values are abnormally low. This was probably because a very slow air stream was used. Some additional experiments were made to test whether these low values indicated a true variation of mobility with time. In the above experiments with a time-interval of 409 seconds, the velocity of the air stream was 7·8 cms. per second. Air velocities of 18·2 cms. and 14·6 cms. per second were now used and a volume of tubing which gave time-intervals of 433 seconds and 540 seconds respectively. Eight good determinations of the last ion of Table III (*d*) gave a mean value of ·00037. The low values for time 409 seconds in the table are therefore probably due to the slow air stream,

the motion of the gasometer being too slow for accuracy. Further observations with more rapid air streams also gave a larger value for the mobility of the last ion in the table; $\cdot 00015$ is the mean value of all the observations.

There are two ways in which we may explain the disappearance of the faster ions and the appearance of the slower ions with time. We might suppose that all the ions are present at the very beginning just as in the case of the spraying of water. The slow ions would be present in very small quantity compared with the faster ions. At short time-intervals the small ions would give so much ionisation that the large ions would be obscured. As time increased the small ions would disappear more quickly than the large ions. The consequence would be that the large ions would come into prominence.

The second way of explaining these results is to suppose that the large ions are not present at the beginning, and that they are formed, as time goes on, from the smaller ions.

For reasons similar to those given when dealing with the effect of pressure on the mobilities, it is difficult to decide between these two theories. The balance of evidence is in favour of the latter view. The most decisive evidence in support of the second theory is obtained from a consideration of the experiments with the very long time-intervals, especially in examining the appearance of the ion of mobility $\cdot 00015$ cm./sec. With these long intervals the rate of decay of the ionisation is slow, and the total quantity of ionisation does not vary much with the different times. Consequently the percentages of ions present in the different experiments can be compared more definitely.

On this view we see that the ion of mobility $\cdot 00034$ cm./sec. is formed between 43 and 85 secs. after bubbling. In the case of air bubbled through mercury the ion of mobility $\cdot 00034$ cm./sec. was present 30 secs. after the ionisation had taken place. The formation of the slower ions does not take place so rapidly with the alcohol ions as with the ions derived from mercury.

The ion of mobility $\cdot 00015$ cm./sec. was not present 433 secs. after bubbling, but it was observed after an interval of 540 secs. So it can be stated that the ion of mobility $\cdot 00015$ cm./sec. is not formed until about 500 secs. have elapsed from the formation of the ions.

It is obvious, from the results obtained in the variation of pressures, that the time which elapses before the appearance of any ion will depend on the pressure of the bubbling. The times given above for the appearance of the two slowest ions relate to the pressure at which most of the experiments were conducted—a pressure of about 8 cms. of mercury. In work to be

described later on it was found that, with a short time-interval and a small pressure, ions of mobilities 1·10, ·50, ·31, ·22 cm./sec. were present. The ion of mobility ·22 cm. sec. was the slowest ion that could be detected. Thus it is quite conceivable that with a very high pressure and a comparatively short time-interval, ions of mobilities ·00034 cm./sec. and ·00015 cm./sec. could be obtained in considerable quantity.

No attempt was made to try what the effect of a longer time-interval would be. It is possible that slower ions than that of mobility ·00015 cm./sec. would be formed.

The More Mobile Ions.

To obtain observations of the more mobile ions two points were attended to. A small pressure was used, and the time between formation and measurement was made as short as possible. A measuring tube suitable for high mobilities was used, and it was fixed vertically over the bubbling vessel. The space between the surface of the alcohol and the end of the insulated terminal was about 300 ccs. in volume, and the time between formation and observation of the ions was about 1½ to 2 secs. The pressure varied between 3 and 5 cm. The following table shows the mobilities observed.—

TABLE IV.

1·10 -	·49		·30		·21
1·10 -	·49		·29 ?		·21
1·32 +	·47 ?		·30		·20
—	·55		·32		·22
—	·55				
—	·42				
—	·52				
MEANS, 1·10 ?	·50		·31		·21

The ion of mobility ·21 cm. sec. was the slowest we could detect. It is probable that if the mobilities could be observed sooner after formation, and if the pressure was smaller, ions of higher mobility would be obtained. It would be difficult with the present apparatus to measure accurately higher mobilities. The three values given in the first column may represent the same ion, but it is difficult to be certain.

The next step was to link up these observations with the previous results. This was done by increasing the time-interval and slightly increasing the pressure. The time was now about 5 secs., and a pressure of

5 to 6 cms. of mercury was employed. The following numbers were obtained :—

TABLE V.

·24	·11	·044	·018
·24	·12	·043	·020
—	·11	·051	·019
—	—	·046	
—	—	·046	
MEANS, 24	·11	·046	·019

The ion of mobility ·24 cm./sec. is obviously the ion of mobility ·21 of the previous section. The ion of mobility ·11 corresponds to the ion of mobility ·12, which we were just able to detect with the apparatus used for the slower ions. The other two ions of mobilities, ·046 and ·019, are the ions in Tables I and II.

The whole range of mobilities from 1·10 to ·00015 has been examined, and all the numbers can be placed in a certain definite number of classes. The only effect of change of pressure or of variation in the time is to change the percentages of the different classes: there is no change in the actual value of the mobilities. The general means of all the numbers observed are as follows :—

1·10? ·50 ·21 ·22 ·12 ·049 ·017 ·0077
 ·0040 ·0023 ·0014 ·00063 ·00034 ·00015

All doubtful numbers are excluded in taking the means. About a dozen observations not given in any of the previous sections are included.

It is thought that the numbers given above represent the mobilities of all the ions between the two extremes.

Discussion of Results.

The results obtained from these observations on the ions produced by bubbling air through alcohol will be considered in conjunction with the work described in the previous paper on the ionisation caused by bubbling air through mercury, and also with the results of J. J. Nolan on the mobilities of the ions produced by spraying distilled water.¹ In Table VI the mobilities of the ions obtained with these three liquids are given.

¹ Proc. Roy. Irish Acad., vol. xxxiii, Sec. A (1916). Proc. Roy. Soc., A, vol. xciv (1917).

TABLE VI.

MERCURY.					
WATER.	Long Time Interval.		Short Time Interval.		ALCOHOL.
	Undried. B	Dried. C	Undried. D	Dried. E	
A					F
1.09	—	—	—	—	1.10 ?
.53	—	—	—	—	.50
—	—	—	—	.32	.31
.24	—	—	.20	—	.22
.12	—	—	—	—	.12
—	—	—	—	.092	—
.046	—	—	.048	.043	.049
—	—	.024	—	—	—
.013	.014	—	.02	—	.017
—	—	.0068	—	.0064	.0077
.0043	.0040	—	.0015	—	.0040
—	—	.0021	—	.0022	.0023
.0010	.0013	—	.0013	—	.0014
—	—	.00056	—	—	.00063
.00038	.00034	—	—	—	.00034
—	—	—	—	—	.00015

Column A gives the ions of mobilities smaller than 1.09 cm. per sec., which are produced by spraying distilled water. The higher mobilities observed when water is sprayed have not been included in this table, as corresponding ions have not been observed in the work with mercury or alcohol. Columns B, C, D, E give the mobilities of the ions produced by bubbling air through mercury. The results in columns B and D were obtained with undried air, and those in columns C and E with air which had been fairly well dried. The time between the production of the ions and the measurement of their mobilities was longer in the case of the values given in columns B and C than for those in columns D and E.

It should be stated that ions of greater mobilities than those given in the table may be formed when air is bubbled through mercury; the small amount of ionisation rendered it difficult to be certain.

Column F gives the mobilities of the ions observed in the present paper when air is bubbled through alcohol.

An examination of this table brings out some interesting points. It is seen that the mobilities in the case of mercury when undried air is used (columns B and D) agree very well with the values in the case of the water; and also that there are corresponding ions in the alcohol column. When dried air is bubbled through mercury (columns C and E) different ions are found, but these also occur in the alcohol column. The agreement between the numbers throughout the table is very good, with a few exceptions.

When dealing in a previous paper with the results obtained by bubbling air through mercury we suggested that there might only be five distinct sets of ions, and that the ions found when the air was dried might be transient forms of the stable ions found in undried air after a long interval. A comparison with the work on water and alcohol now makes it clear that the results with mercury should be set forth as in Table VI, above. The general result brought out by the table is that the ions got by bubbling undried air through mercury also occur when water is sprayed. The ions found when dried air is bubbled through mercury form another set. Both sets are found in the experiments with alcohol. In the experiments with alcohol the air was not dried; neither was it saturated with water vapour. We are examining further the difference between the ions found with water and with alcohol, and we have also work in progress on the mobilities of the ions formed by phosphorus, which may throw further light on the subject. The explanation of the nature of all these different ions will probably be found along the lines suggested in previous papers;¹ but we do not propose to go into the matter in greater detail until we have further experimental results.

¹ Proc. Roy. Soc., A, vol. xciv (1917). Proc. Roy. Irish Acad., vol. xxxiii, Sec. A.

V.

ON THE EQUATION OF THE TANGENT AT A GIVEN POINT
ON A UNI-NODAL QUARTIC CURVE.

By REV. W. R. W. ROBERTS, D.D., S.F.T.C.D.

Read JUNE 24, 1918. Published JANUARY 31, 1919.

THE curve I propose to discuss in this paper belongs to a class of curves which I ventured to call bicursal in a former communication made to this Academy. We suppose that the coordinates of any curve of this class are expressed in terms of a parameter, and in such a manner, that to a given value of the parameter correspond two points on the curve, which points we call corresponding points. The curve in question I have called the uni-nodal quartic, the equation of which, when the axes of x and y pass through the node, can be written in the form

$$Az^2 - 2Bz + C = 0,$$

where A , B , and C are binary quantities of the second, third, and fourth degrees in x and y respectively. It is easy to see how, by a proper choice of the position of the axis of z , the equation of the curve can be reduced to the form

$$Az^2 - 2Bz + AQ = 0, \tag{1}$$

where Q is a binary quartic of the second degree in x and y . Since this reduction can be effected in one way only, it follows that the curve is completely determined when the axis of z and the three binary quantities A , Q , and B are given, and consequently any covariant of the curve can be expressed in terms of z and these quantities and their invariants and covariants.

If we call X , Y , and Z the coordinates of any point of the curve, it is easy to see that we may write

$$\left. \begin{aligned} X &= Ac \\ Y &= Ay \\ Z &= B + \sqrt{R} \end{aligned} \right\}, \tag{2}$$

where

$$A \equiv a_0x^2 + 2a_1xy + a_2y^2 \equiv y^2 e^{\frac{x}{y} \delta} a_2$$

$$Q \equiv q_0x^2 + 2q_1xy + q_2y^2 \equiv y^2 e^{\frac{x}{y} \delta} q_2,$$

$$B \equiv b_0x^3 + 3b_1x^2y + 3b_2xy^2 + b_3y^3 \equiv y^3 e^{\frac{x}{y} \delta} b_3,$$

and

$$R \equiv B^2 - A^2Q,$$

thus expressing X , Y , and Z in terms of a parameter x/y , which we may call θ ; it being understood that δ is an operation which, when applied to any one of the ten quantities which enter into the above quantities, converts it into one of lower weight, so that $\delta c_r = r c_{r-1}$; c_r being typical of any one of these quantities whose weight is r ; while $\delta x = -y$ and $\delta y = 0$.

The coordinates of the corresponding point are expressed as follows:—

$$\left. \begin{aligned} X' &= Ax \\ Y' &= Ay \\ Z' &= B - \sqrt{R} \end{aligned} \right\}. \tag{3}$$

We now proceed to find the equation of the tangent at a point θ on the curve determined by the equation (1), and we arrive at the following result without much difficulty, X , Y , and Z being current coordinates:—

$$\begin{aligned} & X \left\{ yJ - AB_1 + \frac{1}{2\sqrt{R}} [y(2BJ - A^2K) - AR_1] \right\} \\ & - Y \left\{ xJ + AB_2 + \frac{1}{2\sqrt{R}} [x(2BJ - A^2K) + AR_2] \right\} \\ & + 3A^2Z = 0; \end{aligned} \tag{4}$$

the equation of the tangent at the corresponding point being

$$\left. \begin{aligned} & X \left\{ yJ - AB_1 - \frac{1}{2\sqrt{R}} [y(2BJ - A^2K) - AR_1] \right\} \\ & - Y \left\{ xJ + AB_2 - \frac{1}{2\sqrt{R}} [x(2BJ - A^2K) + AR_2] \right\} \\ & + 3A^2Z = 0 \end{aligned} \right\} \tag{5}$$

where

$$B_1 \equiv \frac{dB}{dx}, \quad B_2 \equiv \frac{dB}{dy}, \text{ \&c.,}$$

and

$$J \equiv J(A, B), \quad K \equiv J(A, Q).$$

If we now seek the locus of the intersection of tangents at corresponding points, we obtain, without difficulty, the following expressions for the coordinates X, Y, Z of a point on this locus:—

$$\left. \begin{aligned} X &= 3(2BJ - A^2K)x + 3AR_2 \\ Y &= 3(2BJ - A^2K)y - 3AR_1 \\ Z &= A[8QJ + AJ' - 3BK] \end{aligned} \right\}, \quad (6)$$

where $J' = J(Q, B)$.

Now, as the coordinates of this curve are thus expressed rationally in terms of a parameter — or θ , and involving that parameter in the seventh degree, the locus we seek is a uni-cuspal curve of the seventh degree.

We now pass on and seek to determine the parameters of the two points in which the tangent at a point whose parameter is θ , again meets the curve.

This is effected by eliminating Z between the equation of the tangent, as given in (4), and that of the curve in (1).

The eliminant is clearly a homogeneous equation of the fourth degree in X and Y ; and if we put $X = \theta'Y$ and divide by Y^4 , we obtain

$$A'[\lambda + \mu(\theta' - \theta)]^2 - 6B'A^2[\lambda + \mu(\theta' - \theta)] + 9A^4A'Q' = 0, \quad (7)$$

where $A' = a_0\theta'^2 + 2a_1\theta' + a_2$, and

$$\lambda = 3A(B + \sqrt{R}),$$

$$\mu = A(B_1 - J) + \frac{1}{2\sqrt{R}}[R_1 + A^2K - 2BJ].$$

Now it is clear that this equation must contain the factor $(\theta' - \theta)$, and of which it must be cleared before we can obtain the quadratic equation in θ' , the roots of which determine the parameters of the points we seek.

The work now becomes exceedingly complicated and intricate, and I only give an outline of the method which I have adopted in clearing this equation of the factor $(\theta' - \theta)^2$.

If we call $(\theta' - \theta) = h$, we may write the equation given in (7) in the form

$$A'\mu^2h^2 + 2\mu h \{[\lambda A' - 3B'A^2] + 9A^2\{2(A'B - AB')(B + \sqrt{R}) + A^2A'(Q - Q')\}\} = 0. \quad (8)$$

Our first step is to show that the coefficient of $9A^2$ in the above equation is divisible by h , and I find that

$$2(A'B - AB')(B + \sqrt{R}) - A^2A'(Q - Q') = h\{2\phi(B + \sqrt{R}) + A^2A'\psi\} \quad (9)$$

where

$$\left. \begin{aligned} h\phi &= A'B - AB', \\ h\psi &= Q - Q'. \end{aligned} \right\} \quad (10)$$

As a result we find that equation (8) becomes divisible by h , and can be written in the form

$$(A'\mu^2 + 6\mu A\phi)h + 6\mu AA'\sqrt{R} + 9A^2(2'B + \sqrt{R}) + A^2A'\psi = 0. \quad (11)$$

To show that (10) is divisible by h , we form the following table, and write

$$\begin{aligned} \phi' &= \phi + h(a_0B - 3A(b_0\theta + b_1)) - b_0Ah^2, \\ A' - A &= h(a_0h + A_1), \\ Q' - Q &= h(q_0h + Q_1), \\ A\phi' - A'\phi &= h\{-h(a_0\phi + b_0A^2) + A[a_0B - 3A(b_0\theta + b_1)] - \phi A_1\}, \\ J &= 3BA_1 - 2AB_1, \\ 3\phi' &= J - AB_1, \\ K &= 2\{QA_1 - AQ_1\}, \\ \lambda + 3\phi &= \frac{1}{2\sqrt{R}} \Theta = \frac{1}{2\sqrt{R}} \{AR_1 + A^2K - 2BJ\} \end{aligned}$$

We now find, on dividing by h ,

$$\begin{aligned} (A + hA_1 + h^2a_0)\mu^2 + 18A\sqrt{R}\{-h(a_0\phi + b_0A^2) \\ + A[a_0B - 3A(b_0\theta + b_1)] - \phi A_1\} \\ + 3A\{(a_0h + A_1)\Theta + 6AB[a_0B - 3A(b_0\theta + b_1) - b_0Ah] \\ + 3A^3[a_0q_0h^2 + h[A_1q_0 + a_0q_1 + Q_1A_1 + q_0A]\} \\ + 6\mu A\{\phi + h(a_0B - 3A(b_0\theta + b_1)) - b_0Ah^2\} = 0. \quad (12) \end{aligned}$$

This equation then is the quadratic in θ' which determines the parameters of the two points in which the tangent at θ again meets the curve. Now, if we let $\theta' = \theta$, or $h = 0$, in this equation: then one value of θ' will equal θ , and the tangent becomes an inflexional tangent to the curve. The last term then of the equation when put equal to zero, gives us the equation of the lines joining the points of inflexion on the curve to the node. This result when cleared of radicals can be written in the form

$$16\Pi R\{B\Omega + 4\Pi RQ\} + A^2\Omega^2 = 0. \quad (13)$$

where

$$\begin{aligned} \Pi &= 4BD_0 - 3AI, \\ \Omega &= J(QJ - KB) + 4R.(AD_{12} - D_0Q) + \frac{1}{4}A^2K^2, \\ &\quad - K^2 = 16\{D'A^2 - 2D_{12}AQ + D_0Q^2\}, \end{aligned}$$

where

$$\begin{aligned} D_0 &= a_0a_2 - a_1^2, \\ D_{12} &= a_0q_2 + a_2q_0 - 2a_1q_1, \quad D' = q_0q_2 - q_1^2, \\ I &= ye^{\frac{x}{\delta}}.(a_0b_3 - 2a_1b_2 + a_2b_1). \end{aligned}$$

Now this is an equation of the twentieth degree, and as there are eighteen inflexions the equation must contain A as a factor.

We then show that

$$B\Omega + 4\Pi RQ \text{ is divisible by } A,$$

when we obtain, on dividing by A ,

$$16\Pi R \{B(4B^2D_0 + \Sigma) + 12Q^2 A^2I\} + A\Omega^2 = 0, \quad (14)$$

where

$$\Sigma = \frac{2}{3}JJ' - \frac{1}{3}QAH - 12AQ^2D_0 + \frac{1}{4}AK^2 - 4A^2QD_{12},$$

and H is the Hessian of B .

This equation gives us the eighteen inflexions of the curve and is expressed in terms of the three quantities A , Q , B and their invariants and covariants.

VI.

ON THE SYMMETRICAL OPTICAL INSTRUMENT.

BY H. C. PLUMMER, M.A.

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1. IN the first of a series of three papers¹ on geometrical optics, published in 1905, the late Professor Schwarzschild has treated the errors of an optical instrument on the basis of Hamilton's characteristic function, or Eikonal, as it has been called by Bruns. His method assumes the results of the Gaussian first approximation; but little more than a re-arrangement of the work is required to give a simple and self-contained theory of the errors to the next order of approximation. There may be some advantage in reproducing the theory in this form.

The whole rests on the single principle of Fermat, that the optical path of a ray between two points P_0, P_1 is a minimum, or more exactly, that the effect of a first-order displacement of intermediate points on the length of path is of the second order. From this it follows that the rays from P_0 form a normal congruence in isotropic media, the normal surfaces being defined by

$$\sum \mu s = E(x, y, z, x_0, y_0, z_0) = \text{const.},$$

where s is the length of ray in a medium with index μ from the initial point (x_0, y_0, z_0) to the end point (x, y, z) . The effect of a displacement of P_1 is measured by the projection on the normal to the eikonal surface passing through P_1 , and is therefore

$$\delta E = \mu_1 (l_1 \delta x_1 + m_1 \delta y_1 + n_1 \delta z_1)$$

where (l_1, m_1, n_1) are the direction cosines of the ray at P_1 . If an initial

¹ Astr. Mitth. der K. Sternwarte zu Göttingen, ix-xi. Abhandl. der K. Ges. der Wiss. zu Göttingen, Math.-phys. Kl., Neue Folge, B. iv.

point (x_0, y_0, z_0) is also varied, the total variation of E between the two points may be written shortly

$$\begin{aligned} \delta E &= [\mu (l\delta x + m\delta y + n\delta z)]_0^1 \\ &= \delta [\mu \{l(x-c) + my + nz\}]_0^1 \\ &\quad - [\mu \{l(x-c)\delta l + y\delta m + n\delta z\}]_0^1, \end{aligned}$$

where c has the (constant) values c_1, c_2 at the two ends of the path. If then,

$$W = [E - \mu \{l(x-c) + my + nz\}]_0^1,$$

since

$$l^2 + m^2 + n^2 = 1, \quad l\delta l + m\delta m + n\delta n = 0,$$

it follows that

$$\delta W = - [\mu \{y - \frac{m}{l}(x-c)\}\delta m + \mu \{z - \frac{n}{l}(x-c)\}\delta n]_0^1.$$

The interpretation of this expression in terms of the intersection of the ray and plane

$$\frac{X - c_1}{l} = \frac{Y - y_1}{m} = \frac{Z - z_1}{n}, \quad X = c_2$$

is immediate, and shows that

$$\delta W = -\mu_1 (y_1\delta m_1 + z_1\delta n_1) + \mu_0 (y_0\delta m_0 + z_0\delta n_0) \dots \quad (1)$$

where (y_1, z_1) (y_0, z_0) are now the coordinates of the intersections of the ray with the planes $X = c_1$, $X = c_2$. W is the value of E between the feet of the perpendiculars from $(c_1, 0, 0)$ and $(c_2, 0, 0)$ on the ray, and is a minimum in the same sense as E .

2. Let the axis of x be the axis of a symmetrical optical system, the direction of the ray being that of x increasing. This direction will be called "to the right." Let the effect of refraction at a single surface be considered. The refractive index of the medium to the left will be denoted by μ_1 , of that to the right by μ_2 . The radius of curvature of the surface being r_1 , at the vertex the coordinates of the vertex are taken to be $(a_1, 0, 0)$, and those of the centre of curvature $(c_1, 0, 0)$, so that r_1 is negative when the ray meets a concave surface. The surface being one of revolution, its equation may be written

$$X = a_1 + \frac{1}{2r_1} (Y^2 + Z^2) + \frac{1}{8r_1^3} (Y^2 + Z^2)^2 (1 + b_1) + \dots,$$

where $b_1 = 0$ for a spherical surface and $b_1 = -1$ for a parabolic surface, thus

providing for mirrors of the usual form. The development of X will not be carried to a higher order.

Let the ray considered meet the refracting surface in $P(X, Y, Z)$, and let N_{i-1}, N_i be the feet of the perpendiculars from the fixed points $(c_{i-1}, 0, 0), (c_i, 0, 0)$. Then

$$\begin{aligned} W_i &= \mu_{i-1} \cdot N_{i-1}P + \mu_i \cdot PN_i \\ &= - [\mu \{l(X - c) + mY + nZ\}]_{i-1}^i \\ &= - [\mu (mY + nZ)]_{i-1}^i - [\mu (1 - m^2 - n^2)^{\frac{1}{2}} (a_i - c + \dots)]_{i-1}^i \\ &= - \mu_i (a_i - c_i) + \mu_{i-1} (a_i - c_{i-1}) + W_i^{ii} + W_i^{iv} + \dots \end{aligned}$$

where W_i^{ii} represents the terms of the second order in m, n, Y, Z in the development of W_i , W_i^{iv} those of the fourth order. Thus

$$\begin{aligned} W_i^{ii} &= - \left[\mu \{ (mY + nZ) - \frac{1}{2} (a_i - c) (m^2 + n^2) + \frac{1}{2r_i} (Y^2 + Z^2) \} \right]_{i-1}^i, \\ W_i^{iv} &= - \left[\mu \left\{ \frac{1}{8r_i^3} (Y^2 + Z^2)^2 (1 + b_i) - \frac{1}{4r_i} (m^2 + n^2) (Y^2 + Z^2) \right. \right. \\ &\quad \left. \left. - \frac{1}{8} (a_i - c) (m^2 + n^2)^2 \right\} \right]_{i-1}^i. \end{aligned}$$

It is evident that W_i^{ii} is a sum of similar functions of (m, Y) and of (n, Z) . Only the first need be expressly considered. Then

$$W_i^{ii} = - Y (\mu_i m_i - \mu_{i-1} m_{i-1}) - \frac{1}{2r_i} (\mu_i - \mu_{i-1}) Y^2 + \frac{1}{2} [\mu (a_i - c) m^2]_{i-1}^i.$$

But this expression must be a minimum for small displacements of Y . Hence

$$\frac{Y}{r_i} = - \frac{\mu_i m_i - \mu_{i-1} m_{i-1}}{\mu_i - \mu_{i-1}}, \quad \frac{Z}{r_i} = - \frac{\mu_i n_i - \mu_{i-1} n_{i-1}}{\mu_i - \mu_{i-1}} \dots \quad (2)$$

This expresses the law of refraction to the first order only. But the correction which is required is of the third order, and, owing to the minimum property, will affect W_i in the sixth order only. Hence the law of refraction is sufficiently represented when W_i is developed to the fourth order only. The first part of W_i^{ii} now becomes

$$W_i^{ii} = \frac{1}{2} r_i \frac{(\mu_i m_i - \mu_{i-1} m_{i-1})^2}{\mu_i - \mu_{i-1}} + \frac{1}{2} \mu_i (a_i - c_i) m_i^2 - \frac{1}{2} \mu_{i-1} (a_i - c_{i-1}) m_{i-1}^2.$$

Conjugate planes may be defined as planes perpendicular to the axis through the points $(c_{i-1}, 0, 0), (c_i, 0, 0)$ when c_{i-1}, c_i are such as to make the

last expression a perfect square. The condition for this is at once found to be

$$\frac{\mu_i - \mu_{i-1}}{r_i} + \frac{\mu_i}{a_i - c_i} - \frac{\mu_{i-1}}{a_i - c_{i-1}} = 0,$$

which may be written in the form

$$K_i = \mu_i \left(\frac{1}{a_i - c_i} + \frac{1}{r_i} \right) = \mu_{i-1} \left(\frac{1}{a_i - c_{i-1}} + \frac{1}{r_i} \right) \dots \quad (3)$$

or again,

$$a_i - c_i = \frac{\mu_i r_i}{K_i r_i - \mu_i}, \quad a_i - c_{i-1} = \frac{\mu_{i-1} r_i}{K_i r_i - \mu_{i-1}}.$$

Hence, for the first part of W_i^{ii} ,

$$W_i^{ii} = \frac{r_i}{2(\mu_i - \mu_{i-1})} \left(\mu_i^2 m_i^2 \cdot \frac{K_i r_i - \mu_{i-1}}{K_i r_i - \mu_i} - 2\mu_i \mu_{i-1} m_i m_{i-1} + \mu_{i-1}^2 m_{i-1}^2 \cdot \frac{K_i r_i - \mu_i}{K_i r_i - \mu_{i-1}} \right).$$

It is convenient to write

$$K_i' = K_i r_i - \mu_{i-1}, \quad K_i'' = K_i r_i - \mu_i$$

and then the complete expression of W_i^{ii} becomes

$$W_i^{ii} = \frac{r_i}{2(\mu_i - \mu_{i-1}) K_i' K_i''} \{ (\mu_i m_i K_i' - \mu_{i-1} m_{i-1} K_i'')^2 + (\mu_i n_i K_i' - \mu_{i-1} n_{i-1} K_i'')^2 \}.$$

In the same circumstances W_i^{iv} is slightly simplified, and becomes

$$W_i^{iv} = \frac{1}{8} \left[\mu(a_i - c) \left\{ m^2 + n^2 + \frac{Y^2 + Z^2}{(a_i - c)r_i} \right\}^2 \right]_{i-1} - \frac{b_i(\mu_i - \mu_{i-1})(Y^2 + Z^2)^2}{8r_i^3} \dots \quad (4)$$

for the necessary correction is

$$- (Y^2 + Z^2)^2 \left[\frac{\mu}{8r_i^3} + \frac{\mu}{8(a_i - c)r_i^2} \right]_{i-1},$$

and this is zero by (3).

3. Instead of the conjugate planes through $C_{i-1}(c_{i-1}, 0, 0)$ and $C_i(c_i, 0, 0)$ let another pair be taken through $C'_{i-1}(c'_{i-1}, 0, 0)$ and $C'_i(c'_i, 0, 0)$. If, for the same ray, U_i correspond to W_i , in the same way

$$U_i^{ii} = \frac{r_i}{2(\mu_i - \mu_{i-1}) L_i' L_i''} \{ (\mu_i m_i L_i' - \mu_{i-1} m_{i-1} L_i'')^2 + (\mu_i n_i L_i' - \mu_{i-1} n_{i-1} L_i'')^2 \},$$

where

$$\begin{aligned}
 L_i &= \mu_i \left(\frac{1}{a_i - c_i'} + \frac{1}{r_i} \right) = \mu_{i-1} \left(\frac{1}{a_i - c_{i-1}'} + \frac{1}{r_i} \right), \\
 a_i - c_i' &= \frac{\mu_i r_i}{L_i r_i - \mu_i} = \frac{\mu_i r_i}{L_i''}, & a_i - c_{i-1}' &= \frac{\mu_{i-1} r_i}{L_i r_i - \mu_{i-1}} = \frac{\mu_{i-1} r_i}{L_i'}, \\
 c_i' - c_i &= \frac{\mu_i r_i^2 (L_i - K_i)}{K_i'' L_i''}, & c_{i-1}' - c_{i-1} &= \frac{\mu_{i-1} r_i^2 (L_i - K_i)}{K_i' L_i'} \dots \quad (5)
 \end{aligned}$$

Let the ray intersect the planes through $C_{i-1}, C_i, C_{i-1}', C_i'$ in the points $(c_{i-1}, y_{i-1}, z_{i-1}), (c_i, y_i, z_i), (c_{i-1}', y_{i-1}', z_{i-1}'), (c_i', y_i', z_i')$. By (1), to the lowest order ($W = W_i^{ii}$ or U_i^{ii}),

$$\left. \begin{aligned}
 K_i'' y_i &= K_i' y_{i-1} = \frac{r_i (\mu_{i-1} m_{i-1} K_i'' - \mu_i m_i K_i')}{\mu_i - \mu_{i-1}} \\
 L_i'' y_i' &= L_i' y_{i-1}' = \frac{r_i (\mu_{i-1} m_{i-1} L_i'' - \mu_i m_i L_i')}{\mu_i - \mu_{i-1}}
 \end{aligned} \right\} \dots \quad (6)$$

with similar equations in $(z, n), (z', n)$; since, when W_i^{iv}, U_i^{iv} are neglected

$$-\mu_i y_i = \frac{\partial W_i^{ii}}{\partial m_i}, \quad \mu_{i-1} y_{i-1} = \frac{\partial W_i^{ii}}{\partial m_{i-1}}, \dots$$

By the equation of the ray in the two media

$$\begin{aligned}
 \frac{c_i' - c_i}{l_i} &= \frac{y_i' - y_i}{m_i} = \frac{z_i' - z_i}{n_i}, \\
 \frac{c_{i-1}' - c_{i-1}}{l_{i-1}} &= \frac{y_{i-1}' - y_{i-1}}{m_{i-1}} - 1 = \frac{z_{i-1}' - z_{i-1}}{n_{i-1}},
 \end{aligned}$$

The neglect of the third order in m_i, m_{i-1}, \dots by putting $l_i = l_{i-1} = 1$ will affect W_i in the sixth order only. Therefore to this order

$$m_i = \frac{y_i' - y_i}{c_i' - c_i} = \frac{K_i'' L_i'' (y_i' - y_i)}{\mu_i r_i^2 (L_i - K_i)}, \quad m_{i-1} = \frac{K_i' L_i' (y_{i-1}' - y_{i-1})}{\mu_{i-1} r_i^2 (L_i - K_i)} \dots \quad (7)$$

and the (m, y) part of W_i^{ii} becomes

$$W_i^{ii} = \frac{K_i' K_i''}{2(\mu_i - \mu_{i-1}) r_i^2 (L_i - K_i)^2} \{ L_i'' (y_i' - y_i) - L_i' (y_{i-1}' - y_{i-1}) \}^2.$$

This expression is to be transformed in the light of the first approximation (6). Now,

$$\begin{aligned} & (L_i''(y_i' - y_i) - L_i'(y_{i-1}' - y_{i-1}))^2 \\ &= (L_i''y_i' - L_i'y_{i-1}')^2 - 2(L_i''y_i' - L_i'y_{i-1}') (L_i''y_i - L_i'y_{i-1}) + (L_i''y_i - L_i'y_{i-1})^2 \\ &= (L_i''y_i' - L_i'y_{i-1}')^2 - 2(L_i''y_i' - L_i'y_{i-1}') (K_i''y_i - K_i'y_{i-1}) L_i''/K_i'' \\ &\quad - K_i'' - K_i'y_{i-1}') L_i''/K_i'' + 2(L_i''y_i' - L_i'y_{i-1}') (L_i''y_i - L_i'y_{i-1}) (1 - K_i''L_i''/L_i'K_i'') \\ &\quad - L_i''y_{i-1}') (1 - L_i''K_i''/K_i'L_i') - L_i''y_{i-1}') (1 - K_i''L_i''/L_i'K_i''). \end{aligned}$$

But the first approximation shows that

$$(L_i''y_i' - L_i'y_{i-1}'), (K_i''y_i - K_i'y_{i-1})$$

are of the third order; and

$$\begin{aligned} K_i'L_i'' - L_i'K_i'' &= (K_i'r_i - \mu_{i-1})(L_i'r_i - \mu_i) - (L_i'r_i - \mu_{i-1})(K_i'r_i - \mu_i) \\ &= r_i(\mu_i - \mu_{i-1})(L_i - K_i). \end{aligned}$$

Hence, the sixth order being neglected,

$$\begin{aligned} W_i^{iv} &= \frac{K_i'K_i''}{2r_i^2(L_i - K_i)} \left\{ \frac{L_i''y_i'^2}{K_i''} - \frac{L_i'y_{i-1}^2}{K_i''} - \frac{2y_{i-1}}{K_i''} (L_i''y_i' - L_i'y_{i-1}') \right. \\ &\quad \left. - \frac{L_i''z_i^2}{K_i''} - \frac{L_i'z_{i-1}^2}{K_i''} - \frac{2z_{i-1}}{K_i''} (L_i''z_i' - L_i'z_{i-1}') \right\} \dots \quad (8) \end{aligned}$$

4. On the other hand, the transformation (7) applied to (1) gives for the variation of $m, y,$

$$\begin{aligned} \delta W_i &= \frac{1}{r_i^2(L_i - K_i)} \{ K_i'L_i'y_{i-1}\delta(y_{i-1}' - y_{i-1}) - K_i''L_i''y_i\delta(y_i' - y_i) \} \\ &= \frac{K_i'K_i''}{2r_i^2(L_i - K_i)} \delta \left\{ \frac{L_i''y_i^2}{K_i''} - \frac{L_i'y_{i-1}^2}{K_i''} - \frac{2y_{i-1}}{K_i''} (L_i''y_i' - L_i'y_{i-1}') \right\} \\ &\quad + \frac{1}{r_i^2(L_i - K_i)} \{ L_i''y_i' - L_i'y_{i-1}') K_i'\delta y_{i-1} - (K_i''y_i - K_i'y_{i-1}) L_i''\delta y_i \}. \end{aligned}$$

Hence by (3), when W is developed to the fourth order only,

$$\begin{aligned} r_i^3(L_i - K_i)\delta W_i^{iv} &= L_i''y_i' - L_i'y_{i-1}') K_i'\delta y_{i-1} - (K_i''y_i - K_i'y_{i-1}) L_i''\delta y_i' \\ &\quad + (L_i''z_i' - L_i'z_{i-1}') K_i'\delta z_{i-1} - (K_i''z_i - K_i'z_{i-1}) L_i''\delta z_i', \end{aligned}$$

and therefore

$$\begin{aligned} L_i''y_i' - L_i'y_{i-1}') &= \frac{r_i^3(L_i - K_i)}{K_i'} \frac{\partial W_i^{iv}}{\partial y_{i-1}} - K_i''y_i - K_i'y_{i-1}') - \frac{r_i^3(L_i - K_i)}{L_i''} \frac{\partial W_i^{iv}}{\partial y_i'} \\ L_i''z_i' - L_i'z_{i-1}') &= \frac{r_i^3(L_i - K_i)}{K_i'} \frac{\partial W_i^{iv}}{\partial z_{i-1}} - K_i''z_i - K_i'z_{i-1}') - \frac{r_i^3(L_i - K_i)}{L_i''} \frac{\partial W_i^{iv}}{\partial z_i'} \\ &\dots \quad (9) \end{aligned}$$

It is now necessary to calculate W_i^{iv} according to (4), and here it is clearly possible to use the lowest approximation (6), so as to express the result in terms of $y_{i-1}, y_i', z_{i-1}, z_i'$. Thus (7) give

$$m_i = \frac{L_i''(K_i''y_i' - K_i'y_{i-1})}{\mu_i r_i^2 (L_i - K_i)}, \quad m_{i-1} = \frac{K_i'(L_i''y_i' - L_i'y_{i-1})}{\mu_{i-1} r_i^2 (L_i - K_i)},$$

and therefore, by (2),

$$\frac{Y}{r_i} = \frac{L_i''y_i'(K_i' - K_i'') - K_i'y_{i-1}(L_i' - L_i'')}{r_i^2 (L_i - K_i) (\mu_i - \mu_{i-1})},$$

$$Y = (L_i''y_i' - K_i'y_{i-1}) / r_i (L_i - K_i).$$

Let

$$R_i' = L_i''^2 (y_i'^2 + z_i'^2), \quad R_{i-1} = K_i'^2 (y_{i-1}^2 + z_{i-1}^2), \quad T_i = L_i''K_i' (y_i'y_{i-1} + z_i'z_{i-1}).$$

Then

$$Y^2 + Z^2 = (R_i' + R_{i-1} - 2T_i) / r_i^2 (L_i - K_i)^2$$

$$m_i^2 + n_i^2 = (K_i''^2 R_i' + L_i''^2 R_{i-1} - 2K_i''L_i''T_i) / \mu_i^2 r_i^4 (L_i - K_i)^2$$

$$m_{i-1}^2 + n_{i-1}^2 = (K_i'^2 R_i' + L_i'R_{i-1} - 2K_i'L_i'T_i) / \mu_{i-1}^2 r_i^4 (L_i - K_i)^2.$$

Hence

$$m_i^2 + n_i^2 + (Y^2 + Z^2) / (a_i - c_i)r_i$$

$$= \frac{K_i''^2 R_i' + L_i''^2 R_{i-1} - 2K_i''L_i''T_i + \mu_i K_i'' (R_i' + R_{i-1} - 2T_i)}{\mu_i^2 r_i^4 (L_i - K_i)^2}$$

$$= \frac{r_i K_i K_i'' R_i' - 2r_i L_i K_i'' T_i + r_i R_{i-1} (L_i^2 r_i - 2\mu_i L_i + \mu_i K_i)}{\mu_i^2 r_i^4 (L_i - K_i)^2},$$

and finally by (4)

$$8(L_i - K_i)^4 W_i^{iv} = \frac{1}{\mu_i^2 r_i^5 K_i''} \{ K_i K_i'' R_i' - 2L_i K_i'' T_i + R_{i-1} (L_i^2 r_i - 2\mu_i L_i + \mu_i K_i) \}^2$$

$$- \frac{1}{\mu_{i-1}^2 r_i^5 K_i'} \{ K_i K_i' R_i' - 2L_i K_i' T_i + R_{i-1} (L_i^2 r_i - 2\mu_{i-1} L_i + \mu_{i-1} K_i) \}^2$$

$$- b_i (\mu_i - \mu_{i-1}) r_i^{-7} (R_i' - 2T_i + R_{i-1})^2$$

$$= -2r_i^{-4} (A_i R_{i-1}^2 + B_i R_i'^2 + 4C_i T_i^2 + 2D_i R_{i-1} R_i' - 4E_i R_{i-1} T_i - 4F_i R_i' T_i)$$

where

$$A_i = \frac{1}{2} \left\{ \frac{b_i (\mu_i - \mu_{i-1})}{r_i^3} - \frac{(L_i^2 r_i - 2\mu_i L_i + \mu_i K_i)^2}{\mu_i^2 r_i K_i''} + \frac{(L_i^2 r_i - 2\mu_{i-1} L_i + \mu_{i-1} K_i)^2}{\mu_{i-1}^2 r_i K_i'} \right\}$$

$$B_i = \frac{1}{2} \{ b_i (\mu_i - \mu_{i-1}) r_i^{-3} - K_i^2 (K_i'' / \mu_i^2 r_i - K_i' / \mu_{i-1}^2 r_i) \}$$

$$C_i = \frac{1}{2} \{ b_i (\mu_i - \mu_{i-1}) r_i^{-3} - L_i^2 (K_i'' / \mu_i^2 r_i - K_i' / \mu_{i-1}^2 r_i) \}$$

$$\begin{aligned}
 D_i &= \frac{1}{2} \left\{ \frac{b_i}{r_i^3} \frac{\mu_i - \mu_{i-1}}{r_i^3} - \frac{K_i (L_i^2 r_i - 2\mu_i L_i + \mu_i K_i)}{\mu_i^2 r_i} + \frac{K_i (L_i^2 r_i - 2\mu_{i-1} L_i + \mu_{i-1} K_i)}{\mu_{i-1}^2 r_i} \right\} \\
 E_i &= \frac{1}{2} \left\{ \frac{b_i (u_i - u_{i-1})}{r_i^3} - \frac{L_i (L_i^2 r_i - 2\mu_i L_i + \mu_i K_i)}{\mu_i^2 r_i} + \frac{L_i (L_i^2 r_i - 2\mu_{i-1} L_i + \mu_{i-1} K_i)}{\mu_{i-1}^2 r_i} \right\} \\
 F_i &= \frac{1}{2} \{ b_i (\mu_i - \mu_{i-1}) r_i^{-3} - K_i L_i (K_i''/\mu_i^2 r_i - K_i'/\mu_{i-1}^2 r_i) \}.
 \end{aligned}$$

5. For the sake of clearness, even at the expense of brevity, as little change of notation as possible has been admitted up to this point. It is now necessary to make a transformation which will allow two sections of the characteristic function to be fitted together. Let

$$K_i'' y_i = H_i \eta_i, \quad K_i' y_{i-1} = H_i \eta_{i-1}, \quad L_i'' y_i' = H_i' \eta_i', \quad L_i' y_{i-1}' = H_i' \eta_{i-1}'$$

with the same forms obtained by substituting (z, ζ) for (y, η) . The succeeding refraction can be treated in exactly the same way, by changing the subscript i into $i+1$. The terms of the second order in W_{i+1} are removed and W_{i+1}'' is obtained by substitution. But consistently with the above transformation

$$K_{i+1}' y_i = H_{i+1} \eta_i, \quad L_{i+1}' y_i' = H_{i+1}' \eta_i',$$

and this requires that

$$H_{i+1} H_i = K_{i+1}' / K_i'', \quad H_{i+1}' / H_i' = L_{i+1}' / L_i''.$$

Now (5) give

$$\mu_i r_i^2 (L_i - K_i / K_i'' L_i'') = \mu_i r_{i+1}^2 (L_{i+1} - K_{i+1}') / K_{i+1}' L_{i+1}',$$

since the second pair of planes for i become the first pair for $i+1$. Also if

$$H_i H_i' = r_i^2 (L_i - K_i),$$

which is clearly consistent with what precedes, (9) become

$$\left. \begin{aligned}
 \eta_i' - \eta_{i-1}' &= \frac{\partial W_i^{i0}}{\partial \eta_{i-1}}, & \eta_i - \eta_{i-1} &= - \frac{\partial W_i^{i0}}{\partial \eta_i'} \\
 \zeta_i' - \zeta_{i-1}' &= \frac{\partial W_i^{i0}}{\partial \zeta_{i-1}}, & \zeta_i - \zeta_{i-1} &= - \frac{\partial W_i^{i0}}{\partial \zeta_i'}
 \end{aligned} \right\} \dots \quad (10)$$

Let

$$\begin{aligned}
 \rho_i' &= \eta_i'^2 + \zeta_i'^2 = R_i' / H_i'^2, & \rho_{i-1} &= \eta_{i-1}^2 + \zeta_{i-1}^2 = R_{i-1} / H_i^2, \\
 \tau_i &= \eta_{i-1} \eta_i' + \zeta_{i-1} \zeta_i' = T_i / H_i H_i',
 \end{aligned}$$

and also

$$H_i = h_i r_i (L_i - K_i), \quad H_i' = h_i' r_i (L_i - K_i).$$

Thus

$$\begin{aligned}
 h_i h_i' &= H_i H_i' / r_i^2 (L_i - K_i)^2 = (L_i - K_i)^{-1} \\
 \frac{h_{i+1}}{h_i} &= \frac{K_{i+1}'}{K_i''} \cdot \frac{r_i (L_i - K_i)}{r_{i+1} (L_{i+1} - K_{i+1}')} = \frac{r_{i+1}}{r_i} \cdot \frac{L_i''}{L_{i+1}'} \\
 \frac{h_{i+1}'}{h_i'} &= \frac{L_{i+1}'}{L_i''} \cdot \frac{r_i (L_i - K_i)}{r_{i+1} (L_{i+1} - K_{i+1}')} = \frac{r_{i+1}}{r_i} \cdot \frac{K_i''}{K_{i+1}'}
 \end{aligned}$$

define the successive formation of h_i, h'_i ; and

$$-4W_i^{iv} = A_i h_i^4 \rho_{i-1}^2 + B_i h_i^4 \rho_i'^2 + 4C_i h_i^2 h_i'^2 \tau_i^2 \\ + 2D_i h_i^2 h_i'^2 \rho_{i-1} \rho_i' - 4E_i h_i^3 h_i' \rho_{i-1} \tau_i - 4F_i h_i h_i'^3 \rho_i' \tau_i$$

where the coefficients A_i, \dots, F_i have the meanings found in § 4.

6. It follows at once from (10) that

$$\dots = \eta_{i-1} = \eta_i = \dots, \quad \dots = \zeta_{i-1} = \zeta_i = \dots \\ \dots = \eta'_{i-1} = \eta'_i = \dots, \quad \dots = \zeta'_{i-1} = \zeta'_i = \dots$$

when the third order is neglected. Therefore to the third order, by addition,

$$\eta_j' - \eta_0' = \frac{\partial W^{iv}}{\partial \eta_0}, \quad \eta_j - \eta_0 = -\frac{\partial W^{iv}}{\partial \eta_j'}, \\ \zeta_j' - \zeta_0' = \frac{\partial W^{iv}}{\partial \zeta_0}, \quad \zeta_j - \zeta_0 = -\frac{\partial W^{iv}}{\partial \zeta_j'}$$

where j is the number of the final refracting surface,

$$-4W^{iv} = -4 \sum_{i=1}^j W_i^{iv} \\ = A \rho_0^2 + B \rho_j'^2 + 4C \tau_{0j}^2 + 2D \rho_0 \rho_j' - 4E \rho_0 \tau_{0j} - 4F \rho_j' \tau_{0j} \\ \tau_{0j} = \eta_0 \eta_j' + \zeta_0 \zeta_j', \quad \rho_0 = \eta_0^2 + \zeta_0^2, \quad \rho_j' = \eta_j'^2 + \zeta_j'^2,$$

and in terms of the quantities already found (§ 4)

$$A = \Sigma A_i h_i^4, \quad B = \Sigma B_i h_i'^4, \quad C = \Sigma C_i h_i^2 h_i'^2, \\ D = \Sigma D_i h_i^2 h_i'^2, \quad E = \Sigma E_i h_i^3 h_i', \quad F = \Sigma F_i h_i h_i'^3.$$

Let $d_i = a_{i+1} - a_i$ be the distance (from left to right) between the surfaces i and $i + 1$. Then

$$d_i = (a_{i+1} - c_i) - (a_i - c_i) = (a_{i+1} - c_i') - (a_i - c_i'),$$

and, to repeat the notation,

$$K_i = \mu_i \left(\frac{1}{a_i - c_i} + \frac{1}{r_i} \right) = \mu_{i-1} \left(\frac{1}{a_i - c_{i-1}} + \frac{1}{r_i} \right), \\ L_i = \mu_i \left(\frac{1}{a_i - c_i'} + \frac{1}{r_i} \right) = \mu_{i-1} \left(\frac{1}{a_i - c_{i-1}'} + \frac{1}{r_i} \right), \\ K_i' = K_i r_i - \mu_{i-1}, \quad K_i'' = K_i r_i - \mu_i, \\ L_i' = L_i r_i - \mu_{i-1}, \quad L_i'' = L_i r_i - \mu_i$$

$$\frac{h_{i+1}}{h_i} = \frac{r_{i+1}}{r_i} \cdot \frac{L_i''}{L_{i+1}'}, \quad \frac{h'_{i+1}}{h'_i} = \frac{r_{i+1}}{r_i} \cdot \frac{K_i''}{K_{i+1}'},$$

$$h_i h'_i = (L_i - K_i)^{-1},$$

$$H_{i+1}/H_i = K'_{i+1}/K_i'', \quad H'_{i+1}/H'_i = L'_{i+1}/L_i'', \dots$$

$$H_i H'_i = r_i^2 (L_i - K_i), \dots$$

$$K'_i y_i = H_i \eta_i, \quad K'_{i+1} y_{i+1} = H_{i+1} \eta_{i+1}, \quad L_i'' y'_i = H'_i \eta'_i, \quad L'_{i+1} y'_{i+1} = H'_{i+1} \eta'_{i+1}.$$

For the beginning it is possible to write

$$y'_0 = \eta'_0, \quad H'_1 = L'_1, \quad H_1 = r_1^2 (L_1 - K_1)/L'_1,$$

$$h_1 = r_1/L'_1, \quad h'_1 = L'_1/r_1 (L_1 - K_1).$$

These formulae completely determine the Gaussian approximation

$$\eta_0 = \dots = \eta_i = \dots = \eta_j,$$

$$\eta'_0 = \dots = \eta'_i = \dots = \eta'_j,$$

which can be used to find the terms of the third order.

The two systems of conjugate planes are quite arbitrary. With Schwarzschild the first C is identified with the object plane, the second C'_0 with the entrance pupil. The last plane C'_j of the first set is then the image plane in the Gaussian sense, and the last C'_j of the second set coincides with the exit pupil. Thus the limits of η' or η'' define the limits of the effective pencil which forms the image.

Schwarzschild remarks on the analogy of the method with the theory of planetary perturbations. But a more special analogy in the variation of constants will be seen in the method of Delaunay's Lunar Theory. The essential point consists in the treatment of the second-order terms in the characteristic function whereby the principal part is removed and only residual terms of a higher (sixth) order are left. Thus the analogy is very close.

7. The formulae of § 4 are easily adapted to a reflecting system. It is only necessary to write

$$\mu_{i-1} = 1, \quad \mu_i = -1, \quad K'_i = K_i \rho_i - 1, \quad K''_i = K_i \rho_i + 1$$

$$L'_i = L_i \rho_i - 1, \quad L''_i = L_i \rho_i + 1.$$

Then

$$A_i = \frac{b_i}{r_i^3} - \frac{(2L_i - K_i)^2 + (2K_i^2 + L_i^2 - 4K_i L_i) L_i^2 r_i^2}{r_i (K_i^2 r_i^2 - 1)},$$

$$B_i = b_i/r_i^3 + K_i^2/r_i,$$

$$C_i = b_i/r_i^3 + L_i^2/r_i,$$

$$D_i = b_i/r_i^3 + K_i(2L_i - K_i)/r_i,$$

$$E_i = b_i/r_i^3 + L_i(2L_i - K_i)/r_i,$$

$$F_i = b_i/r_i^3 + K_i L_i/r_i.$$

Here the sign has been changed throughout, the result of reversing the sign of r_i . This has been done because the reflecting surfaces are usually concave to the incident ray. With this change of sign

$$K_i = \frac{1}{a_i - c_{i-1}} - \frac{1}{r_i} = \frac{1}{r_i} - \frac{1}{a_i - c_i};$$

or, if A_i is the vertex of the mirror and C_{i-1} , C_i the points where the conjugate planes meet the axis,

$$K_i = 1/C_{i-1}A_i - 1/r_i = 1/r_i - 1/C_iA_i.$$

After the reflexion it is perhaps most convenient to reverse the axis of x at the vertex r_i . Let d_i be the (positive) distance between the mirrors i and $i + 1$. Then, c_i , c'_i having double meanings for the two directions of the axis,

$$\begin{aligned} d_i &= C_iA_{i+1} + C_iA_i = (a_{i+1} - c_i) + (a_i - c_i) \\ &= C'_iA_{i+1} + C'_iA_i = (a_{i+1} - c'_i) + (a_i - c'_i). \end{aligned}$$

The necessary changes in the remaining formulae give

$$\begin{aligned} L_i &= \frac{1}{a_i - c'_{i-1}} - \frac{1}{r_i} = \frac{1}{r_i} - \frac{1}{a_i - c'_i} \\ -K'_i &= K_i r_i + 1, \quad -K''_i = K_i r_i - 1, \\ -L'_i &= L_i r_i + 1, \quad -L''_i = L_i r_i - 1, \\ \frac{h_{i+1}}{h_i} &= \frac{r_{i+1}}{r_i} \cdot \frac{L_i r_i - 1}{L_{i+1} r_{i+1} + 1}, \quad \frac{h'_{i+1}}{h'_i} = \frac{r_{i+1}}{r_i} \cdot \frac{K_i r_i - 1}{K_{i+1} r_{i+1} + 1}, \\ h_1 &= \frac{r_1}{L_1 r_1 + 1}, \quad h'_1 = \frac{L_1 r_1 + 1}{r_1 (L_1 - K_1)}, \quad h_i h'_i = \frac{1}{L_i - K_i}, \\ \frac{H_{i+1}}{H_i} &= \frac{K_{i+1} r_{i+1} + 1}{K_i r_i - 1}, \quad \frac{H'_{i+1}}{H'_i} = \frac{L_{i+1} r_{i+1} + 1}{L_i r_i - 1}, \\ H_1 &= \frac{-r_1^2 (L_1 - K_1)}{L_1 r_1 + 1}, \quad H'_1 = -(L_1 r_1 + 1), \quad H_i H'_i = r_i^2 (L_i - K_i). \end{aligned}$$

No further alteration is required. Schwarzschild has given a treatment of the mirror system which is independent of the previous theory for a refracting system.

8. The theory of the errors of the third order is contained in the equations

$$\eta_j - \eta_0 = - \frac{\partial W^{iv}}{\partial \eta_j'}, \quad \zeta_j - \zeta_0 = - \frac{\partial W^{iv}}{\partial \zeta_j'},$$

$$-4W^{iv} = A\rho_0^2 + B\rho_j'^2 + 4C\tau_0^2 + 2D\rho_0\rho_j' - 4E\rho_0\tau_0i - 4F\rho_j'\tau_0i,$$

and their effects in the image plane follow immediately. But it is convenient to consider the incidence of the ray on a parallel plane at a small distance e before the image plane. The displacement of the point of incidence is given by

$$\frac{\Delta y}{e} = - \frac{y' - y_0}{c_j' - c_j} = - \left(\frac{H_j' \eta_j'}{L_j''} - \frac{H_j \eta_j}{K_j''} \right) / \mu_j \rho_j'^2 (L_j - K_j),$$

$$\Delta \eta_j = - e \cdot \frac{H_j' K_j'' \eta_j'}{\mu_j \rho_j'^2 (L_j - K_j) H_j} + e \cdot \frac{K_j'' L_j'' \eta_j}{\mu_j \rho_j'^2 (L_j - K_j)}.$$

The second term depends only on the object-point. It represents a linear distortion, or, in other words, a simple change of scale value. Therefore it needs no further consideration. Let the ray now meet a sphere of radius ρ , such that the image plane is the tangent plane at the point where it meets the axis. Then $2\rho e = y_j'^2$ when $z_j = 0$, and the first term becomes

$$\Delta \eta_j = \frac{H_j' K_j'' \eta_j'}{2\mu_j \rho_j'^2 (L_j - K_j) H_j \rho} - \frac{H_j H_j' \eta_j'^2 \eta_j'}{2\mu_j \rho_j'^2 (L_j - K_j) \rho}$$

$$= - \eta_0^2 \eta_j' / 2\mu_j \rho.$$

The assumption that $z_j = 0$, and therefore $\zeta_j = 0$ to the first order, does not restrict the generality. Similarly

$$\Delta \zeta_j = - \eta_0^2 \zeta_j' / 2\mu_j \rho.$$

Now the errors which have the same form are those multiplied by C and D . When $\zeta_0 = 0$ they are

$$\eta_j - \eta_0 = (2C + D) \eta_0^2 \eta_j'$$

$$\zeta_j = D \eta_0^2 \zeta_j'.$$

If $\rho = \rho_1$ where

$$1/\rho_1 = 2\mu_j (2C + D)$$

the image clearly becomes a straight line transversal to the axis, for

$$\eta_j - \eta_0 + \Delta \eta_j = 0.$$

This gives the locus of the primary focus. If $\rho = \rho_2$ where

$$1/\rho_2 = 2\mu_j D$$

the image becomes a straight line radial to the axis, for

$$\zeta_j - \zeta_0 + \Delta\zeta_j = 0.$$

This gives the locus of the secondary focus.

Finally, if

$$\begin{aligned} 2\mu_j(2C + D) - \rho^{-1} + 2\mu_j D - \rho^{-1} &= 0 \\ \rho^{-1} &= 2\mu_j(C + D) = \frac{1}{2}(\rho_1^{-1} + \rho_2^{-1}) \end{aligned}$$

it follows that

$$\eta_j - \eta_0 + \Delta\eta_j = C\eta_0^2\eta'_j, \quad \zeta_j - \zeta_0 + \Delta\zeta_j = -C\eta_0^2\zeta'_j.$$

This gives the spherical locus of the circles of least confusion. If $C = 0$ astigmatism disappears, but curvature of the field remains.

The quantities C and D are the pair most easily expressed. For, when b_i is omitted,

$$\begin{aligned} C &= \Sigma C_i h_i^2 h_i'^2 = \Sigma \frac{L_i^2}{2(L_i - K_i)^2 r_i} \left(\frac{K_i'}{\mu_{i-1}^2} - \frac{K_i''}{\mu_i^2} \right) \\ &= \Sigma \frac{L_i^2 (\mu_i - \mu_{i-1})}{2\mu_i^2 \mu_{i-1}^2 (L_i - K_i)^2 r_i} \{ K_i r_i (\mu_i + \mu_{i-1}) - \mu_i \mu_{i-1} \}, \end{aligned}$$

and

$$\begin{aligned} D &= \Sigma D_i h_i^2 h_i'^2 \\ &= \Sigma \frac{K_i}{2(L_i - K_i)^2 r_i} \left(\frac{L_i^2 r_i - 2\mu_{i-1} L_i + \mu_{i-1} K_i}{\mu_{i-1}^2} - \frac{L_i^2 r_i - 2\mu_i L_i + \mu_i K_i}{\mu_i^2} \right) \\ &= \Sigma \frac{K_i (\mu_i - \mu_{i-1})}{2\mu_i^2 \mu_{i-1}^2 (L_i - K_i)^2 r_i} \{ L_i^2 r_i (\mu_i + \mu_{i-1}) - \mu_i \mu_{i-1} (2L_i - K_i) \} \\ &= C + \frac{1}{2} \Sigma \frac{\mu_i - \mu_{i-1}}{2\mu_i \mu_{i-1} r_i}. \end{aligned}$$

Hence the meaning of the Petzval condition is expressed by

$$0 = \Sigma \frac{1}{r_i} \left(\frac{1}{\mu_i} - \frac{1}{\mu_{i-1}} \right) = 2(C - D) = \frac{1}{2\mu_j} \left(\frac{1}{\rho_1} - \frac{3}{\rho_2} \right).$$

In the absence of astigmatism $C = 0$, $\rho_1 = \rho_2 = \rho$, and this condition secures flatness of field. But the independent condition for flatness of the best possible field is

$$0 = C + D = \Sigma \frac{\mu_i - \mu_{i-1}}{\mu_i^2 \mu_{i-1}^2 (L_i - K_i)^2 r_i} \{ K_i L_i^2 r_i (\mu_i + \mu_{i-1}) - \frac{1}{2} \mu_i \mu_{i-1} (L_i^2 + 2K_i L_i - K_i^2) \}.$$

9. The theory has been built up by considering the successive refractions and their combined effect. For some purposes the intermediate steps are unnecessary, and a general qualitative theory of the symmetrical instrument can be based on the consideration of the first and final ray alone. The equation (1), now written in the form

$$\delta W = -\mu_j(y_j\delta m_j + z_j\delta n_j) + \mu_0(y_0\delta m_0 + z_0\delta n_0),$$

is general. The equations, corresponding to (7),

$$\begin{aligned} \mu_j &= \frac{K_j'' L_j'' (y_j' - y_j)}{\mu_j r_j^2 (L_j - K_j)}, & \mu_0 &= \frac{K_1' L_1' (y_0' - y_0)}{\mu_0 r_1^2 (L_1 - K_1)}, \\ n_j &= \frac{K_j'' L_j'' (z_j' - z_j)}{\mu_j r_j^2 (L_j - K_j)}, & n_0 &= \frac{K_1' L_1' (z_0' - z_0)}{\mu_0 r_1^2 (L_1 - K_1)}, \end{aligned}$$

represent a general transformation. Here (y_0', z_0') , (y_j', z_j') are not strictly the intersections of the ray with the planes of the entrance and exit pupils, but coincide with them to the first (Gaussian) order. The result for the variation of m, y is, in the notation of § 6,

$$\begin{aligned} \delta W &= -\frac{K_j'' L_j'' y_j}{r_j^2 (L_j - K_j)} \delta(y_j' - y_j) + \frac{K_1' L_1' y_0}{r_1^2 (L_1 - K_1)} \delta(y_0' - y_0) \\ &= -\eta_j \delta \eta_j' + \eta_0 \delta \eta_0' + \frac{1}{2} \delta \left(\frac{L_j'' H_j}{K_j'' H_j'} \eta_j^2 - \frac{L_1' H_1}{K_1' H_1'} \eta_0^2 \right) \\ &= -\eta_j \delta \eta_j' - \eta_0' \delta \eta_0 + \eta_0 \delta \eta_j' + \eta_j' \delta \eta_0 \\ &\quad + \left(\frac{1}{2} \eta_j^2 \cdot \frac{L_j'' H_j}{K_j'' H_j'} - \frac{1}{2} \eta_0^2 \cdot \frac{L_1' H_1}{K_1' H_1'} - \eta_0 (\eta_j' - \eta_0') \right). \end{aligned}$$

Therefore, if

$$\begin{aligned} S &= W + \eta_0 (\eta_j' - \eta_0') + \zeta_0 (\zeta_j' - \zeta_0') \\ &\quad - \frac{1}{2} \left\{ \frac{L_j'' H_j}{K_j'' H_j'} (\eta_j^2 + \zeta_j^2) - \frac{L_1' H_1}{K_1' H_1'} (\eta_0^2 + \zeta_0^2) \right\}, \end{aligned}$$

the variation of S depends on $(\eta_0, \zeta_0), (\eta_j', \zeta_j')$ only, and

$$\left. \begin{aligned} \eta_j - \eta_0 &= -\frac{\partial S}{\partial \eta_j'} & \zeta_j - \zeta_0 &= -\frac{\partial S}{\partial \zeta_j'} \\ \eta_0 - \eta_j &= \frac{\partial S}{\partial \eta_j} & \zeta_0 - \zeta_j &= \frac{\partial S}{\partial \zeta_j} \end{aligned} \right\} \dots \quad (11)$$

Now S can contain no terms of the second order, because $\eta_j = \eta_0, \dots$ to the first order. And, owing to the symmetry of the instrument, S can be developed in terms of the three axial invariants ρ, ρ_j' , and τ_j . The meaning of certain classes of terms in S is now easily seen.

10. Thus the terms of the form $\Sigma A' \rho_0^q$ are independent of (η_j', ζ_j') . They disappear on differentiation, and have no effect on the image points. Similarly, terms of the form $\Sigma B' \rho_j'^q$ are independent of the position of the object point. They constitute the whole of the spherical aberration. Terms of the form $\Sigma E' \rho_0^q \tau_{0j}$ are linear in (η_j', ζ_j') . On differentiation they give rise to a pure distortion which affects the position, but does not disturb the quality of the point image.

The remaining terms, which are represented among the third-order errors, and which have not been specially considered, are of the form $\Sigma F' \rho_j'^q \tau_{0j}$. When $\zeta_0 = 0$ they give

$$\begin{aligned} \eta_j - \eta_0 &= -\eta_0 \Sigma F' \rho_j'^q (1 + 2q \eta_j'^2 / \rho_j'^2) \\ \zeta_j &= -\eta_0 \Sigma F' \rho_j'^q \cdot 2q \eta_j' \zeta_j' / \rho_j'^2. \end{aligned}$$

These terms represent coma. The corresponding image formed by any zone of the instrument is the twice-traced circle

$$[\eta_j - \eta_0 \{1 - \Sigma F' \rho_j'^q (1 + q)\}]^2 + \zeta_j^2 = (\Sigma q F' \rho_j'^q)^2 \eta_0^2.$$

In the third order $q = 1$, and this circle is

$$\{\eta_j - \eta_0 (1 - 2F' \rho_j'^2)\}^2 + \zeta_j^2 = F'^2 \eta_0^2 \rho_j'^2,$$

and the whole system touches two straight lines meeting at 60° in the first-order image. This is the characteristic error of the single parabolic mirror for an object at infinity, and might be called the parabolic, as distinguished from the spherical, aberration.

If there is no spherical aberration, S contains no terms independent of (η_0, ζ_0) , and therefore

$$\frac{\partial S}{\partial \eta_j'} = \frac{\partial S}{\partial \zeta_j'} = 0,$$

when $\eta_0 = \zeta_0 = 0$, $\eta_j = \zeta_j = 0$. These points on the axis are stigmatic points. If there is no coma, S contains no terms linear in (η_0, ζ_0) . Then

$$\frac{\partial^2 S}{\partial \eta_j' \partial \eta_0} = \frac{\partial^2 S}{\partial \eta_j' \partial \zeta_0} = \frac{\partial^2 S}{\partial \zeta_j' \partial \eta_0} = \frac{\partial^2 S}{\partial \zeta_j' \partial \zeta_0} = 0,$$

and therefore the point $(\eta_0 + \delta \eta_0, \zeta_0 + \delta \zeta_0)$ to the first order in $\delta \eta_0, \delta \zeta_0$ is represented stigmatically if $\eta_0 = \zeta_0 = 0$ is so represented. In this case the points $\eta_0 = \zeta_0 = 0, \eta_j = \zeta_j = 0$ are aplanatic. The second condition alone can be written

$$\frac{\partial \eta_0'}{\partial \eta_j'} - 1 = \frac{\partial \zeta_0'}{\partial \eta_j'} = \frac{\partial \eta_0'}{\partial \zeta_j'} = \frac{\partial \zeta_0'}{\partial \zeta_j'} - 1 = 0 \dots \dots \quad (12)$$

for all values of (η'_0, ζ'_0) . But when

$$\eta_0 - \zeta_0 - \eta_j = \zeta_j = 0, \quad y_0 = z_0 = y_j = z_j = 0,$$

and

$$\frac{m_j}{m_0} = \frac{y'_j}{y'_0} \cdot \frac{K_j'' L_j''}{K_1' L_1'} \cdot \frac{H_1 H_1'}{H_j H_j'} \cdot \frac{\mu_0}{\mu_j} = \frac{\eta'_j}{\eta'_0} \cdot \frac{\mu_0}{\mu_j} \cdot \frac{K_j''}{K_1'} \cdot \frac{H_1}{H_j}$$

$$\frac{n_j}{n_0} = \frac{\zeta'_j}{\zeta'_0} \cdot \frac{\mu_0}{\mu_j} \cdot \frac{K_j''}{K_1'} \cdot \frac{H_1}{H_j}.$$

Hence if

$$\frac{m_j}{m_0} = \frac{n_j}{n_0} = \frac{\mu_0}{\mu_j} \cdot \frac{K_j''}{K_1'} \cdot \frac{H_1}{H_j}, \dots \quad (13)$$

it follows that

$$\eta'_0 = \eta'_j, \quad \zeta'_0 = \zeta'_j,$$

and the conditions (12) are clearly satisfied. Now

$$\frac{K_j''}{K_1'} \cdot \frac{H_1}{H_j} = \frac{\eta_j}{y_j} \cdot \frac{y_0}{\eta_0} = \frac{z_0}{y_0} = \frac{z_j}{y_j}$$

to the first order, and this ratio is the reciprocal of the magnification. Hence (13) represents the sine condition, and when it is satisfied the instrument is free from coma or the effect (of any order) which depends on the first power of the coordinates of the object in the plane perpendicular to the axis.

11. The equations (11) are general and reduce the problem of calculating the errors for any order to the development of the function S . For a single refraction omitting the similar terms in z, ζ ,

$$\begin{aligned} S_i &= W_i - \frac{K_i' K_i''}{2r_i^2 (L_i - K_i')} \left\{ \frac{L_i'' y_i^2}{K_i'} - \frac{L_i' y_{i-1}^2}{K_i''} - \frac{2y_{i-1}}{K_i''} (L_i'' y_i' - L_i' y'_{i-1}) \right\} \\ &= W_i - \frac{H_i}{2H_i'} \left\{ \eta_i^2 \cdot \frac{L_i''}{K_i''} - \eta_{i-1}^2 \cdot \frac{L_i'}{K_i'} \right\} + \eta_{i-1} (\eta_i' - \eta'_{i-1}). \end{aligned}$$

But

$$\frac{H_{i-1}}{H'_{i-1}} \cdot \frac{L'_{i-1}}{K'_{i-1}} = \frac{H_i}{H_i'} \cdot \frac{L_i''}{K_i''}$$

Therefore in the sum, since $W = \sum W_i$,

$$\begin{aligned} \sum S_i &= W + \frac{1}{2} \left\{ \frac{H_j L_j''}{H_j' K_j''} (\eta^2 + \zeta^2) - \frac{H_1 L_1'}{H_1' K_1'} (\eta_0^2 + \zeta_0^2) \right\} \\ &\quad + \sum_{i=1}^j \{ \eta_{i-1} (\eta_i' - \eta'_{i-1}) + \zeta_{i-1} (\zeta_i' - \zeta'_{i-1}) \} \\ &= S + \sum_{i=1}^j \{ (\eta_{i-1} - \eta_0) (\eta_i' - \eta'_{i-1}) + (\zeta_{i-1} - \zeta_0) (\zeta_i' - \zeta'_{i-1}) \}. \end{aligned}$$

first approximation can be used in the terms of the third order. Hence

$$\frac{Y}{r_i} = -\frac{\mu_i m_i - \mu_{i-1} m_{i-1}}{\mu_i - \mu_{i-1}} (1 - M),$$

$$\frac{Z}{r_i} = -\frac{\mu_i n_i - \mu_{i-1} n_{i-1}}{\mu_i - \mu_{i-1}} (1 - M),$$

where

$$M = \frac{1 + b_i}{2(\mu_i - \mu_{i-1})} \{(\mu_i m_i - \mu_{i-1} m_{i-1})^2 + (\mu_i n_i - \mu_{i-1} n_{i-1})^2\}$$

$$- \{\mu_i (m_i^2 + n_i^2) - \mu_{i-1} (m_{i-1}^2 + n_{i-1}^2)\}$$

$$= \frac{1}{2} \mu_i \mu_{i-1} (\mu_i - \mu_{i-1})^{-1} \{(m_i - m_{i-1})^2 + (n_i - n_{i-1})^2\}$$

$$+ \frac{1}{2} b_i (\mu_i - \mu_{i-1})^{-1} \{(\mu_i m_i - \mu_{i-1} m_{i-1})^2 + (\mu_i n_i - \mu_{i-1} n_{i-1})^2\}.$$

The last line vanishes with b_i for spherical surfaces. The errors in the point of incidence (Y, Z) are now of the fifth order, and will only affect the calculation of W_i^r and the optical errors of the ninth order.

These indications will suffice to show that the calculation of the nine errors of the fifth order for a symmetrical optical system, though complicated, would present no serious difficulty. That the calculation has not apparently been made doubtless results from the practical difficulty of reconciling the removal of the errors of the third order with the conditions of achromatism—a difficulty which hitherto has not been completely overcome.

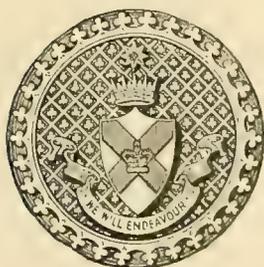
12. It may be convenient to add a brief summary of the contents of this paper:—

- § 1. The modified characteristic function.
- § 2. Refraction at one surface. Form of the second order terms W_i^{ii} .
- § 3. Introduction of new variables. Transformation of W_i^{ii} .
- § 4. Elimination of second-order terms. Calculation of W_i^{ie} .
- § 5. Changes in the coordinates.
- § 6. Extension to any number of refractions.
- § 7. Formulæ adapted to a mirror system.
- § 8. Astigmatism and curvature of the field. The Petzval condition.
- § 9. The theory in most general terms.
- § 10. Spherical aberration and coma. The sine condition.
- § 11. Further development. Preparation of formulæ for calculating errors of the fifth order.

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PROCEEDINGS
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PAPERS READ BEFORE THE ACADEMY

I.

REPORT ON THE SPONGES COLLECTED OFF THE COAST OF
IRELAND BY THE DREDGING EXPEDITIONS OF THE
ROYAL IRISH ACADEMY AND THE ROYAL DUBLIN
SOCIETY.

BY JANE STEPHENS, B.A., B.Sc.

PLATE I.

Read JUNE 11. Published JULY 13, 1917.

A SHORT account is given in the following paper of collections of sponges obtained a good many years ago by the Royal Irish Academy and by the Royal Dublin Society off the west and south-west coasts of Ireland. These sponges were deposited in the National Museum, Dublin, where they have since remained unnamed, with the exception of two or three, which were referred to in the report on the marine sponges of the Clare Island Survey (12), as they were the sole representatives of their species known within the area of that survey.

Excepting the first cruise of the "Porcupine" in the year 1869, the earliest attempts at deep-sea dredging off the west and south-west coasts of Ireland were carried out by the Royal Irish Academy, which equipped three dredging expeditions in the years 1885, 1886, and 1888. Accounts of the invertebrates then obtained, with the exception of the sponges, were published in the Proceedings of the Academy (4 and 5).

Later on, in the years 1890 and 1891, the Royal Dublin Society organized a survey of the fishing grounds off the west coast of Ireland. In the course of this survey large collections of invertebrates were made. A preliminary list of the species was published in the report on the Survey (8), in which mention was made of about half a dozen of the commonest sponges.

Several of the groups have since been worked out in considerable detail, but again the sponges were left untouched.

The number of sponges in these united collections is not great. In fact, as always happened in the earlier dredging expeditions, the only sponges that were collected as such were the larger and more conspicuous kinds. Shells, corals, stones, and other material dredged up were not examined and retained, as they would be to-day, for small, encrusting sponges, which are now known to exist in extraordinary numbers and in great variety of species. However, a search through other groups in the Royal Irish Academy and Royal Dublin Society collections in the National Museum, such as the mollusca, the hydroids, and particularly the corals, resulted in the discovery of a number of small, for the most part encrusting, sponges of considerable interest.

The number of species in all is only thirty-eight. Of these two, *Mycale* (*Paresperella*) *atlantica* and *Focerpia fragilis*, are described as new. The former is interesting on account of the fact that it is the first representative of the sub-genus *Paresperella* found in the Atlantic Ocean.

The following five species are noted for the first time within the Irish area :—

- Laxosuberites ectyoninus* *Topsent*.
- Desmacidon fruticosum* (*Montagu*).
- Hymenancora conjungens* *Lundbeck*.
- Microciona lævis* *Bowerbank*.
- Tragosia polypoides* (*Schmidt*).

Two of these species, *Laxosuberites ectyoninus* and *Hymenancora conjungens*, have not been taken previously off any part of the British Isles; each, in fact, has only been recorded once up to the present, the first-mentioned in the Mediterranean, the second off the south coast of Iceland.

CALCAREA.

The five calcareous sponges represented in the collection are among the commonest species found round our coast, and call for no special remark. They are as follows :—

Clathrina coriacea (*Montagu*).

R.D.S. Survey. Blacksod Bay.

Leucosolenia complicata (*Montagu*).

R.D.S. Survey. Station 238, Lough Swilly, 8–12 fathoms.

Sycon ciliatum (Fabricius).

R.I.A. Exp., 1886. Log 41, Crookhaven, $3\frac{1}{2}$ fathoms.

R.D.S. Survey. Blacksod Bay; Kilkieran Bay; Clare Island; Station 23, rock pools, west shore of Killeany Bay; Station 158, Greatman's Bay, Co. Galway; Station 238, Lough Swilly, 8-12 fathoms.

Grantia compressa (Fabricius).

R.D.S. Survey. Kilkieran Bay; Clare Island; Smerwick Harbour; Station 167, Blacksod Bay, 3-4 fathoms; Station 238, Lough Swilly, 8-12 fathoms.

Leucandra nivea (Grant).

R.D.S. Survey. Blacksod Bay, 5 fathoms.

NON-CALCAREA.

Order MYXOSPONGIDA.

Halisarca Dujardini Johnston.

R.D.S. Survey. Station 240, Lough Swilly, 6-8 $\frac{1}{2}$ fathoms.

This common species is represented by one specimen growing on the leg of a crab (*Hyas araneus*), which is thickly covered with Polyzoa and Hydroids.

Order TETRAXONIDA.

Family THENEIDAE.

Thenea muricata Bowerbank.

R.I.A. Exp., 1888. Log 69, 51° 1' N., 11° 50' W., 750 fathoms.

The only specimen in the collection is 45 mm. by 38 mm. in diameter. It has one large osculum placed almost centrally on the upper surface of the sponge.

A large number of specimens of this species have been obtained within recent years by the Irish Fisheries Branch off the south-west coast of Ireland at depths varying between 625 and 982 fathoms (13).

Family PACHASTRELLIDAE.

Poecillastra compressa (Bowerbank).

R.I.A. Exp., 1886. Log 53 (or ? log 20). Off the Skelligs, 70-80 fathoms.

This species is represented by one small fragment. Like *Thenea muricata*, numerous specimens of this species have been dredged within recent years off the south-west coast of Ireland at depths of 468-728 fathoms (13). These depths are considerably greater than that at which the present specimen was

obtained; but the species is known to occur in shallower water, for example off the north-west coast of France at about 28 fathoms, and off Rockall at 60 fathoms.

Family GEODIIDAE.

***Pachymatisma johnstonia* (Bowerbank).**

R.D.S. Survey. Station 86, off Inishmaan, 20-7 fathoms.

This species is doubtfully recorded by Mr. Holt (8). There is no specimen from this station in the Museum, so that the identification cannot be verified. The species is, however, well known round the Irish coast between tide-marks at extreme low water, as well as in rather shallow water-dredgings.

Family CLIONIDAE.

***Cliona celata* Grant.**

R.D.S. Survey. Station 22, Birtanbui Bay; Station 196, Davalaun Sound, 16-13 fathoms; s.s. "Harlequin," neighbourhood of Cork Harbour.

All the specimens in the collection are the massive form of this common boring sponge. The specimens from station 196 are recorded by Mr. Holt (8) as "great masses of sponge (*Rhaphoceras Griffithsii*)," a broken piece of which measured 20 inches by 17 inches by 8 inches.

***Cliona vastifica* Hancock.**

R.I.A. Exp. 1886. Log 49, 51° 20' N., 11° 26' W., 42 miles from Great Skellig, 160 fathoms.

R.D.S. Survey. Station 124, 50 miles W. of Bolus Head, 220 fathoms.

Both the specimens are boring in coral. The sponge from the first-mentioned station is boring extensively in a specimen of *Caryophyllia clavus*, that from the second locality is in *Lophohelia prolifera*. Only a very small piece of the sponge was found in the *Lophohelia*.

***Alectona Millari* Carter.**

R.D.S. Survey. Station 124, 50 miles W. of Bolus Head, 220 fathoms.

This sponge was found boring in coral (*Lophohelia prolifera*). Both this and the preceding species have recently been recorded for the Irish area (13), having been obtained in the course of the dredgings carried on by the Irish Fisheries Branch.

Family SUBERITIDAE.

***Laxosuberites incrustans* Stephens.**

R.I.A. Exp. 1886. Log 49, 51° 20' N., 11° 26' W., 42 miles from Great Skellig, 160 fathoms.

The single small specimen in the collection is growing on a coral (*Caryophyllia clavus*). This species was recently described (13) from specimens dredged by the Irish Fisheries Branch off the west and south-west coasts of Ireland, all of which, with two exceptions, are also growing on *Caryophyllia clavus*.

Laxosuberites ectyoninus Topsent.

R.D.S. Survey. Station 124, 50 miles W. of Bolus Head, 220 fathoms.

The two specimens form small thin encrustations on coral (*Lophohelia prolifera*). The spicules agree exactly in shape and size with those of the type, of which a detailed description and figures are given by Professor Topsent (16). The species has been obtained only once previously, namely off Banyuls, at a depth of 500-600 metres.

Suberites carnosus (Johnston).

R.I.A. Exp., 1888. Log 70, Berehaven, 5 fathoms, one specimen.

R.D.S. Survey. Blacksod Bay, two specimens: Station 33, Clifden Harbour, 6 fathoms, two specimens; Station 133, Dingle Bay, 40 fathoms, two specimens.

This species is widely distributed round the Irish coast, but is not very common.

Ficulina ficus (Linn.).

R.I.A. Exp., 1885. Log 3, 40 miles off south-west Ireland, 51° 15' N., 10° 31' W., 80 fathoms, one specimen.

R.I.A. Exp., 1888. Log 70, Berehaven, 5 fathoms, one specimen; log 73, probably off south of Ireland, 50 fathoms, one specimen.

R.D.S. Survey. Blacksod Bay, eight specimens; station 33, Clifden Harbour, 6 fathoms, one specimen and fragments; station 73, Killary Bay, 15-9 fathoms, three specimens; Kenmare River, three specimens; station 114, off the Skelligs, 80 fathoms, one specimen.

The usual forms assumed by this polymorphic sponge are represented in the collection, namely, encrusting, massive, and "suberea" forms. The last-named, which covers shells inhabited by hermit crabs, is very common off the coast. Mr. Holt (8) records the species, under the name *Suberites domunculus*, for station 38, Blacksod Bay.

Family HAPLOSCLERIDAE.

Sub-family GELLINAE.

Gellius flagellifer Ridley and Dendy.

R.D.S. Survey. Station 124, 50 miles W. of Bolus Head, 220 fathoms.

One small specimen belonging to this species is growing on coral

(*Lophohelia prolifera*. *Gellius flapulifer* has already been recorded for the Irish area (14). It was obtained by the Irish Fisheries Branch, and was growing on *Lophohelia*.

Gellius ravus Stephens.

R.D.S. Survey. Blacksod Bay.

The specimen, which is growing on an oyster shell, has been already referred to in the course of the description of the species given in the report on the sponges of the Clare Island Survey (12). It differs from the type in having shorter and more slender oxea. The species is evidently widely distributed round our shores, as it has been found at several places off the west, north-west, and east coasts.

Oceanapia robusta (Bowerbank).

R.D.S. Survey. Station 80, off Slyne Head, 55 fathoms.

The merest fragment of a fistula of this well-characterized species is in the collection. The species has been recorded previously for the Irish area (14).

Sub-family RENIERINAE.

Reniera simulans (Johnston).

R.D.S. Survey. Neighbourhood of Cork Harbour: west coast of Ireland. Two specimens of this common *Reniera* are in the collection.

Reniera *sp.*

R.D.S. Survey. Station 124, 50 miles W. of Bolus Head, 220 fathoms.

A number of small specimens of a *Reniera* are growing on a piece of coral (*Lophohelia prolifera*). They are oval in outline, with a single osculum at the summit. They are soft and fragile in texture and measure only 3 or 4 mm. in height. Their skeleton consists of a tripartite network of oxea cemented together at the ends by a little spongin. The oxea measure 0.18 - 0.22 mm. by 0.009 mm.

The sponge seems very similar in appearance and structure to *Reniera simulans* Topsent (17), but the oxea are much smaller than those of Professor Topsent's species.

Halichondria panicea (Pallas).

R.I.A. Exp., 1886. Log 41, Crookhaven, 3½ fathoms.

R.D.S. Survey. Neighbourhood of Cork Harbour, west coast of Ireland.

Thus the commonest sponge round our coasts, is represented in the collection by a few fragments.

Family DESMACIDONIDAE.

Sub-family MYCALINAE.

Mycale macilenta (Bowerbank).

R.D.S. Survey. Blacksod Bay. Two specimens.

The sponges are covering the valves of two living *Pectens* (*P. opercularis*).

Mycale placoides (Carter) Lundbeck.

R.I.A. Exp., 1886. Log 53, 5–8 miles west of Great Skellig, 70–80 fathoms. Three small fragments.

R.D.S. Survey. ? Blacksod Bay, fragments; station 72, 20 miles off Achill Head, 127 fathoms, two specimens.

This species is taken in the sense in which it is understood by Lundbeck (11), who carefully distinguishes Carter's species from its near ally, *Mycale lingua* (Bowerbank).

The largest specimen obtained measures 130 mm. by 90 mm. by 43 mm. in thickness.

The specimens which are labelled Blacksod Bay have already been referred to (12, p. 34). It is probable that the locality is wrongly given on the label, as *Mycale placoides* has never been taken in such shallow water as obtains in Blacksod Bay, where the soundings are, for the most part, 6 to 8 fathoms, a depth of 10 fathoms occurring towards the mouth of the Bay.

Since the foregoing specimens were collected, numbers of large specimens have been obtained off the west and south-west coasts of Ireland by the Irish Fisheries Branch (14).

Mycale (Paresperella) atlantica, n. sp. Plate I, fig. 1.

R.D.S. Survey. Station 124, 50 miles W. of Bolus Head, 220 fathoms.

The sponge is growing on *Lophohelia prolifera*, and it formed apparently a thick encrustation or cushion on the coral. Its longer diameter is about 18 mm., but the sponge is greatly damaged, so that its exact shape and limits cannot be made out. It is well characterized, however, by its distinctive and beautiful spiculation. The texture of the sponge is soft and fragile, and the surface, seen under the lens, is very slightly hispid.

A second specimen of the species, merely a small fragment, was growing on another branch of the coral.

Skeleton.—As far as can be seen from the scanty material available the main skeleton is composed of fibres, up to about 0.05 mm. in thickness, which consist of closely packed subtylostyli. These fibres run upwards through the sponge, branching here and there. At a short distance below the surface they

divide into finer divergent strands. The terminal spicules of these strands spread out in a fan-like manner, and their tips, at least in the preserved sponge, pierce the dermis and project for a short distance above it. The dermal skeleton is an irregular net-work of fibres. These fibres are much more slender than those of the skeleton, consisting sometimes of only two or three rows of spicules. The pores are seen in the meshes of the dermal net-work; they vary in diameter from about 0·05–0·25 mm.

Spicules.—(1) The megascleres are subtylostyli; they measure 0·35–0·45 mm. in length, and have a maximum thickness of 0·008 mm. Their shaft is slightly fusiform, and usually slightly crooked. The rounded end is sometimes fairly well marked off by a constriction beneath it; the other end tapers to a short point.

(2) Anisochelae of two sizes are present; the larger form rosettes, which are present in great numbers both in the dermal membrane and throughout the sponge. The smaller anisochelae are also scattered both in the dermis and in the cleansome. The first-mentioned anisochelae have a rather egg-shaped larger end, as the lower angles of the alae are rounded off, the lower margin of the tooth being rounded off in the same way. The free portion of the shaft is extremely short. The smaller alae also have rounded corners. The length of the rosette anisochelae is very constant, being 0·027–0·03 mm. The breadth of the larger alae is about 0·012 mm. The smaller anisochelae are similar in shape to the foregoing, but only reach a length of 0·019 mm.

(3) *Sigmata*.—These are conical; the ends of the spicule are very slender, and sharply pointed; one is bent in abruptly, while the other has a wider curve. The outer margin of the spicule is serrated towards both ends, the character which distinguishes the species assigned to the sub-genus *Paresperella*. The longer axis of the *sigmata* is from 0·1–0·165 mm., and the maximum thickness is 0·005 mm. The *sigmata*, which are often in bundles, occur in enormous numbers through the whole sponge.

(4) *Toxa*.—These spicules are rather scarce. They occur in small bundles in the interior of the sponge. They were not seen in those portions of the dermis which were examined. The *toxa* are extremely slender, and are 0·08 mm. in length; the curve in the centre of the spicule is very wide.

The foregoing sponge is closely allied in spiculation to Carter's species, *Macle* (*Porespella*) *maculata* (2), the type species of *Paresperella* Dendy (3), but differs from it in the greater length of the various kinds of spicules, as well as in the shape of the megascleres, as can be seen from a comparison of the figure (Plate I, fig. 1*a*, *b*) with that of the subtylostylus of the older species given by Professor Dendy (3, Pl. XI, fig. 2*c*). The *toxa*, too, differ in shape in the two species.

The Irish species approaches even more closely a sponge found on the beach at Vancouver Island, and assigned by Lambe (9) to Carter's species, but which, as Professor Dendy has already pointed out (3, p. 162), is no doubt a distinct species. The same kinds of spicules are present in this sponge as in the Irish specimen, but here again the measurements are different. The subtylostyli in the Vancouver sponge are shorter and thicker, the anisochelae longer, while the toxa, differing in shape, are only half the length of the corresponding spicules in the new species.

The remaining species assigned to this sub-genus are—*penicillium* Lendenfeld, see Hallmann (6), *macrosigma* Lindgren (10), *moluccensis* Thiele (15), *bidentata* Dendy (3), *repens* Whitelegge (19), *dichela* Hentschel (7). None of these possesses toxa, and all are further marked off from the new species by differences in the form and measurements of the spicules. The new species is the first representative of the sub-genus which has been found in the Atlantic Ocean, those previously described having been taken off Ceylon, or in various parts of the Pacific Ocean.

***Desmacidon fruticosum* (Montagu).**

R.D.S. Survey. Station 133, Dingle Bay, 40 fathoms.

Several pieces of this sponge, now recorded for the first time within the Irish area, are in the collection. The largest piece is 80 mm. in height and 105 mm. in its greatest breadth. It is very similar in shape to the specimen figured by Bowerbank (1, vol. iii, Pl. LXI).

***Forcepia fragilis*, n. sp. Plate I, fig. 2.**

R.I.A. Exp., 1888. Log 69, 51° 1' N., 11° 50' W., 750 fathoms.

The sponge is not attached to any support. It is somewhat oval in outline, and measures 25 mm. by 18 mm. by 15 mm. It is very fragile in texture, and its surface is damaged.

Skeleton.—The main skeleton consists of a loose, irregular network of styli. Sometimes only two or three spicules lie side by side to form the meshes, but usually the styli are multiseriably arranged. The arrangement of the dermal skeleton cannot be made out, as the surface of the sponge is rubbed away.

Spicules.—(1) The styli are slightly and somewhat irregularly curved. At one end they taper to a short point; the other end is rounded. They measure 0.6–0.77 mm. in length by 0.018–0.021 mm.

(2) The dermal spicules are tylota, measuring 0.4–0.45 mm. in length by 0.005–0.008 mm. One end of these spicules is sometimes rather more rounded than the other, but the difference is slight.

(3) The isochelae arcuatae have a slightly curved shaft: they are 0·024–0·033 mm. in length. The tooth is rather narrow, and is about the same length as the alae.

(4) Forceipes.—These are all of one kind, and, measured from the curve to the end of the longer leg, they are 0·038–0·043 mm. in length, and at the most are about 0·002 mm. in thickness at the curve. The legs are slightly divergent: one is a little longer than the other, and each terminates in a small button-like knob. Sometimes the spicule is twisted so that the legs cross each other. The forceipes are very minutely spined. Under a high power of the microscope it can be seen that the spines are arranged in rows, and that the points are directed towards the curve of the spicule.

(5) The sigmata are plane, and have a longer axis measuring 0·13–0·16 mm. in length. Their thickness is 0·006 mm.

All the forms of the microscleres are present in great abundance throughout the sponge.

Forceps parvulus n. sp. may be compared with the sponge assigned by Professor Topsent (17) to *Forcepia halimosa* (Carter), which Lundbeck has decided is a distinct species, and to which he has given the name *Forcepia azorica* (11, Part II, p. 210). Judging from the description given by Professor Topsent, the forceipes in his sponge are a different shape and size from those in the new species, and, what is more important, more than one kind of forceps appears to be present in the specimen from the Azores. In addition the styli of *Forcepia azorica* are sometimes slightly spined, while the styli of the Irish species are quite smooth.

The spination of *Forceps parvulus* is very similar to that of *Forcepia Thales* Lundbeck (11, in which species only one kind of forceps is present, but this spicule differs in shape from, as well as being longer than, the forceps of the new species.

Grayella sp.

R.D.S. Station 124, 50 miles W. of Bolus Head, 220 fathoms.

There are about half a dozen small encrusting specimens of a species of *Grayella* growing on a piece of *Lophosiphonia peltata*. They are much contracted, and their pore-bearing areas appear like small papillae on the surface of the sponge. Their spicules measure as follows:—(1) Tornota, 0·25–0·325 mm. in length; (2) Acanthostyli, 0·1–0·18 mm. in length; (3) Isochelae arcuatae, 0·019–0·021 mm. in length.

The foregoing measurements agree very well with those given by Professor Topsent (18, p. 49) for several encrusting specimens of *Grayella* obtained off the coast of Belgium, the north of France, and in the Gulf of Lions, which

specimens Professor Topsent is inclined to think may have to be assigned to *Grayella pyrula* (Carter), a species which is typically pedunculate, and which has, typically, considerably longer megasclera than these sponges possess. Professor Topsent states that he has tried to establish a distinct species for these specimens, but found there was too little difference in the size of their spicules and those of a globular *Grayella* which he had referred (17) to *Grayella pertusa* (Topsent), and which Lundbeck later regarded as identical with *Grayella pyrula* (11). It may be stated here that encrusting specimens of *Grayella pyrula* are known.

As Professor Topsent says, the species of *Grayella* must be increased in number to a large extent or a great variability must be admitted in *Grayella pyrula*. It would be necessary to study a large series of specimens before these questions could be decided, so that the only course is to leave the Irish specimens unnamed for the present.

The species *Grayella pyrula* (Carter) has been taken off the Irish coast (14).

Sub-family ECTYONINAE.

Hymedesmia paupertas (Bowerbank).

R.D.S. Survey. Station 124, 50 miles W. of Bolus Head, 220 fathoms.

The sponge is growing in a small patch on coral (*Lophohelia prolifera*). The species was first obtained off the Irish coast in the course of the Clare Island Survey (12), and it has since been taken at other stations by the Irish Fisheries Branch.

Hymedesmia pansa Bowerbank.

R.D.S. Survey. Blacksod Bay.

The sponge is growing in a thin encrustation on an oyster shell. A description of it has been published in the report of the sponges of the Clare Island Survey (12).

Hymedesmia Dujardini (Bowerbank).

R.D.S. Survey. Station 124, 50 miles W. of Bolus Head, 220 fathoms.

Several small specimens are growing on *Lophohelia prolifera*. The species has previously been obtained on several occasions within the Irish area.

Hymenancora conjungens Lundbeck.

R.D.S. Survey. Station 124, 50 miles W. of Bolus Head, 220 fathoms.

The sponge is growing in two patches on *Lophohelia prolifera*.

This species was taken only once previously, namely, to the south of Iceland in 296 fathoms (11). The spicules of the Irish specimen agree

[D*]

exactly with those of the type, except that the large acanthostyli are rather shorter, their maximum length being 0.31 mm. as against 0.41 mm. of the first found specimen.

This is the first time that a sponge belonging to the genus *Hymenancora* has been found within the Irish area.

***Microciona laevis* Bowerbank. Plate I, fig. 3.**

R.D.S. Survey. Station 124, 50 miles W. of Bolus Head, 220 fathoms.

The sponge is growing in two small patches on pieces of coral (*Lophohelia prolifera*). Its surface is very hispid. As far as can be seen from the scanty material available for examination, the dermal spicules are collected together in vertical brushes, their ends projecting above the surface of the sponge. The skeletal fibres are very short and plumose, the smaller styli being placed towards the exterior of the fibre. The long styli project far above the surface of the sponge. There is a considerable quantity of spongin round the bases of the styli.

Spicules—(1). The skeletal styli vary very much in size. The largest reach a length of about 1.4 mm., and are 0.024 mm. in diameter above the head. The shaft is slightly curved and tapers towards one end to a rather short point, and at the other end the rounded head is slightly constricted off from the shaft, and is smooth or is set with a few minute spines. The smallest styli are about 0.14 mm. in length, with a diameter of 0.007 mm. above the head. They are of the same shape as the largest styli, but are furnished with minute spines along the shaft, as well as having the head well spined. These two extremes are united by styli of intermediate sizes and degrees of spination.

(2) The dermal styli have a very slender, sometimes rather crooked, shaft, and the head is microspined. Their length varies from about 0.5 to 0.78 mm., and the maximum diameter is 0.006 mm.

(3) The toxæ are scattered in great abundance throughout the sponge. Their shape is very constant, but they vary greatly in size, from extremely minute to about 0.16 mm. in length, with a thickness of 0.004 mm. The curve in the middle of the spicule is even and not very abrupt, and the ends are slightly re-curved, and sharply pointed.

This species has been taken only once previously, namely, off the Shetlands (1).

***Plocamia microcionides* (Carter).**

R.D.S. Survey. Station 124, 50 miles W. of Bolus Head, 220 fathoms.

The specimen is spreading over several branches of a coral (*Lophohelia prolifera*), and it is easily poked out from among the numerous encrusting

sponges with which it is growing by its long styli, which project for about 3 mm. above the surface of the sponge. *Plocamia microcionides* is distinguished from *Plocamia ambigua* (Bowerbank) chiefly by its very long, perfectly smooth styli instead of acanthostyli, and by its acanthostrongyla, which have stout, blunt spines, with microspined summits, instead of the sharply pointed spines of the corresponding spicules of *Plocamia ambigua*.

Plocamia microcionides has been found on *Lophohelia* dredged by the Irish Fisheries Branch (14), and it is hoped to publish a description and figures of the species in a forthcoming paper.

Family AXINELLIDAE.

Phakellia ventilabrum (Johnston).

R.I.A. Exp. Log 20 (or ? log 53), off the Skelligs, 70 to 80 fathoms. Eight specimens.

R.I.A. Exp. 1886. Log 53, 5–8 miles W. of Great Skellig, 70 to 80 fathoms. Twelve specimens.

R.D.S. Survey. Station 12, off Dingle Bay, 53 fathoms, one specimen; Station 80, off Slyne Head, 55 fathoms, two specimens; Station 85, Galway Bay, 19–15 fathoms, one specimen; Station 225, Rosses Bay, 32–25 fathoms. Fourteen small specimens.

The specimens obtained at Station 225 are small cup-shaped sponges, varying in diameter from 25 to 60 mm., while those dredged off the Skelligs are much larger, the largest having a diameter of 185 mm. The specimens from the latter locality are fan- or cup-shaped sponges, most of them having the margin deeply cut into a number of lobes, the indentations sometimes reaching nearly to the base of the sponge. These specimens are referred to by Professor Haddon (5, p. 38). Mr. Holt (8) records the species from Station 115, off the Skelligs, 62–52 fathoms. As may be judged from the foregoing list of stations, the species is fairly common off the west and south-west coasts, at depths of about 18 to 100 fathoms.

Phakellia rugosa (Bowerbank).

R.D.S. Survey. Station 80, off Slyne Head, 55 fathoms.

The species is represented by one small, stalked, club-shaped specimen, only 9 mm. in height. *Phakellia rugosa* has been recorded once previously for the Irish area (14).

Tragosia infundibuliformis (Johnston).

R.I.A. Exp. Log 53 (or ? log 20), off the Skelligs, 70–80 fathoms. One specimen.

R.I.A. Exp. 1886. Station unknown. One specimen.

R.D.S. Survey. Station 225, Rosses Bay, 32–35 fathoms. Three specimens.

This sponge, which has been obtained fairly often in recent years off the west and south-west coasts of Ireland, is evidently not as common as *Phakellia ventilabrum*, small cup-shaped specimens of which it resembles superficially. The two species can, with practice, be distinguished without microscopical examination owing to a difference in texture and in the margin of the cup, which is rather thick and rounded in *Tragosia*, and which is thinned to a rather sharp edge in *Phakellia*.

***Tragosia polyoides* (Schmidt).**

R.D.S. Survey. West coast of Ireland.

The sponge is branching in one plane, and has a fan-shaped outline. It is 46 mm. in height by 51 mm. in its greatest breadth. This is the first time the species has been obtained within the Irish area.

***Hymeniacion caruncula* Bowerbank.**

R.D.S. Survey. Blacksod Bay.

The only fragment of this very common species in the collection was preserved owing to its being overgrown by a gymnoblastic hydroid.

Order EUCERATOSA.

Family SPONGELIIDAE.

***Spongelia fragilis* (Montagu).**

R.D.S. Survey. Station 240, Lough Swilly, 6–8½ fathoms.

A specimen of this common species is growing on the back of a crab (*Haemulon*), which is thickly covered with Polyzoa and Hydroids, and which has on one leg a growth of *Holisarca Dujardini*.

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EXPLANATION OF PLATE I.

FIG.

1. *Mycale (Paresperilla) atlantica* n. sp.

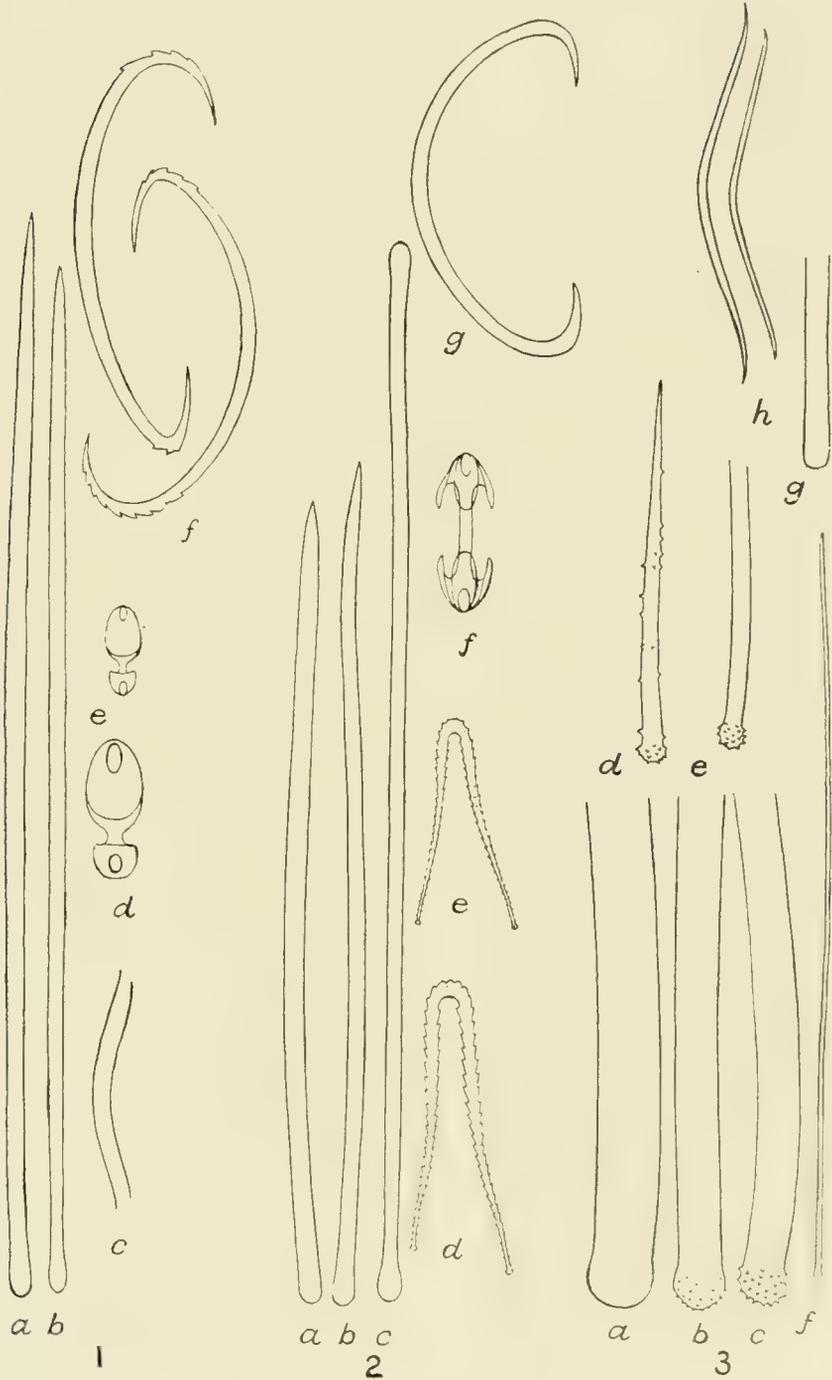
a, b, styli, $\times 330$; *c*, toxa, $\times 330$; *d, e*, large and small anisochelae $\times 600$; *f*, sigmata, $\times 330$.

2. *Forcepia fragilis* n. sp.

a, b, styli, $\times 140$; *c*, tylotum, $\times 330$; *d, e*, two forcipes, $\times 900$ and $\times 600$; *f*, isochela arcuata, $\times 600$; *g*, sigma, $\times 330$.

3. *Microciona lacris* Bowerbank.

a, b, c, heads of style of different sizes, $\times 330$; *d*, small stylus, $\times 330$; *e*, dermal stylus, $\times 140$; *f*, head of dermal stylus, $\times 600$; *g*, toxa $\times 330$.



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II.

ON THE ATTACHMENT ORGANS OF THE COMMON
CORTICOLOUS RAMALINAE.

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PLATES II-IV.

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I.—AIM OF RESEARCH.

THE aim of the present investigation was, in the first instance, the examination of the so-called "rhizoids" of the corticolous members of the genus *Ramalina*. It is obvious that these organs are not comparable with the rhizoids of, for example, the Parmeliae, and that the work hitherto published on the subject does not explain all the phenomena connected with the development and spread of these plants. This involved a certain amount of research in the general anatomy of the species under consideration, especially as the investigator is met at the outset by fundamental disagreement or misunderstanding among the leading authorities on the subject.

In the course of the work a secondary aim, though one of more practical importance, obtruded itself, namely, an estimation of the amount of damage done by these lichens to their hosts. This amount is generally stated to be negligible, and, in the case of timber trees, probably is so. Evidence accumulated, however, to show that penetration of the host plant by lichen elements is not limited to the dead tissues of the cortex, and demanded more complete examination.

II.—HISTORY.

The earliest detailed work on the anatomy of species of *Ramalina* is that of D. J. Speerschnieder.¹ It explains the characters which distinguish the

¹ Speerschnieder. "Mikroskopisch-Anatomische Untersuchung über *Ramalina calicaris* Fr. und deren Varietäten *fraxinea*, *fastigiata*, *canaliculata* und *farinacea*" (Bot. Zeitung, 1855, p. 345).

so-called varieties of *R. calicaris*, with the exception of *R. canaliculata* recognized as species, and gives in detail the histological and physical peculiarities of the tissues concerned. Briefly, he recognizes an outer cortex, a gonidial layer and a medulla in all varieties, the relative development of cortex and medulla being in some cases characteristic: he distinguishes two opposed cortices, an upper and an under; he notes the more or less loose nature of the medullary tissue, and the fact that the gonidial layer is an interrupted one, sometimes penetrating the lichen cortex. In his detailed account of the cortex he asserts that the apical swellings of the longitudinally arranged hyphæ are disposed at right angles to the surface, being firmly laid together to form the very smooth surface of the lichen. The cortical hyphæ are described as thin tubes with fine lumen and thick walls, and as being bound together by a cement, the decomposition product of the cell walls; this is stated to be an easily soluble, structureless substance lying between the cells; no cross walls could be found.

In 1860-2 Schwendener¹ published his researches on the lichen thallus. He regards the outermost layer Speerschneider's "apical swellings," as the true cortex, strengthened internally by strands of mechanical tissue, which consists of longitudinally arranged hyphæ. He recognizes cross walls and regards the "cementing substance" as a part of the thick hyphal wall, supposing that Speerschneider mistook the lumina of the cortical cells for the complete cells and their walls. He distinguishes in all epiphloeodic lichens, whether crustaceous or foliaceous, a basal layer or disc of tissue, free from algal cells, growing within the periderm and serving for attachment and nourishment. This he names the "hypothallus," remaining in the substratum under the "protothallus." In the former term he includes rhizoids of foliose lichens, basal discs of strap lichens and gonidialess hyphal layers of crustaceous lichens.

He further states with regard to the mode of attachment, that in *Usnea* the attachment-point gives rise to rows of hyphæ which take root round projections of the bark, thus fastening the lichen to the substratum, and that these attaching hyphæ arise from the medullary tissue. In 1894 Crombie,² in his monograph, following Nylander,³ distinguishes between species of *Rosellina* having an amorphous and those having a filamentous cortex, most of the corticulous species coming under the latter heading. He describes the

¹ Schwendener. "Untersuchungen über den Flechtenthallus" (Nageli's Beiträge z. w. Botanik, 2, 4).

² Crombie, J. M. A Monograph of Lichens found in Britain. London, 1894.

³ Nylander, W. Recognitio monographica Ramularum (Bull. Soc. Linn. de Norm. 2 iv, 1868-9).

medullary layer as arachnoid, becoming sometimes very lax, and the cortical layer as composed either of indistinct cells or of longitudinal conglutinate filaments; that is, he does not distinguish cortex and mechanical strengthening tissue.

Lindau,¹ 1895, follows Schwendener closely as to anatomy and mode of attachment, but whilst condemning the general use of the term hypothallus, expands the idea. He regards it as a structure of secondary origin, the hyphae of which are able to penetrate between the periderm cells, forcing apart the cell layers, but unable to bore through the walls.

The occurrence of definite cavities and cell remnants connected with the basal disc is attributed to the chemical action of atmospheric agents, and he suggests that the hyphae are able to assimilate the decomposition products of the cellulose, which are thus rendered available as nourishment for the whole organism. He figures and explains the basal disc in *Evernia prunastri* as clearly cut off from the thallus itself by a narrow zone of brown-coloured hyphae, which is to be regarded as the outermost layer of the lichen thallus. This hyphal cylinder is open below, and the medulla of the lichen is directly connected with the hyphae of the basal disc. On this appearance he bases his view that the disc is secondary in origin, and supports it by the fact that broken-off, isolated parts of the periderm, which are surrounded by hyphal masses, move gradually outwards.

He shows, too, in *Evernia* that sucker-like outgrowths arise. A branch of the thallus may attach itself to the bark of the twig on which the plant grows, or to that of a neighbouring one. If the connexion with the mother plant is accidentally torn, an independent individual arises, the origin of which is not obvious later. He refers elsewhere to the thickly-packed, alga-containing lobes of the cortex occurring in connexion with the thallus itself, but dismisses them as non-typical in structure, mere occasional forms of attachment, having no further meaning.

Reinke² includes in his account of the comparative morphology of lichens a review of the *Ramalinae*. He refers to Schwendener's work on the anatomy of this genus, but disregards the mechanical tissue, indicating merely the presence of a thickly-woven cortex, a loose medulla, and a gonidial layer between them. Darbshire,³ in his account of the *Ramalinae* of Schleswig-

¹ Lindau, G. "Lichenologische Untersuchungen, I, Über Wachstum und Anheftungsweise der Rindenflechten." Dresden, 1895.

² J. Reinke. "Abhandlungen über Flechten" IV (Pringsheim's Jahrbücher f. w. Botanik 28, 1895).

³ O. V. Darbshire. "Einer Abhandlung über die Naturgeschichte der Einheimischen Flechten," with R. v. Fischer Benzon's Die Flechten Schleswig-Holstein. Kiel, 1901.

Holstein, distinguishes merely cortex, gonidial layer, and medullary tissue; he describes and figures the ruptures of the cortex of *R. fraxinea*, where the medullary tissue comes to the surface, and names them "Atemporen," i.e. breathing pores: he further regards the attaching organs as the portion first formed.

In 1901, also, Bitter,¹ in his account of the variability of some foliose lichens, describes *R. obtusata* Arn. as having two opposed cortices, scattered groups of gonidia, and a loose mesh of medullary tissue. He observes the effect of light on the cortices as producing gaps in the cortical tissue on the under surface, but rarely on the upper. He cites similar occurrences in *R. dilacerata* Hoffm., and in *R. minuscula*, a rare British species; he refers to gaps in *R. fraxinea* as piercing the thallus. He further points out in reference to Lindau's account of the sucker-like reproduction of *Eccernia prunastri*, that in the allied but prostrate species *E. furfuracea*, the method is common. Brandt,² in 1906, investigated the anatomy of many species of *Ramalina*. He discusses previous work, dismissing that of Speerschneider as primitive in method, and regarding all failures to distinguish between cortex and mechanical tissue as regrettable oversights. He explains that his material is dried and treated with potash to dissolve out the usnic acid between the hyphae, neutralized with acetic acid, and finally stained with alcoholic solution of iodine. By these means he finds pseudoparenchymatic tissue in the mechanical strands, consisting of more or less isolated hyphae enclosed in dark walls—an appearance which will be discussed later. He also regards the tissue of the basal disc as secondary in origin, but does not give details of its structure nor of his reasons for the view. His account of the varying proportions of cortical and other tissues present in the different species, in the light of Bitter's work on the effect of external influences, may possibly be unnecessarily detailed, the differences being physiological rather than specific. Zahlbrückner³ also follows Schwendener in distinguishing an inner cortex of mechanical tissue in which the hyphae run more or less longitudinally, and a true cortex in which they are more or less at right angles to the longitudinal axis; he regards the inner cortex as frequently cut into supporting "pillars" by out-growths of the medullary tissue towards the surface.

Fünfstück,⁴ in his general account of lichens, refers to the thickly-woven

¹ Pringsheim, 36. 1901.

² Brandt, Th. Beiträge zur anatomische Kenntnis der Flechtengattung *Ramalina* (*Hedwigia*, 45. 1906).

³ Zahlbrückner. Engler and Prantl's *Natürlichen Pflanzenfamilien—Flechten Teil I*, p. 220.

⁴ Fünfstück. Engler and Prantl's *Natürlichen Pflanzenfamilien—Flechten Teil I*, p. 20.

strands of the *Ramalinae* as possessing only a slight capacity for water conduction. He further states the view generally held that rhizoids of corticolous lichens never reach the living tissues.

III.—MATERIAL AND METHODS USED.

The species of *Ramalina* used in this investigation were the commoner corticolous ones—*R. calicaris*, *fraxinea*, *farinacea*, *fastigiata*, (*populina*), and *pollinaria*, i.e. the closely allied species of the section *Euramalinae* Stizbg. and the sub-section *Compressiusculae* Wainio, characterized by the flattening or bilaterality of the thallus segments. All the above species agree in being more or less longitudinally striato-nerved, and possessing a filamentous cortical layer (Crombie); the medulla gives no reaction on treatment with potash.

R. calicaris and *fraxinea* do not give rise to soredia, and the latter is distinguished by its broader, flatter thallus, largely rugose receptacle of the apothecia, and its curved spores.

R. fastigiata is distinguished, especially from young states of *R. fraxinea*, by its more caespitose habit and its numerous apothecia, which are peltatosessile rather than distinctly stalked; its spores are curved.

R. farinacea is typically more or less covered with whitish, round or oval soredia, especially towards the tips of the laciniae, the bases being frequently smooth; its apothecia are rare.

R. pollinaria differs from *R. farinacea* in that the laciniae of the latter are stiff; those of the former tend to be flaccid and inflated. Its soredia are white, farinose, and scattered; its apothecia are rare.

The morphology of the above species was studied in the fresh condition, abnormal and sub-specific forms being discarded.

Comparisons were made with the collections in the Herbaria of the University of Manchester and of University College, Cork, by kind permission of the curators, Miss G. Wigglesworth and Miss B. E. Duke, and at Bangor with the collection of Mr. Griffith,¹ to whom my thanks are due.

The anatomical investigations were carried out as far as possible on the fresh material, comparisons being made with the dried material, preserved material and specimens treated with various reagents.

Throughout the observations recorded potash was used with caution, as its clarifying properties are neutralized to a great extent by its action on the walls of the hyphae, and especially by the swelling it causes in the walls of the periderm.

¹ Griffith, J. Flora of Anglesey and Carnarvonshire, Bangor.

When reagents were used with hand sections the method of Lindau was adopted, *ie.* treatment with alcohol to drive out air, transference to chloral hydrate, and finally, after preliminary examination, treatment with chlor-zinc-iod or iodine solution; this method results in a limited and uniform swelling of the section.

For microtome sections the thallus, with a squared block of the stem or twig to which it was attached, was fixed in alcohol, and then transferred slowly from pure alcohol to pure xylol (25 per cent. alcohol, 50 per cent., 100 per cent.; 5 per cent. xylol, 10, 25, 50, 70, 100 per cent.).

Penetration of the tissues by paraffin wax dissolved in xylol is a slow process which cannot safely be hastened in any way, since the tissue of the periderm tends to burst, making complete sections impossible, and creating artificial lacunae.

For differentiating stains chlor-zinc-iodine was used; it gave better effects when used after potash. Fuchsin gave good results when varying thicknesses of cork cell walls were to be examined, or to show up the path of a hypha between the walls. In cases where hyphae apparently passed through a cork cell wall the illusion is best dispelled by use of Hoffmann's Blue.

IV.—DESCRIPTION.

1. *General anatomy of the thallus.*

Fig. 1 represents a longitudinal section of the thallus of *R. farinacea*, illustrating the closely packed longitudinal hyphae of the general cortical tissue (c); they turn outwards to the surface at their apices, but hardly at right angles to the axis: the general effect may, however, be roughly stated as "more or less at right angles." Further, the assemblage of these apices is, in the specimen depicted, scarcely sufficiently developed in comparison with the rest of the cortex to justify its being regarded as a tissue *sui generis*. In specimens obtained from more exposed localities a broader expanse of apices does undoubtedly occur, but is correlated with a greater width of longitudinally arranged tissue; a similar correlation is observable in the lighted and unlighted surfaces of the thallus of *R. farinosa*. This contrast between the cortices of the two surfaces is not so marked in thalli of *R. farinacea*, since in that species there is greater tendency to cylindrical development of the laciniae.

In the figure we have an example of the emergence of the gonidial (g) and medullary (m) tissues at the surface, but whether the phenomenon is connected with the development of soredial structure or an "atemporal" is irrelevant to the present investigation.

The grouping of the apices of the hyphae into lobes or bundles should be noted, as it is apparently continued for a short distance into the general cortex.

Fig. 2 is a cross section taken near the base of a bushy specimen of *R. farinacea* just above the surface of the periderm of Oak. The white patches (*c*) are pillars and convolutions of cortical tissue, i.e. longitudinal hyphae. The dark internal portions consist of loosely-woven medullary tissue, edged here and there with a few gonidia. Externally and between the lobes are masses and layers of varying character, in places distinctly soredial or even gonidial, but as a rule indefinable. The figure resembles Brandt's figures of *R. Curnowii*.¹ Whether each hyphal mass is continuous with one lacinia would be hard to decide, but they are frequently separate and continuous for some distance into the periderm.

Fig. 3 represents a portion of the transverse section of the thallus of *R. farinacea*, showing the more or less horizontal direction of the apices (*a*); the cut ends of the vertical hyphae, interspersed with other hyphae running in various directions; and, internally, the gonidial and medullary tissues.

2. *Attachment of the lichen, and anatomy of the hypothallus.*

In fig. 4 we have the longitudinal section of *R. farinacea* on Hawthorn. This is very similar to the figures given by Lindau representing the attachment of strap and fruticulose lichens to their hosts. We have here the apparently sudden end of the portion of the thallus above the periderm (*p*), whereas the hypothallus or basal disc consists of hyphae or hyphal masses scattered among the periderm layers. Here, too, may be seen the wedge-like, disintegrating action of these hyphae on the cork cells.

Figs. 5, 6, 7, and 8 represent the paths of hyphae between the cells and across the gaps in the periderm tissue. 5, 6, and 7 are portions of *R. farinacea* on Hawthorn, 8 is from a transverse section of *R. calicaris* on Sycamore, showing the spread of hyphae outwards from the basal disc.

In all these sections 4-8 the attaching hyphae appear inconsiderable in bulk and power compared with the thallus to be supported, and with the size of the gaps in the periderm. In some cases the latter discrepancy is due to the growth of the periderm after penetration by the hyphae. But in all these sections the two points of interest are the bridging of gaps by single hyphae and the close adherence of the hyphae elsewhere to the walls of the periderm cells, such cells frequently presenting a crushed or collapsed appearance.

¹ Brandt, *loc. cit.*, p. 152, and Plate VI, figs. 1 and 2.

In the next series of figures we have the explanation of the apparent discrepancy between the size of the basal disc and that of the thallus which depends on it for resistance to wind action.

In fig. 9, a longitudinal section of *R. calicaris* on Sycamore, we have a well-developed specimen of many years' growth. It has one definite main "hapteron" (*h*), consisting of longitudinally arranged, intertwined hyphae continuous with the similar cortical hyphae (*c*) rather than with the loose tissue of the medulla (*m*) which here ends above the level of the basal disc. From the main hapteron arise lateral branches of hyphal tissue penetrating the periderm in all directions.

In sections of older thalli, fig. 10, the medullary tissue extends a short distance below the surface of the periderm, and is seen to merge gradually into the more compact cortical tissue. Possibly its appearance below the surface level of the periderm is due to the growth of the latter round the base of the thallus proper.

In fig. 11 of *R. farinacea* on Oak we have a branched system of haptera with islands of periderm tissue and cell-remnants scattered among the hyphae. The layers of cork cells are obviously crushed and distorted. The lichen thallus above the periderm gradually merges into a layer of algal cells, fungal hyphae, bark debris, &c., which spreads for some distance over the surface of the stem.

In fig. 12 this layer (*h*) is especially well developed. Figs. 12 and 13 are two of a series of transverse sections taken between a young specimen of *R. calicaris* and its parent plant, 3 cm. distant on a twig of *Prunus spinosa*. It will be seen in fig. 12 that though a well-formed hapteron occurs in the outer layers of the periderm (*p*), the gaps containing smaller hyphal masses are most frequent towards the bast (*b*) and cambium (*k*), even affecting the wood (*w*).

In fig. 14 we have an example of the spread of a young Ramalina in the spine of a Hawthorn. Considering the hard, smooth surface of such a spine, it is clearly probable that the younger plants arose from hyphal masses within the periderm, rather than from spores or soredial developments on the surface.

3. *Action of the lichens on the host plant.*

In fig. 15 representing a young *R. farinacea* on Alder, the centre of the twig is completely decomposed, and the outer part below the lichen shows signs of decay. In 16 and 17 we have sections of the edge of the hollow nearest the lichen, showing the state of the affected tissue and the extension of branched and separate hyphae into the open space. It was not found possible to trace any

hypha or mass of hyphæ directly from the lichen to the centre, and the possibility remains that the hyphæ figured belong to some species of parasitic fungus; but, on the other hand, the section represents a state of affairs too frequent to be the result of the chance co-operation of two sets of mycelia.

Fig. 18 represents hypertrophy of the periderm and erosion of the wood. Here the host is Alder, and the lichen probably *R. pollinaria*, as well-developed plants of this species were frequent on this and neighbouring twigs. Not only does the typical periderm tissue develop as a cushion round the base of the lichen, but, besides the hyphal masses penetrating the external tissues, we have tongues of tissue consisting of polygonal, pitted cells (T), apparently eating their way into the otherwise normal wood (*w*), as in fig. 19.

Fig. 20 gives in detail the character of these ingrowths.

V.—DISCUSSION OF RESULTS.

With regard to the structure of the cortex of these lichens, the figures obtained hardly seem to justify the distinction between cortex and mechanical tissue. For convenience the terms inner and outer cortex might be retained, with the reservation that the one is a mere continuation, with more or less change of direction, of the other. The swollen appearance of the apices described by Speerschneider is probably due to his use of caustic potash, since other less violent clearing agents, such as chloral hydrate, do not produce this effect. The pseudoparenchyma described by Brandt has been alluded to, and may certainly be more or less satisfactorily obtained by his method. If, however, fig. 3 be examined closely, it will be noted that the cortex consists of hyphæ cut in all directions, the majority transverse. On treatment with potash these last appear as isolated cell sections, whilst the interwoven hyphæ form more or less complete enclosures round them. On addition of acetic acid this appearance becomes still more sharply defined, and on staining with alcoholic iodine the hyphæ become coloured so that the contents of the cell sections show up clearly, and the interwoven hyphæ apparently form cell-walls around them.

In the intraperidermal extensions of the cortical cells it is almost impossible to induce this parenchymatic appearance, and this may be attributed to the fact that here the hyphæ are more rarely interwoven, the main direction being longitudinal.

With regard to the action of potash as a clearing agent, it should be remembered that this alkali is a solvent of usneic acid, which is apparently the most common of lichen acids. In the case of *R. thrausta* it occurs as minute crystals in the cortex, giving to that tissue its yellowish-green colour,

though only present to the extent of ·3 per cent. as shown by Zopf.¹ In the case of *R. farinacea* it is present to the extent of ·25 per cent., in *R. pollinaria* ·16 per cent.; but undoubtedly of the three species, *R. farinacea* is normally the lightest in colour, apart from the whitish, farinaceous appearance given by its soredia. Further, if the acid be present in crystalline form it can hardly appear as a structureless cement between the hyphae. Its presence is commonly regarded as substantiated if the addition of caustic potash gives a yellow colouration, but this generalization should be regarded with suspicion, as a similar colour is given with potash by ramalic acid in *R. pollinaria*, by cetraric acid in species of *Cetraria* and *Cladonia*, and probably by others. Again, it should be noted that these acids are obtained and investigated after extraction from dried and crumbled lichens by means of hot ether (Zopf)¹ or milk of lime (Stenhouse, Hesse),² and cannot therefore be regarded with any certainty as occurring naturally in the forms described, except in the few rare cases exemplified by *R. thrausta*.

The excreted substances, acting as cements, are therefore probably of the nature of lichenin, the gum-like substance occurring in *Cetraria islandica*, the Iceland Moss; they become mucilaginous and semi-transparent in water, as noted by Speerschneider, but are hydrolyzed readily with acids, and in some cases with alkalis, forming in some cases sugars, e.g. glucose from the extract from *Evernia prunastri*, mannite from *Xanthoria parietina*.

This gummy character would account for the adhesion of the hyphae to the cell-walls of a gap in periderm tissue, enabling them to absorb the decomposition products of the cellulose, according to Lindau's theory (*Untersuchungen*, I, p. 57).

In this case the basal disc must be regarded as an organ of nourishment as well as of attachment, an important conclusion, involving the partial independence of the fungal hyphae of their algal companions and emphasizing the symbiotic, rather than the parasitic, nature of the combination (*Fünfstück*, p. 15).

With regard to the attachment organs themselves, three points distinguish those of the *Ramalinae* investigated from those of *Usnea* and *Evernia* as described by Schwendener and Lindau. In the first place there is no limiting zone, the tissues of the thallus above and below the surface of the periderm being continuous. In the second, this tissue is cortical, consisting of thickly-woven strands which only become loose masses at their apices

¹ Zopf, W. Zur Kenntnis der Flechtenstoffe vii. *Annalen der Chemie*, 313, 227, and 300.

² Hesse, O. Über einige Flechtenstoffe. *Annalen der Chemie*, 284.

or periphery. In no case has the medullary tissue been traced into the peridermal gaps.

Finally, in the *Ramalinae* there is a definite "hapteral system"—the term is used tentatively—consisting of one or more main haptera piercing the periderm, with lateral branches in all directions. The whole system resembles the "cortex roots" and suckers of *Viscum album*, the Mistletoe, but has not their parasitic function to such a marked degree.

The periderm tissue bordering the main and lateral haptera is crushed into confused, dark-coloured layers, and fragments of cells lie scattered among the hyphae. The lateral haptera taper to a point which is lost among the periderm cells, apparently dwindling into small bundles of hyphae which are capable of changing their direction of growth, and of branching and increasing in diameter. They exert a wedge-like action on the cork layers, as described by Lindau.

The question therefore arises as to whether the bushy masses in which the *Ramalinae* often occur are the result of direct development of spores or of soredia, or of "runners" from a parent plant; and further, in the last case, whether the effective runners are superficial or intraperidermal.

In this connexion it is interesting to note the view of Bornet,¹ that the algae of hypophloeodic lichens are already present when the fungus begins to immigrate, and the opposed view of Frank,² that from a germinating spore a protothallus grows into the periderm and only later is colonized by immigrating algae. The sucker-like outgrowths of *Evernia prunastri* as described by Lindau have been mentioned above. This method of reproduction is undoubtedly very common with the *Ramalinac*, but probably not so much so as that of the stolon-like forms.

Assuming that the plant reaches its host from the outside, the bundles of hyphae grow out and penetrate between the periderm cells. The best points of entrance are where a crack in the bark leads to a weak place in the tissue, or a lenticel. Here, too, is a sufficient supply of water or moisture for the growth of the hyphae; consequently the hyphal bundle increases in length and diameter, and crushes aside the dead cells of the bark.

The surface of these hyphal bundles being somewhat of the same character as that of the lichen cortex, the lateral haptera are formed by the intrusion of one or more hyphae between the horizontal layers of periderm, the exact

¹ Bornet, E. Recherches sur les gonidies des Lichens. Ann. des Sc. Nat., 5 sér. Bot. 1873, xvii, p. 45.

² Frank, A. B. Über die biologischen Verhältnisse des Thallus einiger Krustenflechten. Cohn's Beitr. 1877, ii, p. 123.

stratification of which facilitates the splitting process. This power of the hyphal tissue has been demonstrated by Lindau in his account of the development of suckers. "The events which lead to the attachment of the thallus are as follows:—Out of the superficial layer spring hyphae in thick bundles of parallel threads which reach to the surface of the substratum, and here by any crack leading into the loose tissue of the upper periderm layers act exactly as the hyphae of the basal disc. . . ."

Such a system, especially when composed of numerous haptera, is capable of keeping pace with the development of the bark, and the thallus need not be torn off by wind action when the outer periderm is quite dead. Probably therefore the theories of Bornet¹ and Frank² are not mutually exclusive, Bornet's theory being supported by the reproduction of *Ramalinae* by the sucker and stolon methods. *Protococcus* cells are very frequent on the surfaces affected, and in two examples, one of *R. Farinacea* and one of *Xanthoria parietina*, were found in the periderm some distance below the surface, apparently unconnected with any hyphae or hyphal mass. No clear case has yet, however, arisen to prove conclusively that a young plant is directly or solely connected with the parent plant by means of an intraperidermal hyphal strand. In most cases the evidence consists of the existence of such strands running more or less horizontally along the twig, a state of affairs comparable with the "Flechtenmycel" of Zukal, which he defines (*ex* Funfstück, p. 8) as "hyphal complex usually arising from an old lichen thallus, which often permeates the substratum for a foot's length, and gives rise at single points to new thallus formations, e.g., in *Peltidea venosa*, *Solorina sarcata*, *Diploschistes serapiosus*, *Xanthoria parietina*, *Cladonia macilenta*, &c."

The surface of a twig is frequently covered by a more or less continuous gonidial layer which is too uniform to be considered as soredial in character, though possibly fragments rounded off in times of drought may act as soredia, or under other adverse circumstances may produce the familiar *Lepraria* forms. There is, as yet, no evidence, in the case of *Ramalina*, of direct vertical connection between this superficial layer and the intraperidermal hyphal strands, except where a plant-outgrowth occurs. The conjunction of these strands, at a favourable crack or lenticel, may be the determining condition for the development of a new plant. Again, *Xanthoria* supplies suggestive evidence. A specimen growing on a twig of Hawthorn with

¹ Bornet, E. Recherches sur les gomdies des Lichens. Ann. des Sc. Nat., 5 sér. Bot. 1873, xvii, p. 45.

² Frank, A. B. "Über die biologischen Verhältnisse des Thallus einiger Krustenflechten Cohn's Beiter," 1877, ii, p. 123.

four annual rings had for length of lobe from centre .25 inches, and at a distance of .37 inches a small specimen of the same species occurred on a branch showing three annual rings, the intervening surface being covered by a thin layer of gonidia containing hyphal tissue and the periderm being traversed horizontally by hyphae. On the other hand, this superficial layer has been seen in connexion with *Xanthoria*, covering a lenticel without sending downward growths into it.

Injurious Effect of Lichen Growth on Trees.

Though it is usually asserted that lichen growth does not to any great extent injure trees from the point of view of the forester, there is no doubt that it is regarded unfavourably by the arboriculturist, and in particular, the fruit grower. Even the forester may admit that boughs broken off in a storm are often covered by a luxuriant growth of lichens, but there is no direct evidence that such growth renders boughs more liable to damage by wind.

The indirect evidence on which Lindau bases his assertion that the effect of the hyphae is directly injurious may be summarized as follows:—

1. They block the lenticels.
2. Packing tissue of lenticels disappears.
3. Cork layers are torn apart horizontally.
4. Apart from lenticels, vertical cracks are forced open.
5. Cell walls are frequently torn across, especially in Oaks.
6. Atmospheric decomposition of the cell walls causes decrease in thickness of cork cell walls from within outwards, thus rendering the cork less impermeable.

In fig. 12 we have evidence of more definitely harmful action, as here the hyphae occur in periderm, bast, cambium, and even the youngest cells of the wood. That, in this case, the hyphae are not those of a parasitic fungus is proved by the fact that they did not occur in these positions except between the young plant and its supposed parent. A parasite could hardly be limited to this short distance.

This is, as yet, the most striking case observed in which the hyphae were found inside the periderm, and occurs in *Prunus spinosa*, the Sloe, a shrub of very leisurely growth. Hartig¹ remarks that "the slower the growth of a

¹ Hartig, R. *Diseases of Trees*: Trans. Somerville and Marshall Ward, London, 1894, p. 55.

tree the more slowly do the outer cortical layers die, and so much the more suitable are the conditions for the growth of lichens." He compares the absence of lichens on Beeches grown under favourable conditions, i.e., on calcareous soil, with their abundance on the slow-growing Beeches of sandy soils.

Lindau in his section on lichens, in his edition of Sorauer's *Plant Diseases*,¹ states that it is impossible for the hyphae to penetrate within the periderm tissues except possibly by means of cracks or fissures already present. He had not observed any cases of the presence of hyphae in living tissues in his researches on a list of species which includes those of *Ramalina*. He appears, however, to have used as material chiefly the larger species of tree for his researches on fruticulose lichens. Further evidence must, however, be sought before his conclusion can be disproved, founded as it is on many investigations and much knowledge of lichen-growth.

There is, however, this further consideration. He differentiates between the harmful actions of lichens on fruit and on forest trees. In the former case he points out that the lichen holds water, and so keeps the bark moist, hastening its decomposition, and at the same time offering itself as a shelter to noxious insects. In the latter he considers that wealth of lichen-growth indicates unfavourable conditions, dampness of situation, exclusion of light, poor soil; and that these are the causes of the death of such trees rather than the lichens themselves. On the other hand, if conditions are so bad that the rate of annual apical growth is reduced to a minimum, the lichen may cover the tips of the branches and cause suffocation. The remedy is here obviously to allow the entrance of light and wind. In the case of forests on a large scale these statements hold, but for the small scattered woodlands of the British Isles it is more frequently found that the maximum lichen-growth is on the side of the wood, and of the trees in the wood, which is exposed to the prevailing wind, i.e., the moisture-laden south-west. The light factor is here not of such great importance as it would be in a wood of great extent. Judging, indeed, from the luxuriant growth of lichens on the exposed sides of stunted Oak, Birch, Hawthorn, and Sloe around our coasts and on the highest wooded portions of our mountains, it would seem that moisture and slow growth of the host were the important factors. The presence of salt in the moisture is apparently not harmful to the lichens, though wind-blown sand is undoubtedly so, the action probably being a purely physical one.

¹ Sorauer, P. *Handbuch der Pflanzenkrankheiten* ii, 1908, p. 484.

The remedies for lichen-growth on fruit trees may be summarized as follows:—

1. Scraping off the outer bark scales and painting with lime-wash.
2. Spraying with Bordeaux mixture.
3. Spraying with 5 per cent. soda solution to which 3 to 4 per cent. carbolic acid has been added. If the percentage of acid is increased, the spraying must be done in winter or the buds will be injured, though the increase has the merit of removing scale and other insects.

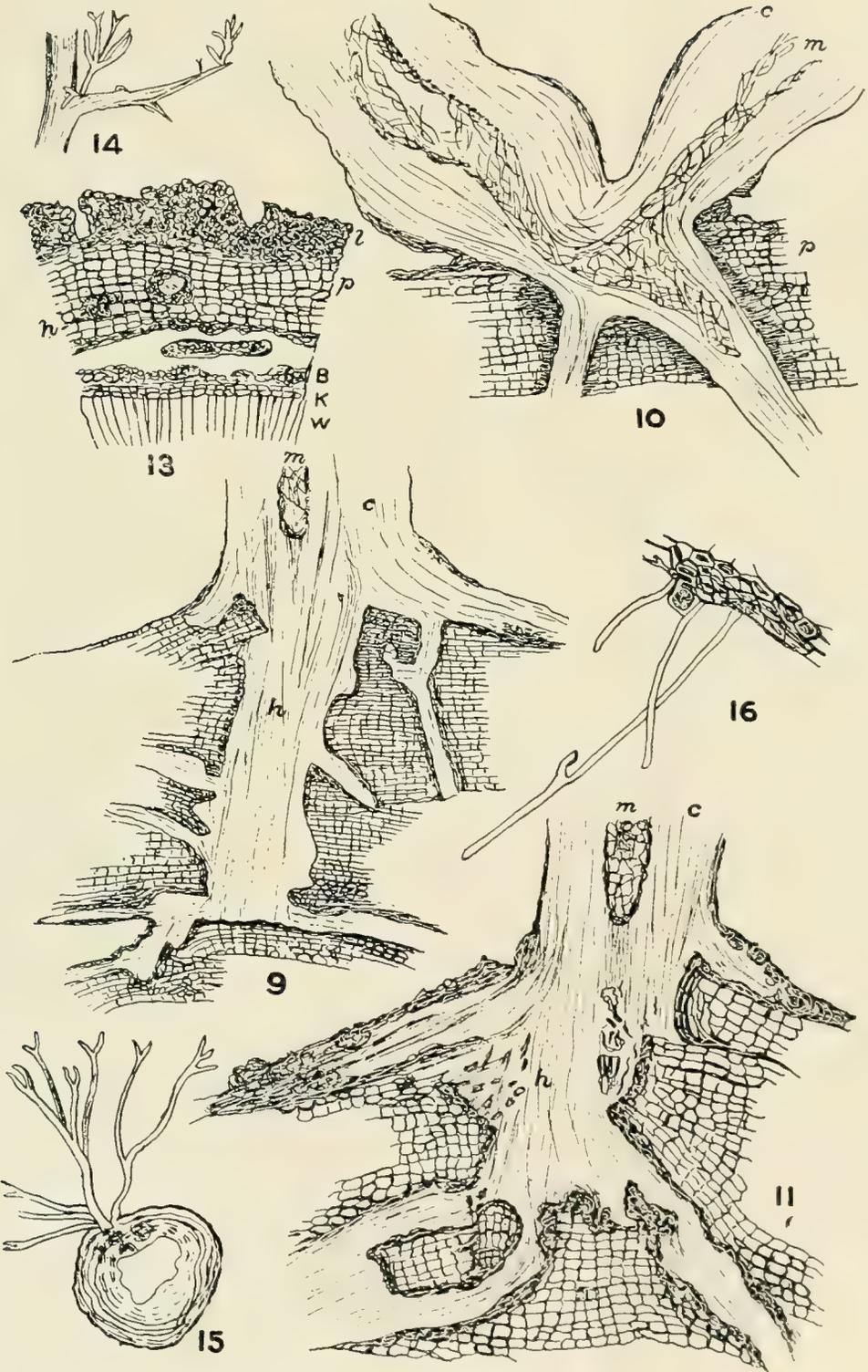
VI.—SUMMARY OF CONCLUSIONS.

1. The thallus of the *Ramalinae* consists of cortex, gonidial layer, and medulla.
2. The cortex consists of longitudinally arranged hyphae whose apices turn outwards to the surface.
3. Differentiation of the inner and outer cortices, and pseudoparenchymatic appearance of the former may be produced by suitable reagents.
4. The attachment organs are strands of closely woven hyphae, longitudinally arranged, and continuous with the cortical tissue.
5. They penetrate the periderm by cracks or lenticels, and by wedge-action cause extensive splitting.
6. They give rise to branches in all directions.
7. From these horizontal branches, or from the superficial soredial layer, or from both acting in conjunction, arise new plants.
8. These organs may penetrate the living tissues as far as the new wood, causing direct injury to the tree.
9. They also cause hypertrophy of the peridermal tissue, and erosion of the wood by ingrowths of hypertrophied tissue.

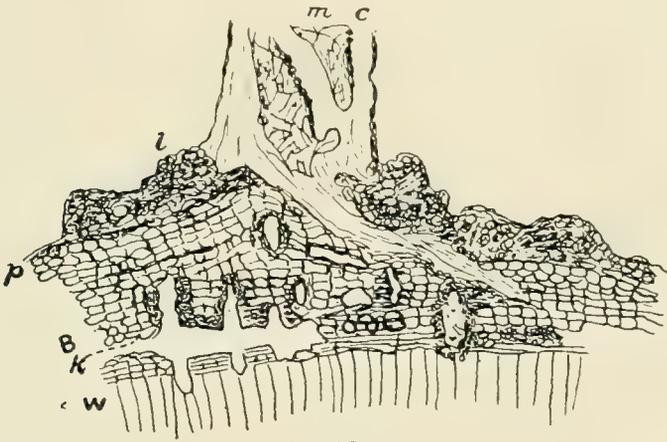
In conclusion, the author's thanks are due to Dr. O. V. Darbishire, of Bristol University, for proposing the subject under consideration, and for the loan of otherwise inaccessible literature; to Professor R. W. Phillips, of the University College of North Wales, Bangor, for advice and encouragement in the practical investigations; and to Professor M. Hartog, of University College, Cork, for criticisms and suggestions as to the arrangement of the work.

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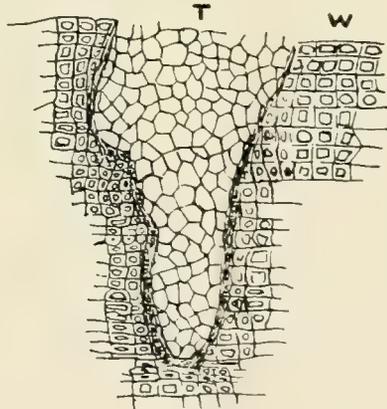
PORTER.—ATTACHMENT ORGANS OF RAMALINAE.



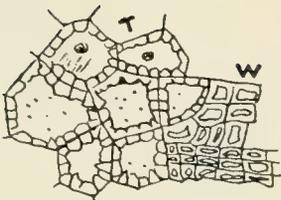
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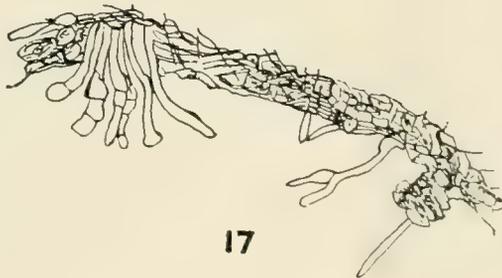
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III.

THE EXPLORATION OF CASTLEPOOK CAVE, COUNTY CORK,

Being the Third Report from the Committee appointed to Explore
Irish Caves.

BY R. F. SCHARFF, B.Sc., Ph.D.; PROFESSOR H. J. SEYMOUR,
B.A., B.Sc., F.G.S.; AND E. T. NEWTON, F.R.S.

PLATES V.-VII.

[Read JUNE 25, 1917. Published JANUARY 9, 1918.]

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1.—INTRODUCTION.

IN our second report¹ some of the caves of Co. Clare, and their contents, were described. The present report deals with a cave considerably further south, namely, in Co. Cork. Situated about two and a-half miles north of Doneraile, in the townland of Castlepook South, it is easily accessible from an old quarry by a low tunnel. Mr. Ussher's attention was first drawn to it by Lord Castletown, on whose estate the cave is situated, and who afforded Mr. Ussher every facility for its exploration. Mr. Ussher at once recognized that this investigation was likely to yield valuable results; and having had full charge of similar operations in previous years, he commenced the excavation of Castlepook cave on the 1st September, 1904.² Unfortunately,

¹ "The Exploration of the Caves of County Clare." Trans. R. I. Acad., vol. xxxiii, Sect. B, pt. 1. 1906.

² A short description was read before the British Association meeting in Dublin, and published in the Report of the Association of 1908.

he is no longer with us, and it is sad to think that this report has to be issued without bearing the name of the one who bestowed such painstaking and valuable work on the undertaking. It is now four years since we have had to mourn Mr. Ussher's death, and I may safely state that it will be impossible to find anyone to devote more care and industry to work of that nature. Cave exploration was with him a labour of love; and, in spite of his advancing years, he willingly exposed himself to the greatest hardships, and even dangers, in order to gain the knowledge which was procured by his unremitting activity.

The Committee are much indebted to Professor H. J. Seymour, of University College, Dublin, for his valuable services in connexion with this exploration. Mr. E. T. Newton kindly undertook to name the bones of birds obtained in the cave, while Mr. Hinton placed his special knowledge of the rodents at my disposal, and was most helpful in determining the lemming remains. To all these gentlemen the Committee wish to express their thanks. No less than 343 parcels of bones were sent to Dublin from the cave. As each of these contained on an average about 100 specimens, which had all to be sorted, cleaned, and catalogued, this alone entailed much labour. Of these 34,000 bones, only the small fraction of five or six thousand could be accurately named. By far the greater number were too fragmentary for determination. The entire collection of animal remains and rocks procured during the cave exploration has been deposited in the National Museum of Ireland. I have to acknowledge the valuable help given by Dr. Smith Woodward and Dr. Andrews during my examination of some of the cave bones at the British Museum.

The present entrance to Castlepeak cave is situated about 300 feet above sea level (Plate VI). It is close to the road in a disused quarry, and not far from a stream that falls into the Brogoge. The stream flows southward from the mountains, and carries with it the sandstone detritus, filling all the river valleys of the district. To the north and west of the cave is a marshy flat, probably the bed of a former lake, and this is flooded at times by the Castlepeak stream. A series of low crags here extends in east-westward direction, and in partially quarrying the stone away for building purposes one of the former entrances to the cave was thus laid bare. Mr. Ussher refers to others, but these are blocked by detritus near their orifices. Some of these may at times have been used as stables for cattle. Before Mr. Ussher explored the cave it had apparently been entered within recent years, and

¹ I retain the original name as given above rather than that of "Mammoth Cave," a term more recently applied to this cave by Mr. Ussher.

most of the halls and galleries could have been examined by anyone possessing the requisite courage and tenacity. Some of them could not have been visited by man before Mr. Ussher made them accessible by excavation. He penetrated into the cave to the distance from the entrance of about 400 feet, but the portion he explored may only be a small fraction of the whole. By removing the earthfalls and rocks now obstructing many of the passages new galleries may be discovered. It is doubtful whether the cave ever was suitable for human occupation. The early inhabitants of Ireland frequently lived in caves, but they selected such that were dry enough in winter; and they never penetrated very deeply into the recesses of a cave, but lived in close proximity to the entrance, where they still had the advantage of a certain amount of daylight.

Mr. Ussher noticed that sand was present in all the halls and galleries (except where it has been washed away), and that the great harvest of animal remains occurred whenever it was found to be of a deep red or yellowish-brown colour. Bones were frequently met with on or near the surface of a bed of sand. Where a stalagmite floor had been formed on this bed of sand, and the sand beneath it had been washed away, bones were sometimes seen adhering to the bottom of the stalagmite. In other places the upper sand was rich in bones, the lower barren.

The following is a short description of the cave, written by Mr. Ussher and sent to me a couple of years before his death:—

“The ENTRANCE GALLERY (Plate VII, 1 to 2) is one of a series of orifices in the base of the crags. Four of them are open caves, which run into the rock from north to south, and each of them exhibits the features of tunnel and shelf. We excavated one of these, the Goat-house, and found a stalagmite floor which had been undermined by the washing away of the bed on which it had stood; and a loose, pale, barren sand, with cobbles of sandstone in it, had been intruded into the hollow thus formed.

In the Entrance Gallery we found sandstone cobbles in limestone rubble on the surface, and beneath them a thick floor of granular stalagmite about three feet below the shelf, with a Bear's humerus embedded in it beneath, and under this a washed-out hollow into which pale, barren sand had entered.

In sinking a hole for the door frame, near 2, some bones of Bear and Reindeer turned up; but in the Entrance Hall (2) and Cloak-room leading east from it was deep, barren sand, only yielding fox-earth bones. This Cloak-room ends in an earthfall probably covering another entrance. We follow a diagonal passage to 3; all these have traces of the shelf, but no stalagmite *in situ*.

Before coming to 3 we cross the line of the Little Narrow Gallery, which affords a beautiful example of the swelling tunnel above the deep trench, and of the undermined walls of the latter hollowed away beneath. The line of this gallery crosses the Hyæna Hall, and one side of its tunnel and shelf may be seen in the south part of the latter. It is then interrupted by a break-up of the roof, but is continued in the deep gallery called the Abyss.

The HYÆNA HALL (3A to 4 and 5), so called because the jaws of the Hyæna were found here first, but not to be confounded with Hyæna Land. This hall is over 40 feet \times 30 feet, and is formed of seven parallel galleries, the north ends of which may be seen in their vaultings; but their dividing partitions have collapsed, and these, together with fallen roof-blocks, formed a pile filling the body of the hall in 1904, when we began. The rock-wall, now removed, that flanked the continuation southward of the Narrow Gallery, traversed the hall: but, though standing, it was separated by an open crack from the roof, and had been undermined, as it stood on sand beneath. As we enter the Hyæna Hall the pendent portions of partitions on the left show the same course of events.

Portion of a deep, narrow partition between the two eastern galleries still stands, being propped by a block. The pale sand that filled the deep trenches at each side of it was particularly rich in bones of Bear and Reindeer. This hall was rich in animal remains. The masses of blocks at its northern end were covered with a lower stalagmite floor, resting in places on sand, but having fallen in where the latter was washed away. Under this stalagmite covering, and sometimes adhering to it beneath, were numerous bones and teeth.

The part near the passage that leads to the Elephant Hall (5) had also a lower stalagmite floor: and partly in this, partly in rubble, were several pieces of a Mammoth's skeleton, the long bones wanting their extremities, as though these had been gnawed away, and a Hyæna's jaw was found near them.

In the hollow of one of these large bones was a tooth of a young Mammoth. It was noticed that the bones found in the rubble were coated with hardened mud, and this was observed in many parts of the cave-system where bones were in rubble. This suggests that bones and limestone fragments had been contained in a bed of sand that was drained away by waters that bore a muddy deposit which covered the bones.

At the north-east corner of the Hyæna Hall the irregular Sand Gallery, on a lower level, is plainly one of those water-courses that at a later time worked their way athwart the north and south system of galleries. It has quantities of loose, pale sand; but, with the exception of a few bits of ancient

bones (probably drifted out of the higher sand-beds), it only contained fox-earth bones.

Huge earthfalls, intrusions from roof-fissures, occupy some of the west and nearly the whole of the south side of the hall. In removing some of the latter we found dark, wet earth, lumps of charcoal, and teeth of horse and ox—all foreign to the cave. The passage (5 to 5A) that leads from the Hyæna Hall to the Elephant Hall has the upper stalagmite sheet very close to the roof. It had also a lower stalagmite floor of later formation.

The ELEPHANT HALL (5A, 6A, 6, 11), so called from the shoulder-blade of a Mammoth, the first bone of that animal found by us. This hall is divided into three portions by walls or masses of rock that formerly divided separate galleries. The principal of these, which starts from the eastern division, is the Long Gallery, which extends some 120 feet, and is the finest in the cave. Another short, descending gallery leads from an alcove in the east wall of the hall, and after a turn, made by a cross-gallery, opens into the abyss. The eastern wall of the Elephant Hall is undermined, and seems unaccountably supported, as a large crack separates it from the roof, similar to what we noticed in the Hyæna Hall. Running north from the above alcove is a very small gallery, in which we discovered a skull of Mammoth in sand and rubble that partially filled it, and in a cavity communicating with this was the hip-bone. Other bones were in the neighbouring lower stalagmite, which floored much of this and the next division of the hall, and rested on a bed of dark sand. This sand contained broken masses of older stalagmite, with skulls of Bear and Reindeer. About a foot under it was buried another stalagmite floor, which, though broken, seemed to be *in situ*. Under this again was a paler sand. We encountered a huge mass of limestone covered with the former stalagmite that contained Mammoth's bones. This mass may have been the eastern wall of the Long Gallery, which had fallen down before the bones were deposited, as a rib of the Elephant was embedded on top of it. All that remains of the Long Gallery here, before we come to the fallen rock called the Tortoise (6), is the apex in the roof and the deep trench which is cut in a bed of the harder rock that dips to the north. A similar sloping rock-bed, with the trench excavated in it, was found in the next division of this hall, indicating a gallery whose tunnel-structure and sides are gone. Here the rock was buried deep under a bed of varied inter-stratified sands, which yielded no bones but those of Rabbit, Fox, and the prey of the latter. A rock-mass of fallen roof, 11 feet by 7 feet, lay over it. The vicinity of the north wall, however, produced Mammoth, Bear, and Reindeer, some bones being cemented to it. The western or third division of the Elephant Hall is encumbered with huge fallen masses of the roof, but

in its north-east corner is a small gallery communicating with one of the orifices in the crags near the entrance.

Returning to the Long Gallery (6. 7. 16) of which a fine view may be seen from the south end of the Tortoise block that spans it (see Plate VII, cross-sections), we find the tunnel very large, with pronounced shelf and deep trench, at the enlarged bottom of which it is perforated and crossed by the low-level water-courses that cut across the galleries. The principal of these descended into a cavity called the Lowest Cellar, which communicated with the bottom of the Abyss and the Straddling Gallery east of it. This great swallow-hole had undermined the eastern wall of the gallery, which fell, and its ruins now lie coated with stalagmite at the bottom of the Bride's Hall, a portion of the Long Gallery whose roof is adorned with innumerable small stalactites. A diagonal gallery here crosses it, and from this crossing southwards the Long Gallery possesses the longest stretch of upper stalagmite remaining unbroken in the cave. There is, however, a piece of it in the roof further south and between the two the upper stalagmite has fallen, and its wreck is lodged in masses in the jaws of the trench, being cemented together by fresher stalagmite. In spite of being so splendid an example of a gallery, it contained but few fossil bones, its sand-bed having been almost all washed away. It ends in an earthfall, but has there an opening to the east into a chamber that has communication by a deep passage with the Abyss, which is parallel with the Long Gallery.

FABRY-LAND.

The ABYSS (9). We have crossed the line of this gallery (between 2 and 3) where we find it in the Little Narrow Gallery, and we have traced one side of it which remains in the southern part of the Hyena Hall. We have found the southern extension of the Abyss running parallel with the Long Gallery in that direction, but it is the central portion where it is best preserved, that now demands our attention.

We enter it by a short passage descending from the above in the Elephant Hall, and there it is choked northwards by a high bed of sand surmounted by an earthfall and fallen blocks. From this point southward the Abyss is clear for 30 or 40 feet. Its great height and depth seem unbroken by tunnel or shelf. Portions of the upper stalagmite sheeting remain overhead, the west wall being perpendicular both above and below this stalagmite, and the gallery seems all one great trench which does not narrow nor expand much anywhere, though its dark sides are uneven and rough. A high talus of sand sloped down from where we now enter the Abyss, and this contained

bones of Mammoth, &c., but we worked it out in 1904, piling the sand further south. It was covered with rubble, under which were 2 or 3 feet of red-brown bone-sand, then pale, barren sand, then again red-brown sand with bones, and lowest black, barren sand. Vertebrae and bits of tusk of Mammoth were in the dark red sand as well as in rubble and breccia, and the leg bone of a Bear was placed perpendicularly in the sand-bed.

On the east side of the Abyss (about No. 7 level) is a series of openings into the next gallery that remind one of a clerestory, and the bases of this series run in an inclined plane of bedding, dipping north. They were apparently made by water which ran from this gallery into the next or *vice versa*, and in the orifice by which we squeeze into the next, the Straddling Gallery, Mr. R. Evans found a Bear's femur. At the lowest level explored are water channels of a much later period communicating with the galleries on both sides of the Abyss.

The STRADDLING GALLERY (10) is dark, narrow, and uniform in breadth like the Abyss, but the upper stalagmite is continuous overhead. Entering through one of the clerestory openings (between 9 and 10) one finds ledges on each side which afford footing far above the bottom. Proceeding along these a hole is reached on the east side by which one passes into the third gallery, and a corresponding opening leads into the fourth gallery of this section, called Fairy-land. At the bottom of the Straddling Gallery was a bed of sand that contained bones of Bear and Reindeer.

The THIRD GALLERY. At the point where we enter the roof to the right shows a small twin gallery; the partition must have fallen before the formation of the upper stalagmite, as this extends across both it and the main gallery in an unbroken sheet. This Third Gallery contained in places three distinct floors of stalagmite at different levels, the lower floors being chiefly composed of broken masses united together, and such a secondary floor was found even under upper stalagmite unbroken. It was prolific in bones, chiefly below the third stalagmite floor, and these were coated with hardened mud. Though the curve of the roof widens above the upper stalagmite more than the perpendicular walls below, yet the tunnel shape is not developed either here or elsewhere in Fairy-land, and the deep trench, though represented, is not much narrower than the body of the gallery. There are side openings in the walls far above the level of the clerestory in the Abyss.

Near the southern end of this long gallery is an opening low down on the west side that leads into deep, empty caverns and swallow-holes in the line of the Straddling Gallery.

The FOURTH GALLERY. The roof is duplicated as in the Third Gallery. It shows the simple vaulting above the upper stalagmite, which remains in

two places, the walls being approximately perpendicular down to the level of the trench, which is poorly developed. A secondary stalagnite floor was formed where the wreck of the upper had fallen on a sand-bed; under this was a hollow where the sand had been partially washed away, and there, in and under the second floor of stalagnite, were many bones, *e.g.* a leg bone of Mammoth and others, some of which adhered to the bottom of the stalagnite. We found also the remarkable feature (met with in the Third Gallery) of the secondary floor of broken stalagnite extending under the unbroken upper stalagnite. The sand-bed stretched northward, and was rich in animal remains even where the roof became quite broken up and on a high level. There the walls are split and crushed by pressure, and an opening exists into the

FIFTH and SIXTH GALLERIES, which are narrow, dark, and nearly empty, but a Mammoth's bone was found in the fifth, and bits of bone in the sixth.

From the central portion of the Elephant Hall (11) one creeps through a shallow passage into the HORSE GALLERY (12A to 14). On entering a very striking view is obtained of its wide tunnel and upper stalagnite which forms a bridge or ceiling beneath the apex. Smaller galleries run on each side, one of which has a large cross-opening into the Horse Gallery. The sand in the latter was neatly laden of bones. Further on (towards 14) the whole side of the trench has slipped out into the centre, and this mass of rock we called the Horse.

From (12) one of the low east and west passages of any size leads into the BLUE or FAIRY HALL (13) named from its broad, flattish ceiling of blue limestone with numberless small stalactites. The western wall shows hollowing like the side of a tunnel. At the north end a wide tunnel gallery leads some distance until it is blocked up to the roof with pale sand which fills most of the hall to a depth of several feet. As the above gallery points towards orifices in Hurley's part of the quarry outside it seems that this profusion of pale, barren sand was drifted into the hall from the north as it was into the Goat House a little further east, and into the central part of the Elephant Hall.

Several smaller galleries branch out of the Blue Hall northwards. We excavated one on the west side. The shelf was found about 7 feet below the surface of the sand, and the trench in the rock was 12 or 14 inches wide. It contained some broken-up stalagnite, but this excavation yielded only one or two bones. In the centre of the hall beneath the great bed of pale sand we came on a broken-up stalagnite floor, and under that was a darker sand containing Bears' and Reindeer's bones.

About the middle of the west side is an earthfall on top of which is an orifice that opens into a series of small galleries and swallow-holes. Further

west again is a wider cavity having a floor of limestone rubble as though the sand had been washed out.

From the southern extension of the Blue Hall a rounded opening worn in the rock leads into the Fat Man's Passage, a deep, narrow gallery with regularly vaulted roof, which has another orifice on its east side opposite that by which we enter. These must have conveyed the water of the gallery which stops north of them. Squeezing sideways along the Fat Man's Passage we come to

The HALL OF THE AGONIES (17). This with the HALL OF THE EARTHQUAKES (14-15) opening to the south of the Horse Gallery, are rugged open spaces encumbered with fallen masses of the roof. The gallery structure can only be traced where it issues from them. Continuing southward along what was a Double Gallery (17-18) we find the double form at one part where we pass under a piece of the upper stalagmite. After this the gallery grows narrow with a deep sand-bed which, however, proved barren of animal relics. Before coming to the doorway of Hyæna Land the gallery becomes vaulted, and one can stand upright; but at the Portal (18) the upper stalagmite begins, leaving so little space above our floor that one must kneel to enter, and here the passage was so blocked by limestone that there was barely room to pass the body through about 3 feet above the floor until we opened up a way. Some of the blocks are still incorporated with the stalagmite. It seems probable that the impediment here was such as to cut off

HYÆNA LAND,

the section which we now enter. On working within this portal we at once unearthed such abundance of bones, including those of Hyænas, as we had never yet found; and this richness of animal remains continued through all portions of this very distinct section of the cave. It presented special features, the gallery structure being modified as follows:—The sand-bed was never far below the roof, seldom allowing one to stand upright; all the galleries that we worked had an abundance of it often packed tightly. The roof-vaulting, where present, consisted of a small pointed arch above the upper stalagmite, and the swelling tunnel was absent as well as the profoundly deep trench. Where the trench existed it was in a sloping rock-bed disconnected with the roof in an open space chamber or hall. There was a series of east and west openings connecting the galleries and in some cases terminating them. There is moreover no steady air-current here, such as we used to find elsewhere, and at times candles burn dimly in Hyæna Land. The nearness to the surface was realized when we heard a mowing-machine overhead. In

the galleries of this section we found worn sandstone cobbles in the sand-beds. On passing through the portal and crossing transversely two low galleries filled up in our working (18-19) we came to two consisting of trenches in a bed of rock over which a low hall (19) extends westwards. These four galleries were called the Quadruple Set. A breach in the wall of the trenches between the third and fourth of these was filled with rubble, and in this was a radius of adult Mammoth coated with hardened mud. This fourth gallery leads into the Threatening Gallery where the thick upper stalgamite holds on by one side only, supporting blocks of limestone. This gallery, rich in bones, had been inhabited by Hyenas, of which the most perfect skull that we found was only 8 inches below the surface of the sand. These animals appear to have made the Mammoth their prey especially in the very young state, from the remains we found here; and the presence of bones of Reindeer packed into this passage, and similar places, indicated that it co-existed with the Hyena. Remains of Bear were among the deepest that we found. A few worn pieces of sandstone occurred in the Threatening Gallery along with the limestone pieces. It terminates in a cul-de-sac, but close to this are openings right and left. That on the east communicates with the Aged Carnivores Gallery which here ends in an avalanche of stone. The orifice on the west side opens into a short piece of gallery called Dalton Gallery, where the globular head of a Mammoth's femur had been left and was found loose on the surface coated with mud. Entering Dalton Gallery by a sloping water-worn orifice we pass on out of it by a corresponding one, both these openings being considerably above the bottoms of the galleries. Below the level of these side openings in Dalton Gallery was a bed of pale sand 15 inches deep, with dark sand under it, and a paler sand still beneath these. Bones were found in both these sands, most numerously in the pale one. Hyena remains were abundant also, a spine of a Mammoth's vertebra, and ends of Reindeer's bones, all less than 2 feet deep. Under this was a buried stalagmite floor, plainly that which had fallen from overhead. A broken skull of Bear was 1 foot below the surface, a piece of the broken stalagmite resting on it, and we continued to find Bears' remains down to 3 feet deep. While excavating it was remarked that both in this and the last gallery the remains of Hyena were usually near the surface, while bones of Bear were among the deepest. Beyond Dalton Gallery we found a barren stony chamber, and we return through the Threatening Gallery to the low hall (now filled up). This extends westwards over benches of rock that dip to the north. On this rocky floor sand and bones had accumulated, and a thick stalagmite floor had formed. We took bones of Reindeer out of this floor and beneath it. It is evident that the gallery-structure had here disappeared, and that sand had been

deposited on the rocky bottom, and the hall thus formed inhabited by the extinct animals, and also that stalagmite had formed before that fauna had disappeared. One difference between this and the former halls is that the space between the upper stalagmite (observable in parts of galleries that remain) and this second or lower floor is very much less. We had to cut bones out of this stalagmite with a cold chisel. Others of Mammoth, Bear, Hyæna, and Reindeer were met with either loose among rubble or in sand under this stalagmite; a tibia and horns of Reindeer showed marks of the teeth of rodents, but had been subsequently coated with sandy mud over the tooth-marks, showing that these were ancient.

The west side of the low hall was open into the side of the largest gallery in Hyæna Land. It extends north and south beyond the limits of the low hall, and from the teeth of old Bears and Hyænas found there I called it the Gallery of the Aged Carnivores (19). Portions of the upper stalagmite remain two or three inches below the roof bridging over the gallery, seven feet wide. Under this was an empty space, and then pale, barren sand on the surface covering the darker sand-bed, which was rich in bones. Among the first of these was part of a Mammoth's mandible with molar tooth. We first excavated the sand northward to a depth of 3 feet until at 19 feet we were stopped by an earthfall, and we then worked back southwards, digging deeper. The bone-sand contained great numbers of remains of the above animals from Mammoth to Lemming, including two bones of Irish Elk, and notably jaws and teeth of Hyæna, a cranium of which was found deep in a fissure or swallow-hole on the east side. There were also coprolites of this animal, and remains of very old and very young Bears. Reindeers' bones were plentiful, and the recesses at the sides of the gallery were specially prolific.

We then worked this gallery southward (where it was 8 feet wide) for 17 feet, and there a pile of fallen stone and earth stopped further progress. In this part we discovered a broken skull and other bones of Wolf, and a very brittle skull of Fox was 3 feet deep under sand packed with stones. At various points and depths were rounded pieces of sandstone or cobbles. These could not have been intruded with earthfalls at a later date unless the whole sand-bed with its profusion of bones was *remanié*. The objection to such a supposition is that delicate skulls lay in the same sand-stratum with heavy blocks of limestone and stalagmite, and where the latter had fallen its remains lay buried 3 feet or more under the bones. The pale barren sand had indeed been drifted in on the surface, but beneath that all seemed undisturbed since the deposition of the animal remains.

On the west side of the above gallery is a large water-worn orifice, sloping north, which leads into the parallel GALLERY OF THE ELEPHANTS' TEETH

This, at its southern end, has the vaulted roof, the upper stalagmite having there fallen, and its wrecks were found under six feet of sand.

Where the gallery of the Irish Elk branches off, opposite the above orifice, a very deep bed of sand occurred, which contained a surprising assemblage of young and old Reindeers' remains, down to the low level of nine feet below the upper stalagmite. Near them had been a swallow-hole, and it seemed as if bodies of Reindeer had been drawn down by the vortex of water to this vicinity.

The angular space between the two galleries (of the Elephants' Teeth and of the Irish Elk) had a horizontal vacant area, at a high level, in which stands the upper stalagmite sheet, crossing both these galleries as well, within a few inches of the irregular roof. It is found by Professor Seymour to be practically on the same level as the upper stalagmite in the distant parts of the cave, and marks the horizon of its earliest sand-bed of which we have evidence. On this bed, now gone, the stalagmite must have been formed. As we worked northward we found teeth and bones of Mammoth, Hyæna, and Wolf in the sand, which closed up to the upper stalagmite, and after that an earthfall stopped our progress. In this gallery, as well as in that of the Aged Carnivores, was a bed of pale, barren sand, about 18 inches deep above the bone-sand, and this deepened at the swallow-hole above mentioned.

The GALLERY OF THE IRISH ELK has an irregular, slightly-vaulted roof over the upper stalagmite (which remains for 13 feet, and perpendicular sides until we dug down, where we found they closed in V form. At six to seven feet from the corner of the last gallery we found a large limestone block from two feet to three feet below the surface of the sand, with bones of Hyæna and Mammoth. If this block fell at any time from the roof it must have done so before the sheet of upper stalagmite (which is still above) was formed. This would tend to show that the sand and bones among which it lay were more ancient than the upper stalagmite; but in the last two galleries the bone-sand lay over the fallen fragments of the upper stalagmite. Sandstone cobbles were found between the pale upper sand and the coarse, dark bone-sand. There were various bones of Hyæna, Mammoth, Reindeer, and Irish Elk. Of the latter we got a piece of the beam of one antler, apparently gnawed and discarded.

The irregular DIAGONAL GALLERY or chamber on the left or south yielded more of the above bones.

At 18 feet the Gallery of the Irish Elk is intersected by a narrow north-and-south passage, just where its direct course is barred by an earthfall 20'. This we called the GALLERY OF THE VERTEBRA, from a cervical vertebra of a

Mammoth found in it, besides which, on digging deep, we got bones and teeth of the usual fossil mammals. At its southern end this opened on its east side into the BEAR'S DEN, which extended some 20 feet further south, and which terminates its direct course abruptly at each end. At either end it has openings east and west. That opposite the end of the Vertebra Gallery leads into an extension of the gallery of the Swallow-hole (below), and it proved to be very deep and full of bone-sand, in which we got a half mandible of adult *Hyæna*, with Reindeer bones both above and beneath it, as far down as six feet below the surface; also remains of Bear and Mammoth.

The BEAR'S DEN has a simple vaulted roof, with perpendicular sides, which, however, narrowed beneath the sand-bed, leaving barely room to work in. This sand, which was muddy or earthy, contained blocks and rubble that increased as we descended. We dug in places four feet deep, and the first foot or so contained hardly any bones; but the bed below that was the richest I have seen, so that we filled two riddles with remains of Mammoth, Bear, and Reindeer.

The richness of these deep, narrow galleries is due to the bones having been packed into close limits, and buried deep, where they lay undisturbed.

At its southern end the Bear's Den led eastward by another sloping opening into a chamber that crossed the trenches of two narrow galleries. The nearest or western one contained a swallow-hole, in which was found a fine Mammoth's tooth, loose, under a stone. Both these galleries, and the chamber that contained them, yielded from their sand-beds a number of bones.

On the opposite or west side of the Bear's Den (21) the sloping orifice led into the GALLERY OF THE HUMERUS, so named from a Mammoth's humerus discovered in a deep cavity, packed in with pieces of limestone, under a cake of brecciated sand. The extremities of this huge bone had been much gnawed. The southern extremities of this, and of the Gallery of the Swallow-hole, were too narrow to pursue.

An examination of the Low Hall (19-21) shows that its structure is analogous to that of the smaller chamber of the Swallow-hole Gallery. In each of these a wide vacancy was formed, above the bedding-plane, of a harder stratum of rock, leaving the deep trenches of the galleries in the latter. In the Low Hall this plane slopes up above the level of the upper stalagmite, at the mouth of the Threatening Gallery, where it depends from one side, laden with blocks.

A similar slope may be seen in the Elephant Hall, where the trench of the Long Gallery commenced. The dip in these cases is always to the north, and the same slope is observable in the series of east and west openings at

the southern end of the Threatening Gallery, in the opening leading into that of the Elephants' Teeth, and at each end of the Bear's Den, left and right. Such openings are characteristic of this section (Hyæna Land), and plainly conveyed the currents of streams that formed the galleries at a much earlier period than those swallow-holes and cross orifices found at the bottoms of deep trenches (as in the Long Gallery and the Abyss), which point to a late chapter in the cave's history, and which drained away the sand-bed in their vicinity."

2.—GEOLOGY.

The remarks which follow are based on a personal examination of the cave and surrounding district made on the occasion of several visits to Castlepook in company with Mr. Ussher, whose loss, in common with all who had the pleasure of his acquaintance, I most deeply deplore. Only those, perhaps, who day after day watched his ceaseless energy in the cave and the unvarying enthusiasm with which he worked, in spite of conditions trying even to men of half his age, can appreciate what an irreparable loss that particular branch of research in this country has sustained by his death. On several occasions it was my privilege to help him by laying out the main lines of the survey on which his beautiful plan of the cave was based. Those who have attempted with an ordinary field theodolite to carry out a cave survey can realize the severe physical discomforts involved in the process; and not the smallest share of these was borne by Mr. Ussher, and in a manner that compelled admiration. On my last visit, only a few weeks before his death, I spent three days running a series of levels round the whole of the cave, in order to determine the horizon of the shelf and stalagmite floor, &c., and again he gave me most maternal assistance, and took copious notes from which numerous cross-sections were drawn, some being here reproduced (see map).

One result of the levelling was a source of great satisfaction to him as confirming a pre-conceived opinion that the main stalagmite floor developed to a greater or less degree in the various passages in the cave was all on one horizon, and belonged to the same period of formation.

The cave is formed in what is now a bluff or knoll of limestone of Carboniferous Age, the Lower Limestone of the Geological Survey. A few miles to the north are the Ballyhorna Mountains of Old Red Sandstone Age rising to a height of some 1400 feet.

As is usually the case, the cave consists of a number of passages formed by enlargement of the vertical cross-joints of the rock. These of one parallel

set of passages running approximately 10° east of north are more numerous, extensive, and regular, the cross-connecting series being fewer in number, of more irregular form, and generally much smaller, sometimes mere tortuous tunnel-shaped tubes through which one can pass only in a prone position. The main set has generally a characteristic shape in cross-section, which may be likened to a mushroom, consisting of two parts (see map; fig. 3), an upper helmet-shaped portion and a lower narrow and deep trench (the stem), a nearly horizontal shelf occurring at the junction. In a few instances a miniature replica is seen capping the principal cavity.

From a study of the form of the passages, it becomes evident that they were initiated by an underground drainage system which produced small tunnels, the bottoms of which coincided with a main bedding plane of the limestone (see especially fig. 4 on the map). A comparatively dry period followed, during which the stalagmite floor was accumulated on top of a sandy deposit containing numerous bones, belonging to various animal types. A wet period supervened, which allowed of the enlargement of the old passages, but on a lower level—down in fact to the next bedding plane, possibly lower. In some cases the previously formed stalagmite floor has been thus undermined, and has fallen down and become lodged in lower levels, and the bones contained in it thereby become associated with bones of a more recent period. There are some traces also of another stalagmite floor at a still lower level, and apparently *in situ*.

The highest stalagmite floor is, of course, the oldest, and those below are (mostly reconstructed) more and more recent, so that there is an inverted stratigraphical sequence as regards the fossils.

The relative width of the upper and the lower portions of the typical passage is capable of more than one explanation.

Thus it might be the result of differential erosion on two beds of limestone of very different solubility. The bed, however, in which the narrow lower portion is mainly cut is occasionally excavated to the same width as the upper portion. See fig. 2, for instance.

I am inclined therefore to attribute the formation of the main tunnels between the principal stalagmite floor and the conspicuous shelf some three feet below, to the maintenance for a sufficient time of the outflow level or discharge level of the water in circulation, at the level of the shelf. Under such circumstances, any water below that level would be practically stagnant, and would be quickly saturated, and thus incapable of further solution. The upper and lower portions of the passages would, therefore, be forming at the same period, but only in the upper part would considerable solution be taking place. The lowering of the discharge-level would initiate solution at

a lower level, the amount varying locally even on the same level according to the volume of water circulating in the passage. It also appears to me probable that there would be a tendency for the postulated reduced level of discharge to maintain itself for some considerable time at the level of the next lower bedding plane in the limestone, and thus allow of considerable solution at that level, causing undercutting and collapse of dividing walls, which is a feature of the Castlepook cave, and a process which is indeed taking place even now on a limited scale: *vide* "Threatening Gallery."

Referring to the map of the cave (Plate VII), most of the points just touched on will be apparent. The principal shelf is a conspicuous feature, forming a narrow border to the deep clefts or chasms which were once filled with sand and gravel (indicated by dots), all of which was removed by Mr. Ussher.

It was by such excavation that the cave was opened up, the map showing the present extent of the openings which are accessible, but by no means indicating the real extent of this cave, which is capable of considerably more excavation and enlargement at the hands of future workers.

The geological evidence as to the age of the cave is of an inconclusive character, and may be summarized as follows:—There is a high degree of probability that the whole of the region, including the highest summits in the vicinity of Castlepook, was overridden by the great ice sheet of the Glacial Epoch at the period of its maximum development. The resulting boulder-clay, while consisting largely of local material, contains a very few pebbles of a granite similar to that got east and south of Limerick, and most probably derived from a source in Connemara. Some boulders of this rock occur in the walls of the fields on the slopes above the caves, and Mr. G. W. Lamplugh as well as the writer got them in the stream beds in the vicinity.

No foreign erratic of any description was found amongst the hundreds of stones taken from the cave by Mr. Ussher and examined by the writer. Many boxes of specimens were also seen at the Museum, but all were of local rocks only. This (confessedly negative) evidence would seem to indicate that there was no post-glacial, late, or even perhaps inter-glacial circulation of water in the cave so far as our evidence goes, otherwise erratics of granite would be likely to occur in the deposits. Their apparent absence can be readily accounted for on the supposition that the pre-glacial orifices were sealed up under a covering of boulder-clay. Hence it would appear likely that the cave was excavated by a pre-glacial drainage system—an inference which is strongly supported by the largely pre-glacial facies of the fauna associated with the cave deposits.

Between this fauna and the fox-earth with remains of domestic animals

there is an obvious hiatus, which no doubt represents a time-interval commencing with the sealing-up of the cave orifices on the initiation of the Glacial Period and ending when denudation and quarrying operations exposed them again to view from beneath the mantle of lower boulder-clay.

The only argument for a post-glacial age for the cave lies in the fact that the drainage levels of the latter and the level of the present drainage system of the district are not more than about 20 feet apart vertically, possibly even less. If the cave is of pre-glacial age, as seems most probable to the writer, this implies an exceptionally slow rate of denudation locally during the time which has elapsed since the end of the Glacial Period. This, however, may be accounted for on the hypothesis that the present drainage system was established at a period long after the disappearance of the ice sheet, and may possibly have been preceded by a system of drainage in some other direction. River diversion of a temporary or even permanent nature has been a common result of the change of local topography by accumulations of boulder-clay following the Ice Age. The palaeontological evidence, however, in addition to the geological, seems to the writer to point to the cave having been formed before the Glacial Period. The geological evidence is therefore not conclusive one way or another, though inclining, on the apparent absence of any erratic in the cave deposits, to the view that the cave is of pre-glacial age.

3.—ANIMAL REMAINS (except Birds).

NATTERER'S BAT (*Myotis nattereri*).

Only two long bones of bats were found in the cave, one of which belonged to this species, the other to the next. Both looked modern and are probably fairly recent. According to the late Major Barrett-Hamilton,¹ this species still lives in Co. Cork.

SMALL HORSE-SHOE BAT (*Rhinolophus hipposideros*).

This bat was found inhabiting the caves of Co. Clare, and its bones were there met with in the upper and the lower stratum. In Castlepook Cave no recent specimens were observed, only a single long bone which was among the remains of Reindeer, Irish Elk, and Hyæna.

¹ Barrett-Hamilton, G. E. H. : "British Mammals," pt. iv, p. 180. London.

DOMESTIC CAT (*Felis domestica*).

The cave deposits contained but few remains of cats, and most of these were in the first stratum, together with rabbit, horse, sheep, and ox. About half of the teeth and bones of the cats found belonged to adult animals, the remainder being young. All the cats were undersized and below the average stature. The lower carnassial tooth seemed somewhat larger than is usually the case in domestic cats. Nevertheless, all of these cat-remains must be referred to small domestic cats, for none of them showed signs of antiquity. No certain evidence in this cave of the Wild Cat could be detected—an animal which had been observed in the Clare caves and in Ballinamintra Cave.

IRISH STOAT (*Mustela hibernica*, Thomas and Barrett-Hamilton)
= *Putorius ermineus hibernicus*.

During the three years that Mr. Ussher was actively engaged in the Castlepook Cave excavations not a single tooth or bone of any Stoat-like creature was discovered. When he resumed operations shortly before his death in the summer of 1913, he met with the left ramus of a small jaw, which proved to be that of an Irish Stoat. As it was found under a layer of stalagmite together with the bones of Mammoth, Bear, and Reindeer, there can be no doubt of its antiquity. Irish Stoat bones have occurred in the Caves of Kesh and those of Co. Clare. In the former, the bones were associated with those of Lemming and Field Mouse. These facts indicate that the Irish Stoat is one of the early inhabitants of Ireland, and that it came with animals long since extinct in this country.

FOX (*Vulpes vulpes* = *Canis vulpes*).

Fox remains occur abundantly in all or most of the Irish Caves that have been critically examined, and the Fox is still plentiful in Ireland at the present day. In my report on the Fox of the Clare Caves¹ I dwelt on the difficulty of discriminating between small forms of the Common Fox and the Arctic Fox. In the present case, some of the smaller teeth and bones were recent-looking, and thus probably belonged to the Common Fox. Others were distinctly ancient in appearance, yet, although small, they seemed to be referable to this species. A right tibia (M.D. 127) has been gnawed by small rodents.

¹ "Exploration of the Caves of County Clare." *Trans. R. I. Acad.*, vol. xxxiii (Sect. B), p. 47. 1906.

ARCTIC FOX (*Alopex lagopus*).

The former presence of the Arctic Fox in Ireland was proved by the discovery of its remains in the Clare Caves. In the Castlepook Cave the right and left rami of a lower jaw (M.D. 175) could be identified with certainty as belonging to this species. The Arctic Fox, no doubt, was associated with the Reindeer, Lemmings, and other northern forms of animal life that invaded Ireland in past times. All the other remains, such as long bones, pelvis, and vertebrae, which resemble the corresponding parts of the modern Arctic Fox present less characteristic specific characters than the teeth and are not readily discriminated from those of the smaller forms of the Common Fox.

WOLF (*Canis lupus*).

As I have stated on previous occasions, undoubted Wolf-remains are rare in Ireland. It is generally very difficult to discriminate between the Wolf and a large dog. Professor Reynolds¹ lays special stress on this fact in his monograph on the Wolf. The position of the bones in this cave made it easier to identify them because the remains of dogs and other animals were practically confined to surface deposits which had recently been intruded into the cave.

The most important piece of evidence of the occurrence of the Wolf in Castlepook Cave was a large fragment of a skull (M.D. 238) embedded in stalagmite, and containing the first and second unworn molars. A ramus of a lower jaw (M.D. 236) with three teeth probably belonged to the same skull. There were also a number of bones near at hand which indicated the presence of an exceedingly powerful wolf. This creature probably did not exceed the famous Irish wolf-hound in size or speed, for the skull and limb-bones of the latter are larger than the corresponding parts of any wolves I examined. But the teeth of the ancient Irish Wolf were much larger and stronger than those of the wolf-hound. Two first lower molars found in this cave measured $34\frac{1}{2}$ mill. and 30 mill. in length. In a modern Wolf-skull from Sweden, in the National Museum of Ireland, the same tooth was only 27 mill. in length, and in another European Wolf of unknown locality $28\frac{1}{2}$ mill. In an Arctic Wolf (*Canis occidentalis*) from Vancouver the first molar measured 30 mill. in length, while in two skulls of a modern Irish wolf-hound this tooth was only $24\frac{1}{2}$ mill. and $25\frac{1}{2}$ mill. long. In the lower jaw from the Kesh Cave the same tooth measured $31\frac{1}{2}$ mill., and in that of the Shandon Cave it was about

¹ Reynolds, S. H. : "British Pleistocene Mammalia," Palaeontographical Society, vol. ii, pt. 2. 1909.

30 mill. (the tooth being broken the length could not be ascertained with accuracy). In the upper first molar the breadth which is the greatest diameter of this tooth, measured as follows in the various specimens of Wolves examined:—

LOCALITIES.	
Castlepook Cave,	25½ mill.
Vancouver,	24 „
Arctic America,	24 „
Europe,	22 „
Sweden,	21½ „
Irish Wolf-hound,	20 „
Do.,	19½ „

Thus it would seem as if in the nature and strength of its teeth at any rate the extinct Irish Wolf was more nearly allied to the American Wolf (*Canis macrotis*) than to our European Wolf (*Canis lupus*). Until further researches throw light on the relationship of the Irish Wolf, it is preferable to retain for it the name of *Canis lupus*.

DOG (*Canis familiaris*).

There were very few indications of the presence of Dog-remains in the Cave and those that were there had evidently been dragged in by foxes in recent times. A right bone belonged to a breed which I could not definitely identify, but it was considerably smaller than an Irish Terrier. A right tibia was that of the terrier type, though somewhat straighter than any I had seen.

HYÆNA (*Hyaena crocuta*).

The discovery of the Hyæna in this cave has already been announced by Mr. Ussher.¹ The remains of this animal consisted of several skull-fragments, and many teeth and bones, some of skulls and young. These occurred in thirty-eight different parts of the Cave, mostly in sand. From many indications we are led to conclude that this cave was once a den where Hyænas lived for a considerable time, there they secured their food and reared their young. The great quantities of splintered bones as well as the occurrence of coprolites confirm this view. That the climatic conditions must have been at least as favourable as they are now, but probably more so, seems to be implied by the great abundance of food. Only very few of the immature Hyæna bones

¹ Ussher, R. J.: "On the discovery of Hyæna, Mammoth, and other extinct Mammals in a Carboniferous Cavern in Co. Cork." Proc. R. I. Acad., vol. xxv (Sect. B). 1904.

showed traces of having been gnawed, while immense numbers of Reindeer bones which could only have been dragged into the cave by beasts of prey had remained untouched.

As regards the affinities of the Irish Hyæna, they agree with the Spotted Hyæna (*H. crocuta*) rather than with the Striped Hyæna (*Hyaena striata*) or with *Hyaena arvernensis*. The Irish Hyæna resembles the English and Continental Cave Hyæna, which forms a peculiar variety of the Spotted Hyæna.¹ By some it is indeed looked upon as a distinct species (*H. spelæa*). The teeth in this Cave Hyæna were more powerful, so that the whole head was probably more muscular and larger than in its modern representative. The legs and toes, on the other hand, were shorter in the Irish Hyæna. The whole appearance of the latter was more disproportionate than that of its modern relative which still inhabits South Africa.

BEAR (*Ursus arctos*).

In his catalogue of the Mammals of western Europe, based on the British Museum Collection, Mr. Miller² states that the common European Bear (*Ursus arctos*) is not certainly known to have occurred in Ireland. This allegation is all the more remarkable, as there is a skull of a fossil European Bear from Ireland in the British Museum, while I have repeatedly urged that this bear must have been very abundant in this country formerly. I have recorded the European Bear from bogs, and from the caves of Kesh and Clare. Although we have not actually any historical record of its having lived in Ireland, we possess ample evidence of its occurrence in this island within human times, and there are several Irish names for Bear.

In the Castlepook Cave the bones and teeth of Bear were met with everywhere in great profusion, both above and below the stalagmite. There were bones of adults of enormous size, of very small individuals—possibly females—and of young in all stages of growth. Even of tiny and unborn Bears the bones and milk-teeth were discovered. From a series of toe-bones I ascertained that I had examined the remains of at least nine adult Bears. One of these toe-bones (M.D. 106) belonged to an abnormally large specimen. Apart from the size, the Irish Bear does not seem to me to differ from the still existing Brown Bear of Europe. Professor Leith Adams³ expressed the

¹ Reynolds, S. H. : *The Cave Hyæna*. "British Pleistocene Mammalia," vol. ii, pt. 1. Palæontographical Soc. 1902.

² Miller, Gerrit S. : "Catalogue of Mammals of Western Europe," p. 287. London, 1912.

³ Adams, A. Leith : "On the recent and extinct Irish Mammals," p. 62. *Scient. Proc. R. Dublin Society (N.S.)*, vol. ii. 1880.

opinion that the Irish Bear was more like the American Grizzly; and certainly, as far as size is concerned, the former attained quite the dimensions of its American relation. Some authorities¹ look upon the American Grizzly Bear as a large form of the Brown Bear, and I concur in this view.

Owing to the great size of the Irish Bear, some authorities connected it with the Great Cave Bear (*Ursus spelaeus*); but this view is not admissible, for its dental characters agree with those of the Brown Bear. Some of the lower anterior premolars were always present in the jaws found in the Castlepook Cave, while the fourth premolars, which are so characteristic, were always of the *Ursus arctos* type, and the second molars were well constricted posteriorly.

Some of the bones were perfectly fresh-looking, as if the Bears had been living in the neighbourhood of the cave a few years ago; others were deeply embedded in stalagmite or greatly discoloured and blackened by mineral infiltration. A great many of the bones had been gnawed by a large carnivore, probably the Hyæna. Sometimes both ends of a femur or humerus were completely eaten away. The ulnae were almost all preserved intact, as they proved to be too hard a morsel even for a Hyæna.

In the Kesh caves² I found a three-rooted molar tooth of a Bear which I figured, since its specific identification had proved the object of a good deal of speculation. In the Castlepook Cave two similar teeth were discovered, both of them with three roots. As these were in company with a milk premolar, it is almost certain that the problematical tooth from the Kesh Caves is the first milk molar of the Brown Bear, which was hitherto unknown, because it is shed either during or shortly after birth.

BROWN RAT (*Epimys norvegicus* = *Mus decumanus*).

The rat remains were very scarce, and they mostly belonged to young individuals. Altogether the bones did not represent more than four rats. They agreed with the Common Rat, and were all quite recent in appearance, and evidently intruded through rabbit burrows.

FIELD MOUSE (*Apodemus sylvaticus* = *Mus sylvaticus*).

Some of the bones and teeth were modern-looking. Most of them had every appearance of antiquity, and resembled those of the Lemming, with which they often occurred in the same deposit—at least in the sand thrown out of the cave, which was subsequently riddled.

¹ Reynolds, S. H. The Bears. "British Pleistocene Mammalia," vol. ii, pt. 2, p. 32. Palaeontographical Soc. 1906.

² "The Exploration of the Caves of Kesh." Trans. R. I. Acad., vol. xxxii (Sect. B), pt. 4. 1903.

LEMMINGS.

As we pointed out in the preliminary report,¹ the bones and teeth of the Arctic and Scandinavian Lemmings occurred in great abundance in this cave.

Both in the caves of Kesh and Co. Clare only one kind of Lemming had been noticed. In the Cork cave a second form (*Lemmus lemmus*), a species still living in Scandinavia, was discovered and identified by me. In order to make certain of the correctness of the identification, I sent all the Irish Lemming remains to Mr. H. A. C. Hinton, who was then engaged in the classification of the fossil rodents in the British Museum. Mr. Hinton kindly confirmed my identification of the Scandinavian Lemming.

As regards the Arctic Lemming, he points out that the maxillary molar is more reduced in the specimens from Castlepook Cave than in *Dicrostonyx torquatus*, approaching the Arctic American *Dicrostonyx hudsonius* in that respect. As there are some points of difference from the latter in the skull, Mr. Hinton considers the Irish Arctic Lemming sufficiently distinct from the two recent species to rank as a new species, which he calls *Dicrostonyx henseli*.² No specific character discriminating the Lemming's bones from one another has yet been noticed. In the great majority of cases it is impossible, therefore, to determine the species of the Lemming remains. More than a thousand Lemming bones were collected in Castlepook Cave, most of them being associated with the bones of Reindeer and Bear. Out of thirty parcels containing Lemming teeth, seven were referable to *Lemmus lemmus* and four to *Dicrostonyx henseli*.

SCANDINAVIAN LEMMING (*Lemmus lemmus*).

This is the first time that the still existing Scandinavian Lemming has been identified in Ireland. It had been known as a fossil from the south of England and the continent of Europe.

ARCTIC LEMMING (*Dicrostonyx henseli*).

In the paper just quoted² Mr. Hinton gives a description of *Dicrostonyx henseli*, and informs us how it is to be distinguished from the still existing Arctic Lemming (*D. torquatus*). According to Mr. Hinton, the records of *Dicrostonyx torquatus* from the Kesh and Clare caves are not quite correct. The name of *Dicrostonyx henseli* should be substituted, except in a few

¹ Ussher, R. J., H. J. Seymour, E. T. Newton, and R. F. Scharff: "On the Cave of Castlepook, near Doneraile, Co. Cork." Brit. Assoc. Report. Dublin, 1908.

² Hinton, H. A. C.: "Some new Late Pleistocene Voles and Lemmings," Annals and Mag. Nat. Hist. (8), vol. vi. 1910.

instances. Among the Lemming's bones and teeth from the Clare cave Mr. Hinton has found a few which belong to still another Lemming, viz., *D. gulielmi*. It is also referred to in the paper by Mr. Hinton, cited above.

IRISH HARE (*Lepus hibernicus*).

The Irish hare is now generally recognised as distinct from the Variable Hare (*Lepus timidus*, L. = *L. variabilis*, Pall). Irish hare bones were frequently met with in all parts of the Cave, most of them being in a fragmentary state. A single skull fragment (M.D. 315) was discovered. The largest fossil humerus of the Irish hare hitherto examined measured 109 mill. in length. In this cave I noticed one (M.D. 295) measuring 113 mill. Since I wrote my report on the exploration of the caves of Co. Clare,¹ a very important paper by Mr. Hinton on the *Lepus variabilis* group has been published.² Mr. Hinton's contribution deals primarily with the Hare remains discovered in the famous bone-fissure of Ightham, in Kent; but the relationships and origins of the various allied species are fully discussed in the light of the author's special researches into this subject. His conclusion that the south of England was not less mild in Pleistocene times, when the Variable Hare lived there, than it is at present, is of importance, and agrees with the views I have urged on various occasions.³

There are other points in Mr. Hinton's paper, in which I differ from him. The most highly specialized forms, as he remarks, are in general those living furthest from their original centre of dispersion. As the Arctic species of the *variabilis* group of hares are more specialized than the British and Irish forms, he concludes that the group cannot have had a boreal origin. Although this appears to be a logical conclusion, I venture to adhere to the older and opposite opinion that the *variabilis* group of hares has had a boreal origin. In order to put the theory to a thorough test we ought to include the Alpine, Pyrenean, and Asiatic forms of this hare in our survey. Even if we limit our comparison, as Mr. Hinton has done, to the boreal and British forms, the facts noticed by him need not be interpreted by the assumption that the *variabilis* group had a southern origin. Mr. Hinton admits that the Greenland form owes its specialization to climatic causes. As we proceed northwards to colder climes he says (p. 262) the peripheral parts of the animal tend to diminish in size on account of the cold. The

¹ Scharff, Ussher, and others: "Exploration of the Caves of Co. Clare." Trans. R. I. Acad, vol. xxxiii (Sect. B), p. 47. 1906.

² Hinton, H. A. C.: "On the fossil hare of Ightham." Scient. Proc. R. Dublin Society (N.S.) vol. xii. 1909.

³ Scharff, R. F.: "European Animals," pp. 139, 140. London, 1907.

outer ear becomes shorter. On the other hand, the eye has grown larger, which has had its due effect on the skull. This increased specialization was not caused by the northern forms of hares having had to travel furthest from the centre of dispersal. It is due to the fact that the northern members of the *variabilis* group became exposed to abnormal or peculiar climatic conditions. As I have mentioned before, Mr. Hinton urges, and I agree with him, that when the Variable Hare inhabited the south of England the climate of that part of the British Islands was temperate. But in the existing fauna and flora of Greenland there are many indications that the climate of that part of the world was much less severe formerly than it is now.¹ It is probable, then, that while the climate of the British Islands has fluctuated comparatively little within recent geological times, that of Greenland has altered considerably. Thus, although the Greenland form of the *variabilis* group of hares is more specialized than those of the British Islands, it need not necessarily be assumed that it lies on the periphery of the dispersal of the group, nor that it is derived from a southern stock.

RABBIT (*Oryctolagus cuniculus* = *Lepus cuniculus*).

In my report on the animals of the Clare caves I suggested that the Rabbit was indigenous to Ireland. Some of the Clare bones of Rabbit were ancient-looking, and seemed to support this view.

In the Castlepook Cave only two tibiæ and one femur (M.D. 32 and 33) show signs of antiquity. Almost all the other teeth and bones were quite fresh-looking. None of them had been gnawed. The only two very old-looking bones were femur fragments (M.D. 313), and these could doubtfully be referred to this species. They may possibly belong to young hares.

This is the first occasion on which a cave yielded the skull of a Rabbit. As a rule the bones are much broken. The skull alluded to is not perfect. The anterior part is missing, and certain portions of the base are absent. The only difference that could be observed between it and a recent Rabbit skull was that the orbits were slightly nearer one another in the fossil form.

There is no reason to suppose that the Rabbit was a native of the district surrounding this cave at the time when the Hyæna and Mammoth lived in the neighbourhood. This is all we can definitely assert after an examination of the Rabbit remains.

MAMMOTH (*Elephas primigenius*).

Mammoth bones were very abundant in the Castlepook Cave. They

¹ Scharff, R. F. : "Origin of Life in America," pp. 19-25. London, 1911.

occurred in seventy-three of the deposits examined, and in fifty-nine cases they were mingled with those of Reindeer. Hence there cannot be the slightest doubt that these two herbivores lived contemporaneously in Ireland. Moreover, since many of the bones and teeth of the Mammoth belonged to very immature individuals, the young were born and reared in this country. This, again, implies that the food-supply in Ireland was ample, both for the maintenance of herds of Mammoths as well as of Reindeer. We may also assume that the climate of Ireland was mild throughout. If the Mammoth had been subjected to severe winters, with much frost, it would rapidly have become extinct, and could not have successfully reared its progeny in the country.

Almost all the Mammoth bones showed traces of having been gnawed by a large carnivore. Many of the epiphyses of the long bones were eaten away, and showed distinctly the large tooth-marks (e.g. M.D. 22 and 126). A scapula M.D. 20 also exhibited the impression of great teeth very clearly. I have expressed my opinion in dealing with the Reindeer that the Hyæna was largely responsible for the presence of so many skeletons of that species in the cave. In nineteen instances Mammoth and Hyæna bones were found side by side. From this fact we may certainly conclude that the two animals were contemporaneous in Ireland and that the Hyæna had dragged the bones of the Mammoths into the cave to gnaw them at leisure.

Among the bones of the Mammoth found in the cave there were the remains of at least two adults and several young. One incomplete mandible of an immature Mammoth (M.D. 76) had a right and left milk molar *in situ*. There were other single upper and lower milk molars, and a specimen of the extremely rare milk incisor. I am not aware of the previous occurrence of such a tooth in the British Islands.

The Mammoth evidently inhabited all parts of Ireland, for its remains have been discovered in Antrim, Cavan, Galway, and Waterford. It may possibly have been contemporaneous with Man in Ireland; but of this we have no direct evidence. We know, however, that in England and on the Continent of Europe it survived up to the Stone Age.¹

Ox (*Bos taurus*).

Almost all the teeth and bones of Oxen were of young individuals, which had possibly been brought into the cave by foxes within recent times. All these remains of calves belonged to the modern mixed breeds.

Only a single skull fragment seemed somewhat more ancient, and proved

¹ Adams, A. Leith: "Monograph of the British Fossil Elephants." Palaeontological Soc. 1877-1881.

to be that of a breed of very small cattle—smaller than the skull of an average-sized Kerry cow. This diminutive size was especially noticeable in the teeth.

SHEEP (*Ovis aries*).

In a great many instances it was impossible to discriminate clearly between the bones of Sheep and Goat, for it is a well-known fact that the ancient breed of Sheep were very goat-like in their limbs. In only five instances out of thirty-seven Sheep-like remains could sheep be identified with certainty. In two places the Sheep occurred in the same deposit with Reindeer and Bear. None of the Sheep bones nevertheless looked ancient, and it is quite possible that they dropped accidentally into the older deposit during the excavations. The Sheep belonged to a small race of the size of a modern St. Kilda.

The only trace of the undoubted presence of Man in the cave was revealed by the lumbar vertebra of a lamb (M.D. 82) which showed knife incisions. This bone had clearly been brought into the cave within recent years, possibly to provide part of the luncheon of a casual visitor.

GOAT (*Capra hircus*).

Only in seven cases out of thirty-seven Goat-like remains could the Goat be identified with certainty, the majority of the bones belonging to young animals. Although in four instances these goat bones were found together with bones of Reindeer and Bear, it need not necessarily be concluded that they all were contemporaneous, for the former had all the appearance of being perfectly recent.

REINDEER (*Rangifer tarandus*).

Reindeer bones and teeth were extremely numerous in the Cave. The two animals that seemed to abound in Ireland more than any other at the time the Castlepook Cave deposits were formed were the Reindeer and Lemming. Two hundred and fourteen parcels of bones out of the three hundred and forty-three sent by Mr. Ussher from this cave contained Reindeer remains—that is to say over 60 per cent. It must be remembered that only a small portion of the cave has been searched for animal remains, yet it is surprising what a number of Reindeer bones it contained. The fragmentary remains of thirty-nine individuals were recognizable, and there can be no doubt that the Reindeer themselves did not enter the caves. Their bodies and limbs were certainly dragged in by wild animals and devoured there at leisure. Among the carnivore remains associated with those of Reindeer the bones of Bear, Hyæna, and Wolf were conspicuous. To judge from the mingling of the bones of all these species in the same deposit, I think the Reindeer must have lived

in Ireland at the same time as the carnivores alluded to. Mr. Ussher quite concurred in this opinion. In view of the fact that some authorities have urged that the Reindeer could not have lived in the British Islands contemporaneously with the Hyæna, this result of the Castlepook Cave exploration is alone of great importance. The Bear, Hyæna, and Wolf may all have had their share in this Reindeer feast, but the Bear, to judge from its modern representatives, is largely a vegetable feeder, while the scantiness of Wolf remains indicates that the Wolf did not make much use of the cave as a shelter. Hence, most of the bodies of Reindeer were probably dragged into the cave by the Hyæna. Indeed, Reindeer and Hyæna bones occurred in the same deposit in the cave in no less than thirty-two sites. Moreover many thousands of Reindeer bones were broken into small splinters by the action of powerful teeth, and in many cases the marks of teeth were clearly visible on the bones. I exhibited some of these bones at a meeting of the Zoological Society of London in 1909¹ with a view to eliciting the opinion of some of the members of that Society on these tooth-marks. It was thought by several of those present that while rodents might have produced some of the marks the Reindeer themselves may have gnawed the bones, as deer are known to do so. A few of the tooth-marks, especially those on the Reindeer antlers, may be due to the latter cause, but on closer examination I find that there are three distinct types of tooth-marks. The most prevalent of these seems to have been produced by rodents; and it is certain—compare Ussher's remarks, p. 43) that some of these tooth-marks, if not all, were produced at the time when the bones found their way into the cave. They may thus be the work of Lemmings. Some, on the other hand, were clearly caused by larger carnivores—perhaps by young Bears or Hyænas.

To judge from the great number of bones of Reindeer in this cave, it would seem that we ought to be able to gather some information as to the Irish race or variety of this species. Unfortunately the limb-bones of the Reindeer do not differ appreciably in the various varieties. The more subtle features by which races of Mammals can be distinguished lie almost entirely in the skull. The antlers are very characteristic in the different species of deer. Even races and varieties have been distinguished by them. Mr. Lydekker,² for instance, relies upon the shape of the antlers alone in his descriptions of the varieties of Reindeer. Other authorities, such as Professors Nitsche, Camerano,³ and

¹ *Proc. Zoological Society, London, vol. i, p. 204. 1909.*

² Lydekker, R.: "Note on a Reindeer Skull from Novaia Zemlia." *Proc. Zool. Soc., London, vol. ii, pp. 360-362. 1902.*

³ Camerano, L.: "Ricerche intorno alle Renne delle isole Spitzberghe." *Memorie d. Acad. d. Scienze Torino, vol. ii, pp. 159-240. 1902.*

Lönberg, attach greater importance to the position and structure of certain bones of the skull.

Antlers occur in the Reindeer in both sexes, and they are shed annually. Some shed antlers were excavated from the cave. A great many antlers had portions of the skull adhering to them. Altogether I counted 217 antler fragments. These seemed to belong to two types. Some had the two tines close to the skull, viz., the brow-tine and the bez-tine. In other antlers the first or brow-tine was absent. These are probably sexual characters. In one heavy shed antler fragment there were three tines close together. It had so much the look of a Red Deer antler that I was in doubt for a considerable time as to its correct identification. The position of the brow-tine in relation to the burr finally solved the question in favour of the Reindeer. Just above this tine (M.D. 230) the main shaft of the antler had a diameter of 54 mill. The heaviest antler measured 57 mill. in diameter. The antlers were of all sizes. Some belonged to very immature specimens. The antlers of the females were much smaller and more slender than those of the males. The length and number of tines is subject to great variation in the same race of the Reindeer, whereas the shape of the beam seems to be of a more fixed character. Professor Camerano¹ indeed urges that in one type of Reindeer antlers the beam tends to elongate and to become cylindrical throughout its length. The second type includes those antlers in which the beam inclines to become shortened and flattened. The same writer states that to the first group belong the Reindeer of Norway, Greenland, Spitsbergen, and Arctic America, while the second group inhabits Siberia and northern North America.

As all the antlers which have been found in the Castlepook cave are long and rounded, and mostly slender, with generally a posterior tine about midway between the two ends, the race of Reindeer which formerly inhabited Ireland must be referred to Camerano's first type. It should, therefore, be related to the races or varieties still living in Norway, Greenland, Spitsbergen, and Arctic America.

Reindeer remains are by no means confined to this cave in the County Cork. The species has been recorded from Shandon cave, Co. Waterford; from the Kesh caves, Co. Sligo; and from the caves of Clare. It has occurred, moreover, in bogs and marls at Coonagh, Co. Limerick; at Mullingar, Co. Westmeath; at Ballyguiry, Co. Waterford; at Ashbourne, Co. Meath; and at Ballybetagh, Co. Dublin. The antlers of the specimens referred to, so far as they have been preserved, resemble in their general characters those

¹ Camerano : *loc. cit.*, p. 166.

found in the Castlepook Cave. Hence we may conclude that there was only one race or variety of Reindeer in Ireland, that it was widely distributed and abundant in the country. This view agrees with that urged by Professor Leith Adams, who maintained that the antlers of the Irish Reindeer partook of the characters of the Norwegian rather than the Siberian stock.¹

The bones of the skull and the teeth of the Irish Reindeer still remain to be considered. Both jaws and individual teeth of adults and very young Reindeer occurred in great numbers in this cave. The teeth were quite uniform in character, with the exception of a molar tooth (M.D. 257), which had remarkably long pillars on the outer side, and thus resembled the tooth of *Cervus* rather than that of *Rangifer*. Still, as otherwise it is of the Reindeer character, I am inclined to attribute the structure to an abnormality rather than to a generic difference.

As may be expected from the fact that Castlepook cave was a den of Bears, Hyenas, and Wolves, no complete skulls of Reindeer were discovered. This is all the more to be regretted, as the most important character in the skull lies in its front part, and this had invariably been fractured. I mentioned above that some authorities regarded the skull as affording more reliable characters than the antlers for the purpose of discriminating between the various varieties of Reindeer; and, as Professor Lilljeborg² first pointed out, it is the shape of the nasal bones that is so characteristic in the different varieties, and Professors Nitsche, Cameron, and Lönnberg³ concur in this view. No recognizable nasal bones of the Reindeer have been found in the Castlepook cave. But we possess in the Dublin National Museum a magnificent and perfectly preserved skull of an adult Reindeer found in a bog near Ashbourne, Co. Meath. The nasal bones in this skull resemble those of the Swedish form of Reindeer, described by Professor Lönnberg, in being flat above. Although no nasal bones are present in any of the skull fragments from the Castlepook cave, the anterior margin of the frontal bone, as seen in a specimen marked M.D. 234, indicates that the lachrymal vacuity was quite as large as in the Ashbourne skull, and extended far back between the lachrymal and frontal bones. The lachrymal vacuity thus resembled that in the Greenland skulls, while it is very much smaller in the Swedish Reindeer (cf. Lönnberg, fig. 1). The Reindeer skulls which I received from Skansen, in Stockholm, and which belonged to domesticated specimens, also agree in

¹ Adams, A. Leith. "On the recent and extinct Irish Mammals." *Scient. Proc. R. Dublin Soc. (N.S.)*, vol. ii, pp. 45-86. 1880.

² Lilljeborg, W.: "*Sveriges og Norges Rygggradajur.*"

³ Lönnberg, Einar: "Taxonomic notes about Palearctic Reindeer." *Arkiv för Zoologie*, vol. vi, No. 4. 1909.

the possession of a narrow lachrymal vacuity measuring but 6 mill. in width, compared with a width of 16 mill. in the Ashbourne skull, and 17 mill. in a skull from Greenland. Similarly, the width of the nasal bone, just in front of this lachrymal vacuity, measures 35 mill. both in the Ashbourne and in the adult Greenland skull.

In the great length of the nasal bones (131 mill.) the Ashbourne skull of the Irish Reindeer surpasses even the Siberian Reindeer (cf. Lönnberg, p. 17), in which the nasals measured 129 mill. In the Greenland skull the nasals are quite short (100 mill. in length), and arched above the level of the adjoining maxillary bones. In the Ashbourne skull the nasals are flat, as in the wild Swedish Reindeer (cf. Lönnberg, fig. 1). In the Swedish skull, preserved in the Dublin Museum, however, the nasals are arched; and I altogether doubt whether this particular structural character of the nasal bones is of such importance as we are led to believe. Indeed, in the Ashbourne skull the apparent flatness of the nasals is largely due to the greater bulging outward and upward of the maxillary bones. The width of the nasal cavity was much greater in the ancient Irish Reindeer than in the modern Greenland form. Would it be permissible to argue from this fact that the Irish Reindeer had greater need for or made greater use of its nasal cavity than its Greenland relation? Whatever the cause of this modification may be, the extinct Irish Reindeer seems to have been more nearly related to the existing Greenland form than to the others.

Let us reconsider the points of relationship between the Irish, the Scandinavian, and Greenland varieties:—

1. The Irish Reindeer resembled the Scandinavian and Greenland forms, and differed from the Siberian in the structure of its antlers.
2. The Irish Reindeer resembled the Greenland form, and differed from the Scandinavian in the shape of the lachrymal vacuity.
3. The Irish Reindeer resembled the Greenland form, and differed from the Scandinavian in the width of the nasal bones.
4. The Irish Reindeer differed from both the Scandinavian and Greenland forms, and resembled the Siberian in the length of the nasal bones.

The Irish variety or race of the Reindeer deserves a distinct name, for which I would propose *Rangifer tarandus hibernicus*; but until more material is forthcoming, especially from Siberia, we are not in a position to draw very definite conclusions as to the relationship of the different forms of the Reindeer.

[RED DEER (*Cervus elaphus*.)]

The complete absence of the Red Deer from the deposits is one of the

most remarkable features of this cave. Antlers and bones of Red Deer are very abundant in the Irish peat deposits. The skeletons of this deer have also been discovered in the underlying marl, in which the Irish Giant Deer remains are so numerous.¹

All the Irish caves hitherto examined, viz., the Shandon and Ballinamintra caves, the Kesh and Co. Clare caves, have yielded remains of the Red Deer; and, according to Professor Leith Adams² (p. 82), the latter was contemporaneous in Ireland with the Mammoth. In all the caves just alluded to Red Deer and Reindeer were associated in the same stratum; and there can be no doubt at all that those two deer inhabited Ireland at the same time. Why, then, should Red Deer remains be absent from this cave? I think only two theories are admissible. The deposits of this cave may have been laid down altogether prior to the appearance in Ireland of the Red Deer. In this case we must assume that the Mammoth and Reindeer continued to live in this country long after the formation of the cave and its deposits. Or we may suppose that this cave was always surrounded by many miles of open meadow land tenanted only by Mammoths, Irish Giant Deer, and Reindeer, whereas the Red Deer frequented only the wooded districts. The latter view appears to me the more probable one. At the present day we find comparatively few animals scattered uniformly over the country. Most species inhabit certain areas which yield the kind of food suitable to their requirements, and the Red Deer is essentially a forest-loving animal.

GIANT DEER OR IRISH ELK (*Cervus giganteus*).

The Irish Giant Deer or Irish Elk occurred in fifteen different places in the cave. Among the bones that were identified, there was a somewhat water-worn shed antler-fragment, which may have been washed into the cave by a stream. In the case of a similar occurrence in the Edenvale caves I suggested that early Man might have carried the antler into the caves. But in these Co. Clare caves there were other indications of the presence of Man during the time the deposits were laid down. In the Castlepook Cave some of the metatarsal bones of the Irish Elk (M. D. 35 and 225) were split in such a manner as to suggest that the process had been performed by early Man for the purpose of extracting the marrow. No other traces of Man's contemporaneity with the Irish Elk having been discovered in this cave,

¹ Houghton, J. "Observations on the fossil Red Deer, founded on the skeletons found at Bellee, in the County of Fermanagh, in 1863." *Journ. Geol. Soc., Dublin*, vol. x. 1863.

² Adams, A. Leith: "On recent and extinct Irish Mammals." *Scient. Proc. R. Dublin Soc. (N.S.)*, vol. ii, pp. 45-86. 1890.

it is extremely doubtful whether the latter ever was inhabited by human beings.

Hitherto very few bones of young Irish Elk have been identified, and we may suppose that they were more successful in escaping the persecution of their enemies than the adults. In Castlepook Cave, however, a few remains of very young Irish Elk were noticed, such as the proximal part of a shed right antler (M.D. 257), a left astragalus (M.D. 233), and a distal fragment of a metatarsal (M.D. 100). One of the most interesting discoveries made during these excavations is a left third lower milk pre-molar tooth of a large deer (M.D. 102), larger than that of either Red Deer or Reindeer. I consider this tooth to be that of a young Irish Elk. If this view is correct, it is the first example of a milk tooth of the Irish Elk known.

HORSE (*Equus caballus*).

There was no evidence in this cave of the occurrence of the Wild Horse. The only remains of horses that were exhumed had evidently dropped into the cave from the field above, where the animals were probably buried within modern times. Only in one instance was the bone of a horse found together with Reindeer and Mammoth; but there were reasons to believe that the Horse had recently dropped into the excavation. In one other instance Horse and Wolf were found together. Some of the Horse remains may, therefore, be a few centuries old when the Wolf still lived in Ireland.

The bones identified as belonging to the Horse formed part of at least two individuals. The older one (M.D. 39) was a small pony, very aged and badly affected with "spavin" on the right hind limb. The other (M.D. 18, 25, &c.) was a large agricultural horse of modern type.

PIG (*Sus domesticus*).

Another peculiarity of this cave is the complete absence of the Wild Boar. In all the other Irish caves examined, except Shandon, there were many bones and teeth of either wild or domestic pigs. In this cave only a few teeth of young pigs were met with (M.D. 112, 117, 119, and 122), and a single immature skull fragment (M.D. 25). All these were evidently quite modern, and must have been recently introduced into the cave by dogs or foxes.

FROG (*Rana temporaria*).

The Common Frog has at present a wide distribution in Ireland, and is probably a native in spite of the assertions to the contrary. In the Castlepook caves frog remains occurred in eight places, one of them being in the

first stratum and seven in the second. Nevertheless, not one of the latter is without suspicion of a surface intrusion. Foxes and Rabbits have burrowed here and there into the lower stratum; and all of the deposits where Frog bones were found had been disturbed, and contained bones of rabbits or domestic animals. Although I believe the Frog to have been an inhabitant of the country when these caves were used as the dwellings of wild animals, the contents of the caves do not confirm this theory.

FISH REMAINS.

A few vertebrae and teeth of fishes could not be determined with certainty. They may possibly be those of trout brought into the cave by birds of prey.

MOLLUSKS.

The cave deposits contained only two species of Land Shells, and one of these, viz., *Helix aspersa*, was clearly a comparatively modern intruder. The two Mollusks were *Helix aspersa* and *Helix nemoralis*, both of them still living and common all over Ireland.

Some of the specimens of *Helix nemoralis* were in surface deposits, but a shell in which even the bands were plainly visible (M.D. 185) was found under an unbroken stalagmite floor, and deeply embedded in it along with bones of Mammoth and Reindeer. Hence, it is evident that *Helix nemoralis* is an ancient inhabitant of Ireland, co-existing in the country with Mammals long since extinct.

Helix nemoralis and its near relation, *Helix hortensis*, are Western European in range, and have probably crept northward from a southern centre of distribution. Of the two species, *Helix hortensis* has much the widest distribution, for it occurs not only all over continental Western Europe, but in the British islands, the Faroes, Iceland, Greenland, and north-eastern North America. We may suppose, therefore, that it originated before *Helix nemoralis*; and yet, as far as we are able to ascertain from the appearance of the shell, only the latter has so far been detected in a fossil condition in Ireland.

4.—BIRD REMAINS.

The bones of birds from this cave collected by Mr. R. J. Ussher, although numerous, present no special points of interest. Of the 750 specimens sent to me for identification no fewer than 295 are referable to the Common Fowl, and are, no doubt, a comparatively modern introduction to the cave. The bones of Ducks, to the number of 104, may be in part wild and in part domestic birds; and, like the Fowls, have probably been brought in by Foxes. To the same agency may be attributed the 198 bones of Rooks, and possibly Crows, for the bones of the two species cannot be certainly distinguished. The geese are represented by sixty-six bones, and most of these are of a size indicative of the wild grey Goose; but a few may belong to a smaller species. There are eight rather small bones of the Turkey. The remaining species (13) in the following list are each represented by one, two, or three specimens only, and, with the exception of the swan, are just such forms as one might expect to meet with in a comparatively modern deposit; but it must be remembered that, with two or three exceptions, all the species in the accompanying list were probably inhabitants of the British Isles in Pleistocene times.

There are, it appears, at least two definite horizons in this cave: a lower one, with remains of Mammoth, Hyæna, Reindeer, Lemming, &c., sealed down by deposits of stalagmite; and a more modern accumulation above the stalagmite, containing recent mammals, but apparently no extinct forms. There can be no doubt as to the Pleistocene age of the lower deposit, nor of the much more recent period when the upper layer was accumulated. Although a large proportion of the birds' bones doubtless came from the newer deposit, yet Dr. Scharff assures me that some were certainly obtained from the lower beds, and these include Duck, Lesser Black-backed Gull, and Goose, a sternal fragment of the last-named being embedded in the stalagmite, in association with Reindeer and Bear.

[LIST OF SPECIES OF BIRDS IDENTIFIED.]

LIST OF SPECIES OF BIRDS IDENTIFIED.

Missel Thrush (<i>Turdus viscivorus</i>),	1
Blackbird (<i>Turdus merula</i>).	1
Magpie (<i>Pica rustica</i>),	1
Rook (?) (or Crow) (<i>Corvus frugilegus</i>),	198
Skylark (<i>Alauda arvensis</i>),	1
Goose (<i>Anser cinereus</i> (?) and a smaller species),	66
Swan (<i>Cygnus olor</i> (?)),	2
Duck (<i>Anas boscas</i> (?)),	104
Widgeon (?) (<i>Marca penelope</i> (?)),	1
Scaup (?) (<i>Fuligula marila</i> (?)),	1
Grouse (<i>Lagopus scoticus</i>),	1
Common Fowl,	295
Turkey,	8
Quail (?) (<i>Coturnix communis</i> (?)),	1
Landrail (<i>Crex pratensis</i>),	3
Moorhen (<i>Gallinula chloropus</i>),	3
Golden Plover (<i>Charadrius pluvialis</i>),	1
Lesser Black-backed Gull (<i>Larus fuscus</i>),	2
Fragments not yet determined,	60
	750

5.—SUMMARY OF RESULTS.

The results obtained from the laborious and costly work of excavating the Castlepook Cave are of considerable importance in elucidating a phase of the past history of Ireland. There are no unusual features connected with the mode of formation of the cave and its complicated galleries and tunnels. The existence of the cave is due to the solvent action of water on limestone rock, and to the same cause we must assign the occurrence of the layer of stalagmite. The sand which largely fills the passages was brought in mostly by running water.

To fix the geological period when the cave was formed was one of the problems which the promoters of the exploration set themselves to solve. Professor Seymour is inclined to believe that the cave is of pre-glacial age, but he admits that the geological evidence is inconclusive. The palaeontological testimony appears to him of more value. And he infers from this that

the formation of the cave has most probably taken place before the Glacial Period. Due consideration, no doubt, should be given to the evidence derived from the bones of animals which occur in such abundance. They are of great importance in establishing the age of the cave. Yet even this evidence is by no means conclusive. The very nature of the Glacial Period is still shrouded in mystery. Some geologists maintain that there were several Glacial Periods during the Pleistocene Era; others are of opinion that there was only one. If we accept Dr. Holst's view,¹ which is strongly supported by Mr. Kennard² on palaeontological grounds, there was only a single Glacial Period in the British Islands. They believe that it occurred towards the end of the Pleistocene. The deposits laid down during the earlier part of the Pleistocene Era would then be regarded as pre-glacial. If the climate during the Glacial Period was as severe as we are led to believe, no mammals could have wandered to Ireland at that time. And since there is no evidence to show that Ireland and Great Britain were connected with one another by land after Pleistocene times, we must assume that Ireland received its fauna before the Glacial Period. Considering that during the Forest Bed or Cromerian stage of geological history, which is generally looked upon as belonging to late Pliocene, the fauna of the British Islands contained some species which survived to the present time, there is really nothing surprising in this view. On the other hand, Dr. Holst's opinion has not been generally adopted by geologists, for it would tend to prove that the existing Irish fauna has maintained itself in Ireland since pre-glacial times. If Ireland had been completely covered by an ice-sheet, how could the Red Deer, Giant Deer, Reindeer, and Bear have found sustenance in the country to enable them to survive the hardships of an Arctic climate? Thus it must be evident that the animal remains found in Castlepook Cave do not prove that the cave or the fossiliferous sands we meet with are necessarily of pre-glacial origin. And yet it seems as if this cave, with the main part of its contents, is far older than any other cave that has been explored in Ireland. The animal remains are represented by two very distinct sets. The first portion was introduced into the cave long ago when it formed the home of Bears and Hyænas. The second set is apparently of late origin, having been brought in by pitfalls from the cultivated fields above the cave, and partly by means of recent Fox and Rabbit burrows. A very long interval of time, possibly amounting to many thousands of years, elapsed between the introduction into

¹ Holst, N. O.: "The Ice Age in England." *Geol. Mag. (N.S.)*, Dec. VI, vol. ii. 1915.

² Kennard, A. S.: "The Pleistocene Succession in England." *Proc. Prehist. Soc. East Anglia*, vol. ii, pt. 2. 1916.

the cave of these two sets of animal remains, and it appears as if the cave had been sealed up since it was occupied by the earlier inhabitants.

I shall now give a complete list of the animals whose remains have been discovered in the cave, marking those with an asterisk (*) which have been ascertained by their position in the deposits as belonging definitely to the earlier of the two periods.

MAMMALS.

Natterer's Bat.	*Scandinavian Lemming.
*Small Horse-shoe Bat.	*Arctic Lemming.
Domestic Cat.	*Irish Hare.
*Irish Stoat.	Rabbit.
*Fox.	*Mammoth.
*Arctic Fox.	Ox.
*Wolf.	Sheep.
Dog.	Goat.
*Spotted Hyana.	*Reindeer.
*European Bear.	*Irish Elk.
Brown Rat.	Horse.
*Field Mouse.	Domestic Pig.

BIRDS.

Missel Thrush.	Scaup. (?)
Blackbird.	Grouse.
Magpie.	Common Fowl.
Rook (?) (or Crow).	Turkey.
Skylark.	Quail. (?)
*Goose.	Landrail.
Swan.	Moorhen.
*Duck.	Golden Plover.
Widgeon. (?)	*Lesser Black-backed Gull.

AMPHIBIANS.

Common Frog.

MOLLUSKS.

**Helix nemoralis*.

It will be noticed that among those earlier occupants of the cave, a certain number, such as the Fox, Irish Stoat, Irish Hare, and others, have survived to the present day, and that the remains of some of these are also found among the later set of tenants. If the cave therefore was formed before the Glacial

Period, and inhabited by the animals above alluded to, the climatic conditions in Ireland could not at any time have been unfavourable to life. Large and small mammals, as well as birds, must have abounded in Ireland throughout the Glacial Period, for we find the bones of the Irish Elk, Reindeer, Bear, and many kinds of birds in bogs and marls which are certainly post-glacial in origin.

One of the most important facts that have been established by the Castlepook Cave Exploration is the former existence in Ireland of the Spotted Hyæna. It has never been suggested that this animal, which now inhabits central and southern Africa, once lived under arctic conditions. Yet our cave researches prove that the Hyæna devoured the carcasses of Reindeer, and that the Arctic Fox and two kinds of Lemming were contemporaneous with it in Ireland. It has also been shown that the Mammoth and Irish Elk flourished in this country at the same time, and that the climatic conditions were such that they reared their young, and that the latter occasionally fell a prey to the Hyæna. The Wolf was apparently not plentiful, whereas the Bear probably did not seriously interfere with these large herbivores.

A few remarks have already been made in the introduction with regard to the history of the present entrance to the cave and its relation to the old entrances. It may be pointed out that owing to its shallowness and want of good drainage the cave probably never was a dry one. It was at all times subject to earth-falls from above. The old entrances must have been on the north side. Now what Mr. Ussher called the Elephant Hall and the Hyæna Hall, with their adjoining galleries, contained an amazing quantity of bones, those of Reindeer being by far the most abundant. It is quite evident from the fact that the dung (coprolites) of Hyænas was met with, and from the number of crushed bone splinters, that these animals had their temporary abode in those halls which lie within fifty to a hundred feet from the present entrance. The Hyæna probably dragged the carcasses of the Reindeer through the existing entrance to these halls, there to devour them at its leisure.

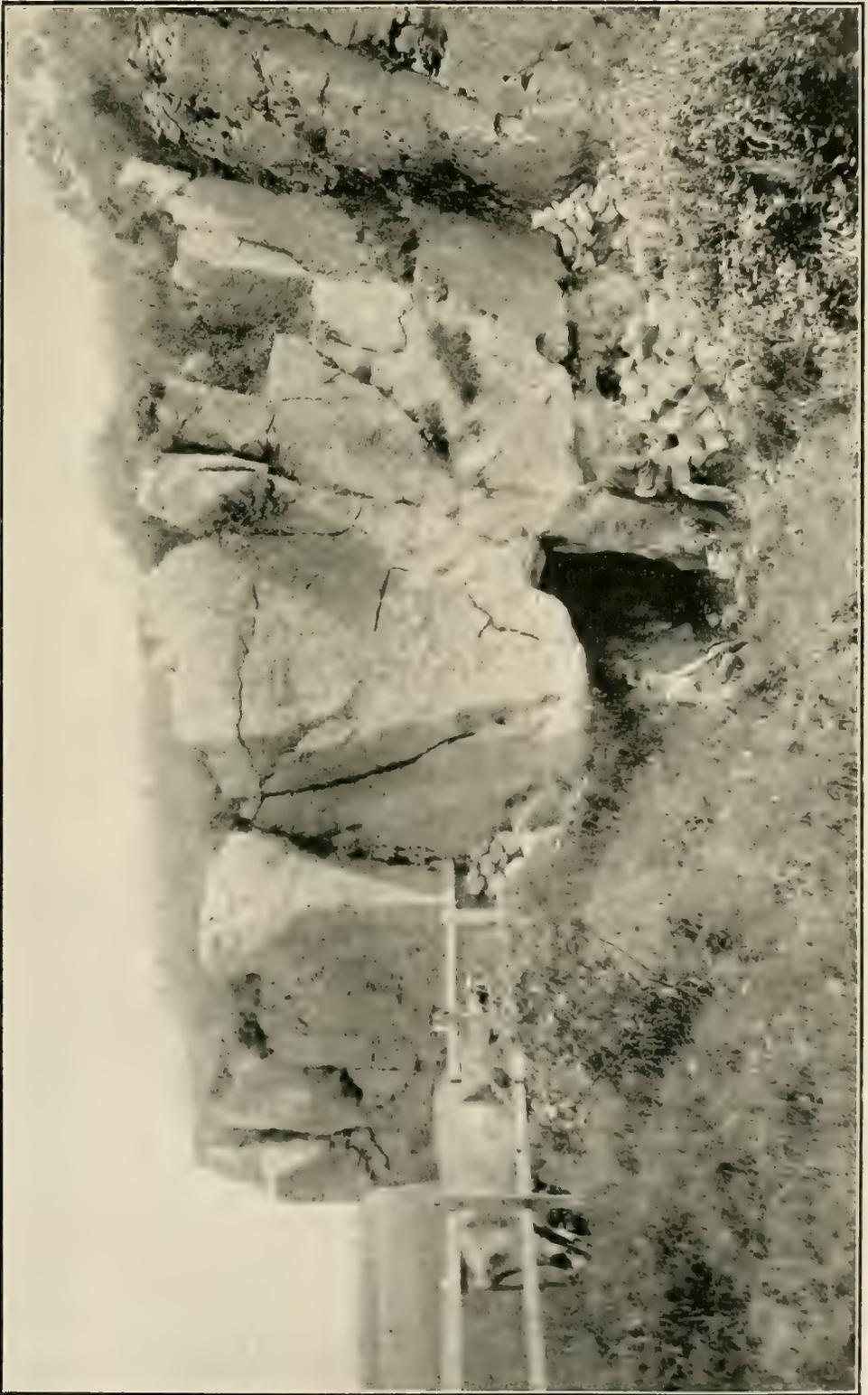
More abundant than Hyæna bones are the remains of Bears in those same halls. Bears must also have lived there, but, as Mr. Ussher has pointed out, their bones were as a rule lower down in the sand than those of the Hyæna. Hence Bears had probably occupied the cave, and abandoned it before the arrival of the Hyæna. We may assume that for a time the present entrance became blocked by pitfalls, when possibly one of the more westerly entrances, which was somewhat narrower, enabled the Hyæna to gain admission to the cave. For a long time this powerful carnivore inhabited the part of the cave known as "Hyæna Land," which is 400 feet from the entrance. It was there that the remains of very young Mammoths were most abundant, and that

also quantities of Hyæna dung occurred. Occasionally food was scarce, and then even old Bear bones were gnawed at. As a rule there was such a wealth of food that hundreds of Reindeer bones remained untouched.

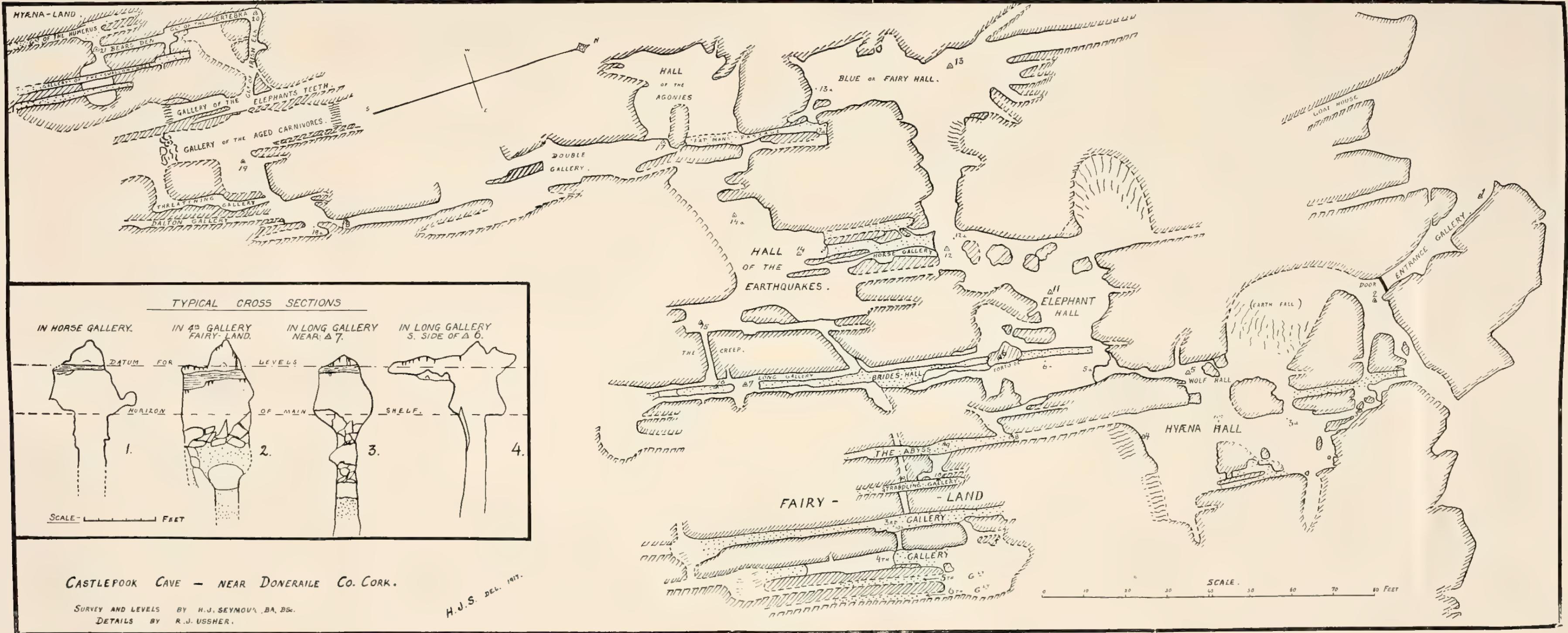
This will enable us to form some idea of the state of Ireland at those remote times. The total absence of any remains of Red Deer, Wild Boar, Badger, and other animals has already been commented upon, and may possibly be due to the nature of the ground surrounding the cave. There is, moreover, no reason to suppose that any human beings ever lived in the cave. No trace of the existence of man, while the cave deposits were laid down, has been discovered. Only a few quite modern implements, bits of charcoal, and an incised bone were met with, mostly due to pitfalls from the fields above the cave.



SCHARFF AND OTHERS.—CASTLEPOOK CAVE.



SCHARF AND OTHERS.—CASTLEPOOK CAVE.



SCHARFF AND OTHERS.—CASTLEPOOK CAVE

IV.

THE PRESENCE OF LATERAL SPIRACLES IN THE LARVA OF
HYPODERMA.

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AND

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[PLATES VIII-XIII.]

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It is well known that in the grubs of most beetles (Coleoptera) and in the caterpillars of moths and butterflies (Lepidoptera) there are paired functional spiracles on one or more of the thoracic segments and on the abdominal segments from the first to the eighth inclusive. But among many of the two-winged flies (Diptera) these breathing-holes are restricted to a large pair at the hinder end of the abdomen, a minute anterior pair, apparently belonging to the prothorax, being sometimes also present: these are the arrangements distinguished by Schiner ('62, p. iv) and Brauer ('69) as "metapneustic" and "amphipneustic" respectively, in contrast with the "peripneustic" type in which nine or more pairs of spiracles are present, extending in lateral series along the body. Probably no student of the morphology of insect larvae doubts that the metapneustic or amphipneustic condition of the respiratory system has been derived from the more primitive peripneustic condition by the suppression of the intermediate spiracles. This specialization through reduction is correlated with the mode of life followed by many dipteran larvae, the grubs of gnats (Culicidae) and the "rat-tailed maggot" of the drone-flies (*Eristalis*) living in water and thrusting the tail-end of the body, where the spiracles open, through the surface-film to reach the atmosphere above, the maggots of muscoid flies feeding half buried in refuse, decaying organic matter, plant-tissues, or (in the case of parasites) in animal bodies, where series of lateral spiracles would be useless or dangerous on account of their liability to become choked. This line of speculation is

worked out in Palmén's classical memoir ('77) on the tracheal system of insects.

If the metapneustic condition be indeed the outcome of the suppression of the greater number of a series of paired spiracles originally present, it might be expected that some of these should be recognizable in a vestigial condition. Yet it appears that no account of such reduced spiracles in any muscoid or similar larva has hitherto been published, although the minute anatomy of such maggots as those of the Bluebottle (*Calliphora*) and the Housefly (*Musca*) has been carefully and repeatedly studied. The only statement of their existence known to us in entomological literature is in a brief paper by Pantel ('91), who, without giving description or figures, writes: "Or d'après nos recherches sur les tachinaires, les larves amphipneustiques possèdent bien les stigmates et trachées stigmatiques complémentaires prévus par Palmén, et ainsi se trouve justifiée, dans ce qu'elle a de fondamentale, la théorie de cet auteur." After stating that in the larvae examined by him, the lateral spiracles "demeurent rudimentaires à tous les stades, aussi bien que les trachées stigmatiques correspondantes," and pointing out that the large complex functional tail-spiracles cannot therefore be, as Palmén imagined, due to the approximation of spiracles originally belonging to three distinct segments [sixth, seventh, and eighth abdominal], Pantel tells us no more about these extremely interesting structures except that "les stigmates rudimentaires adominaux sont situés aux niveaux d'insertion des muscles métamériques."

With the study of the subject in this condition, it is with great satisfaction that we are able to certify the presence of a paired series of minute lateral spiracles and of solidified air-tubes connecting them with branches of the main longitudinal tracheal trunks in the highly specialized larvae of the Ox Warble-fly (*Hypoderma*). These vestigial structures are present in fourth-stage larvae of both the common species of *Hypoderma*—*Hypoderma bovis* (De Geer) and *H. lineatum* (Villers), as well as in the Reindeer Warble-fly, *Oedemopsis borealis* (Linné). The details given in this paper have been established for the most part by observations on *Hypoderma bovis*. These maggots live during their later stages, as is well known, just beneath the skin of the backs of cattle, the large sub-ocular dorso-posterior spiracular plates situated immediately below the breathing-hole that is bored through the hide of the beast which serves as host, while the head end being buried in the sub-cutaneous tissue the mouth absorbs the fluid-products of the inflammation set up in the "warble" or swelling induced by the parasite's presence. The *Hypoderma* larva is therefore typically metapneustic in accordance with its mode of life, yet six pairs of vestigial lateral abdominal spiracles are

present as well as an anterior pair of functionless spiracles just behind the mouth; these latter, which were recognized and figured by Joly ('46, pl. viii, fig. 2, *o*) in the ripe maggot of *Hypoderma bovis*, and by Brauer ('63, Tab. viii, fig. 4) in the final-stage larva of *Oedemagena tarandi*, seem to correspond with the prothoracic, fan-like spiracles of the typical muscoid maggots.

The lateral spiracles in the *Hypoderma* larva were revealed to us through the observation, on dissection, of the white and thread-like solidified air-tubes connecting branches from the longitudinal tracheal trunks with the body-wall, outside the cuticle of which, when thus directed, we had little difficulty in recognizing the tiny spiracular depressions. So far we have not succeeded in finding these lateral spiracles in the earlier instars of *Hypoderma*, nor in any muscoid maggots that we have had the opportunity of examining; nor in the familiar "leather-jacket" grub of the Crane-fly (*Tipula*). But as we have made a fairly full study of the structures in the ripe (fourth-stage) *Hypoderma* larva, we offer our results as some contribution to a fascinating morphological question, hoping that we may be able to supplement our observations at some future date. Before proceeding to the detailed account of the newly discovered spiracles and their relation to the tracheal system, some references to the segmentation of the Warble-maggot and the structure of its cuticle are necessary.

THE SEGMENTATION OF THE HYPODERMA LARVA.

Students of the maggots of the most highly organized Diptera have all recognized the difficulty of interpreting the body-segmentation of these larvae—at once so specialized and so degraded. The forward end shows, as is well known, no definite head, but two or three segments seem to be present in front of that which bears the small anterior spiracles. This segment, according to Lowne ('92, pp. 34-5, fig. 10), is the fourth; according to Hewitt ('08, p. 511, pl. 30, fig. 5), the third post-oral somite, so that the "tail-segment" which bears the posterior spiracles is the fourteenth according to Lowne's or the thirteenth according to Hewitt's reckoning. Neither of these authors suggests what correspondence any of these segments may have with those of a generalized insect, but Hewitt's enumeration may perhaps imply that, the head being degenerate, the segment of the anterior spiracles may be the meta-thorax. Now it seems to us that consideration of the segment of the posterior spiracles may yield more certain guidance, and that as in insects generally the hindmost spiracular segment is the eighth abdominal, this is the correct identification of the "tail-segment" of a muscoid maggot. The segment of the anterior spiracle will thus be reckoned—in conformity with the opinions

of several students—as the prothorax, and the doubtful series in front of this be referred to the head or neck. Such is the scheme of nomenclature which we adopt. In the maggot of *Hypoderma* (see figs. 1, 2, 3), the head region is most abnormally shortened, so that the anterior spiracles lie only a short distance dorsal to the mouth (see figs. 12, 13), close to the suture (figs. 12, 13, *p.g.*), that marks the boundary of the puparium-lid. The extreme anterior position of this front spiracular segment in the Warble-maggot makes it unlikely that the segment can represent anything further back than the prothorax. Accepting this view, the vestigial lateral spiracles occur on the second to the seventh abdominal segments inclusive, and the large posterior spiracles on the eighth, as suggested above. It must not be forgotten, however, that in the peripneustic larvae of some Diptera which may reasonably be regarded as primitive—the Cecidomyiidae and the Bibionidae (Morris, '17), for example—the ninth abdominal segment bears a pair of spiracles larger than those on the other segments. The possibility must therefore be recognized, that in the grubs of the Tipulidae, in the maggots of the Muscoidea, and in metapneustic and amphipneustic larvae generally, the apparent segment that bears the large tail-spiracles may be due to a coalescence of the eighth and ninth abdominal segments.

NOTE ON THE CUTICLE OF THE HYPODERMA LARVA.

The Warble-maggot is notoriously a "tough-skinned" insect, and sections through the body-wall show the extensive thickening of the secondary cuticle (see figs. 11, 14). We have obtained fairly good results with sections cut from spirit-specimens and stained with "light green," by which the two layers of the chitinous cuticle usually recognized are clearly demonstrated. The outermost layer or *primary cuticle* is thin, very hard, and stains strongly in its deeper stratum (figs. 11, 14, *ct. 1*): its superficial region (figs. 11, 14, *ct.*), which hardly takes the green stain, is divided into scale-like areas on the outer surface, which, in microscopical preparations, appears like "crocodile leather" (figs. 5, 6, 13, 14). These areas correspond to the flattened epidermal cells which secrete the cuticle.

Beneath the primary cuticle is the clear, transparent, well-developed *secondary cuticle* (figs. 11, 14, *ct. 2*) which does not take the light green stain, but shows feeble results with such a plasma stain as haematoxylin. It contains a number of clear granules, apparently harder than the general substance of the cuticle; these granules are especially numerous near the attachment of a muscle, or where the spiracular air-tubes pierce the body-wall (fig. 11, *gr.*). The innermost region of the secondary cuticle appears in

places somewhat distinct (fig. 11, *ct.* 2 *a*) as a very clear stratum with the lamination parallel to the surface showing distinctly. Beneath it is the *epidermis* (fig 11, *ep.*) consisting as usual of a sheet of flattened epithelial cells.

THE TRACHEAL SYSTEM OF THE FOURTH-STAGE LARVA OF HYPODERMA.

The tracheal system of the fourth-stage larva of *Hypoderma bovis* consists of a pair of longitudinal trunks dorso-lateral in position and running the whole length of the body, and communicating with the exterior by a pair of thick-lipped, strongly chitinized posterior spiracles, situated on the apparently hindmost segment of the body, towards its dorsal aspect (figs. 1, 2, 3, *p. s.*). A pair of anterior spiracles (figs. 1, 2, 3, *a. s.*) and six pairs of lateral spiracles (figs. 1, 2, 3, *l. s.*) are also present, but the tail-spiracles alone are functional, the air-tubes connected with the anterior and lateral spiracles being plugged with cores of chitin. The longitudinal trunks are connected posteriorly by one, and anteriorly by three, transverse tracheae (fig. 3, *p. c., a. c.*). The posterior connexion is so close to the hinder body-wall and spiracles as not easily to be seen. Of the three anterior connectives, the foremost is the largest, the two hinder being comparatively fine. The longitudinal trunks give off a number of branches, the chief of which are as follows:—Beginning from the posterior end, each trunk gives off from its outer side a tube which at once divides into two, and each branch runs downwards and forwards for some distance until it splits up and is lost in the fat-body; this tube apparently belongs to the eighth abdominal segment. In front of this each trunk gives off twelve tubes arranged in an outer and an inner series of six, belonging to the abdominal segments from the second to the seventh inclusive. The inner tube (figs. 2, 3, *d. int. tr.*) keeps near the dorsal body-wall, and soon divides into many fine branches. The outer tube runs ventralwards and gives off three principal branches; of these, that nearest to the trunk goes to the digestive tract (fig. 3, *dig. tr.*), coming off at an angle from the middle tube (fig. 3, *l. tr.*), which is distributed to the ventral and lateral body-wall, muscles, &c., and which gives off near its base the outermost branch (fig 3, *sp. tr.*), an exceedingly fine tube—as described below, plugged up for nearly all its length and connected with the vestigial lateral spiracle. The intestinal trachea of the fourth abdominal segment on either side (figs. 3, 20, *dig. tr.* 4) is strongly dilated, forming a pyriform sac whose chitinous lining is exceedingly thin, and wants the usual spiral strengthening. This dilated trachea in the ripe warble-maggot was seen and figured by Joly ('46, pl. viii, fig. 13) seventy years ago, and a series of

somewhat similar sacs have since been described by Enderlein ('99, Taf. i, fig. 8) in the larva of *Cobboldia elephantis*.

In front of the tubes so far mentioned, there are given off from each main trunk two outer tubes corresponding with the first and third anterior connectives (which we believe to belong respectively to the mesothorax and the first abdominal segment) in the same way as the rest of the abdominal outer tubes correspond with the inner ones of the same segments. From this it seems likely that these latter may be derived from original transverse connectives which have lost their direct continuity. There are apparently no outer tubes corresponding with the second (metathoracic) of the three anterior connectives (fig. 3, *a, c, 2*). The outer tubes in front of the second abdominal have no connexion with any lateral spiracles, nor do they divide into definite inner and outer ramifications; they break up into a number of fine tracheae, those from the foremost branch going to the sucking pharynx. Of the three anterior transverse connectives, the second and third respectively give off two and eight branches which run forwards (fig. 3, *a, c, 2, 3*). The main longitudinal trunks are continued forwards as plugged tracheae which lead to the anterior spiracles (figs 1, 2, 3, *a, s.*), as described in detail below.

THE LATERAL SPIRACLES AND THEIR TRACHEAL CONNEXIONS.

There are six pairs of exceedingly minute lateral spiracles situated on the second to the seventh abdominal segments inclusive (figs. 1, 2, 3, *l, s.*). The cuticle of the larva is divided into broad dorsal and ventral areas, which are separated along either side of the body by three longitudinal areas, marked on most of the segments by projections or spinose bosses; these three regions may be distinguished as the dorso-lateral, lateral, and ventro-lateral areas (figs. 1, 2, *l, 1, a, l*). The lateral spiracles are situated on the smooth cuticle between the lateral and ventro-lateral areas near the anterior border of each segment. Viewed externally (figs. 4-6) the spiracle appears as a small aperture among the scale-like areas of the superficial cuticle. On the fifth abdominal segment, for example (fig. 4, *iv*) there is a simple cup-like depression, surrounded by a smooth zone showing radiating crack-like markings. In the case of the spiracles at the front and hinder ends of the series (figs. 4, *i, ii, vi, 5*) the cavity is seen to be overhung with a thickened edge of the scale-like area of the cuticle. Viewed from within the body-wall, through the transparent substance of the secondary cuticle, such a spiracle (fig. 6) has the appearance of a conical cavity, one side of which is strengthened by a curved ridge of dense chitin (fig. 6, *d, e*). The surface-markings (fig. 6, *m.*) around the spiracular cavity and the scale-like areas of the outer surface are visible through the secondary cuticle.

A series of sections cut tangential to the surface of the body-wall (figs. 7, 8, 9, 10) show the following features of structure. The spiracular cavity (fig. 7) is lined with a dense but thin layer of chitin (*ct.*) continuous with the outer non-staining layer of the primary cuticle. Around this is the thicker stratum of deeply staining primary cuticle (*ct. 1*) of varying density. Surrounding this is the translucent non-staining chitin which forms the thick secondary cuticle (*ct. 2*) of the body-wall. Tracing the sections inwards, it is found that the walls of the cavity become much folded (fig. 8), and that they finally come together when the dense lining chitin is reduced to a few crumpled sheets in the midst of a solid plug of the deeply staining primary cuticle (fig. 9, *ct. 1*). When the spiracular trachea leaves the body-wall and enters the body-cavity, this plug becomes narrow and sinuous in cross-section, and a continuation of the clear secondary cuticle surrounds it as a sheath (fig. 10, *ct. 1, ct. 2*), the crumpled sheets of dense chitin having altogether disappeared. There is no complete dense chitinous tube formed around this as in the case of the tubes connected with the anterior spiracles (see below, p. 80, fig. 18, *ct. 2 a*). The usual epithelial tube, continuous with the sub-cuticular epidermis (figs. 10, 11, *ep.*), surrounds the whole, and in all our preparations is not in contact with the secondary cuticular coat of the solidified trachea. This structure persists until the solidified tube merges into a short stretch of open trachea with the normal spiral thickening (fig. 20, *sp. tr.*) which comes off as the outermost branch of the outer segmental tube as already described. The presence of the normal spiral thickening at the origin of the spiracular branch is convincing evidence of the nature of the structures whose appearance is here described; this is well demonstrated in the photograph reproduced on Plate XIII (fig. 21).

THE ANTERIOR SPIRACLES.

The anterior spiracles are situated on the first thoracic segment, above and on either side of the mouth (fig. 12). A marked groove (figs. 12, 13, *p. g.*) runs above the mouth, and extends backwards to the dorsal aspect of the first abdominal segment, indicating the suture bounding the lid of the puparium. The anterior spiracles (fig. 12, *a. sp.*) are situated immediately dorsal to this groove. The lower lip (fig. 13, *v. l.*) of each is crescentic in shape and raised rather above the dorsal border of the spiracle, which has no definite lip. The anterior spiracles are situated directly at the extreme anterior ends of the longitudinal tracheal trunks.

The structure of the anterior spiracles is best shown by a series of sections through one of them, cut tangential to the body-wall (figs. 14-18). Tracing

the sections inwards from the exterior, we see that at first the spiracle is a wide open cavity (fig. 14, *c*) in the substance of the body-wall, lined by a thin layer of the dense feebly staining chitin (*ct.*) and surrounded by an area of deeply staining chitin (*ct.* 1). Further in (fig. 15) the cavity is much narrowed, and the walls have become folded, though the same areas of chitin are still discernible. The walls of the cavity now begin to approach each other, so that the aperture becomes smaller and smaller (fig. 16) until finally it disappears entirely, leaving the deeply staining chitin as a central core (fig. 17, *ct.* 1). Before the cavity is finally obliterated, curved pieces of dense, hard chitin, apparently specialized portions of the secondary cuticle (fig. 16, *ct.* 2*a*), have begun to appear round the deeply staining area. When traced inwards, these close round the above-mentioned core, so as to form a continuous tube (fig. 18, *ct.* 2*a*). This structure continues when the tube has left the body-wall and entered the body-cavity, a layer of translucent chitin of the secondary cuticle (fig. 18, *ct.* 2*b*) being interposed between the solid core and the walls of the tube above described, i. e., a tube of hard chitin entirely filled by a deeply staining core with a covering of transparent chitin, but showing no trace of the spiral structure as in the ordinary tracheae. After some distance the trachea widens considerably, the solid core ceases abruptly, and is replaced by a cavity many times its diameter, the walls of which are strengthened by the usual spiral structure (fig. 19).

So far as we are aware, the anterior spiracles in *Hypoderma* or any of its near allies have never been described except for Brauer's drawing of their position in *Oribomyza variabilis* (163 Tab. viii. fig. 4). It is of interest to find that the air-tubes leading to these structures are plugged up with a chitinous core, so that they cannot be functional; they are indeed vestigial like the lateral spiracles described in the present paper. In this respect the anterior spiracles of *Hypoderma* offer a striking contrast to the corresponding structures in *Gastrophilus*, which have recently been well described and figured by Kusek (199 Taf. ii. figs. 26, 27). These are provided with a number of fine apertures, and may be confidently regarded as functional. The divergence in larval structure between *Hypoderma* and *Gastrophilus* is thus considerable, and we have failed to find any trace of lateral spiracles in the latter. In this connexion, it is of interest to note that some modern systematic students of the Diptera have ceased to regard the Oestriidae as a natural family, assigning *Hypoderma* to the Tachinidae, and *Gastrophilus* to the Anthomyiidae. This classification is adopted, for example, by Schnabl and Dziedziicki in their monograph (11) on the latter family, in which special importance is attached to the male genital armature and the arrangement of the thoracic bristles in the fly.

CONCLUSION.

Our failure to find vestigial lateral spiracles, corresponding with those of the *Hypoderma* maggot, in the larva of any other muscoid fly that we have examined for them is rather disappointing in view of Pantel's statement, already quoted, that they are present in tachinine larvae. We have had no opportunity of studying examples of the last-named group, but in the maggot of the bluebottle and in other dipteran larvae—that of *Tipula*, for example—we thought that we had detected them, only to find later that we were examining cuticular bristle-bearing pits from which the bristles had been broken off. We do not for a moment suggest that so careful an insect-anatomist as Pantel could have been deceived in this way; but if we understand aright his statement that "les larves amphipneustiques possèdent bien les stigmates et trachées stigmatiques complémentaires prévus par Palmén," he seems to imply that he has detected them on all the body-segments of the tachinine larvae, whereas in *Hypoderma* we find them only on the abdominal segments from the second to the seventh inclusive.

If these lateral spiracles are indeed absent from many genera of muscoid flies in the larval state, their presence must be regarded as a definitely primitive character, and it becomes all the more surprising to find them in a maggot like that of *Hypoderma*, specialized in many ways for a parasitic life and remarkable for the extreme reduction of the anterior region, so that the front spiracles, belonging to the prothorax, lie only just behind the mouth. The facts set forth in this paper suggest that, if *Hypoderma* be really a near ally of the typical muscoids, it must have diverged from the common stock before these larval lateral spiracles had been lost, so that the specialized parasitic habit of the group must have begun at a period comparatively remote from to-day.

The life-history of *Hypoderma* is of much practical interest on account of the damage caused by the maggots to the hides of cattle, and this paper may be regarded as a by-product of a series of researches, largely economic in their object, affording an illustration of the inadvisability of trying to draw a sharp demarcation between "pure" and "applied" science. And it may be gratifying to those who believe that morphological lines of inquiry have still much instruction to yield to the student to find that one of the commonest and best-known of the insect-larvae of the farm exhibits such a remarkable and unexpected series of vestigial organs, which throw light on the history and relationships of a highly specialized group.

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EXPLANATION OF PLATES.

PLATE VIII.

FIG.

1. *Hypoderma bovis*. Fourth-stage larva. Lateral view. $\times 5$.
a. s., anterior spiracle; *l. s.*, 1-6, lateral spiracles; *p. s.*, posterior spiracles; *p. g.*, suture bounding lid of puparium; *d.*, dorsal; *d. l.*, dorso-lateral; *l.*, lateral; *v. l.*, ventro-lateral; *v.*, ventral area of 2nd abdominal segment. Size of lateral spiracles is exaggerated.
2. *H. bovis*. Diagram of tracheal system. Lateral view. } $\times 5$.
3. The same. Ventral view. }
 I-III, segments of thorax; 1-8, segments of abdomen.
a. s., anterior spiracles; *l. s.*, 1-6, lateral spiracles; *p. s.*, posterior spiracles; *long.*, longitudinal tracheal trunks; *a. c.*, 1-3, anterior connectives; *p. c.*, posterior connective; *d. int. tr.*, dorsal internal tracheae; *dig. tr.*, tracheae to digestive tube (numbers refer to the abdominal segments; note the sac-like swelling of *dig. tr.* 4); *l. tr.*, outer lateral tracheae; *sp. tr.*, spiracular tracheae (solidified).

PLATE IX.

4. *H. bovis*. Fourth-stage larva, I-VI. The six lateral spiracles on the right side as seen in surface view. $\times 500$.
5. Left posterior lateral spiracle, surface view. $\times 500$.
sp. c., spiracular cavity; *c. r.*, chitinous ridge.
6. Left posterior lateral spiracle as viewed from within. $\times 500$.
m., markings around cavity (seen through secondary cuticle);
c. r., chitinous ridge formed by inturned scale-like area of primary cuticle; *ct.*, vestigial spiracular trachea, solidified as chitinous plug.

PLATE X.

7. Lateral spiracle in tangential section.
8. The same, deeper in the body-wall. } $\times 700$.
9. The same, showing closure of cavity. }
10. Solidified spiracular trachea in cross-section. $\times 500$.
11. Transverse section of body-wall, showing lateral spiracle (*l. s.*) and its trachea. $\times 80$.
ct., outer, and *ct. 1*, inner, layer of primary cuticle; *ct. 2*, secondary cuticle; *gr.* granules in same; *ep.* (figs. 10, 11), epidermis.

PLATE X—continued.

FIG.

12. *H. bovis*. Fourth-stage larva, front end, showing position of anterior spiracles (*st. sp.*) in relation to mouth (*m.*) and suture (*p. g.*) bounding puparial lid. $\times 10$.

PLATE XI.

13. *H. bovis*. Fourth-stage larva. Left anterior spiracle. $\times 300$.
r. l., ventral lip of spiracle; *p. g.*, suture bounding puparial lid.
14. Anterior spiracle in tangential section, through spiracular cavity. }
 15. The same, deeper in the body-wall. }
 16. The same, showing closure of cavity. }
 17. Transverse section of anterior spiracular trachea with solid chitinous core and dense envelope of secondary cuticle (*ct. 2 a*). } $\times 700$.
 18. The same at deeper level in the body-wall, showing complete ring of dense secondary cuticle (*ct. 2 a*) surrounding zone of normal secondary cuticle (*ct. 2 b*) enclosing chitinous core (*ct. 1*).

Other lettering as in figs. 7-10.

PLATE XII.

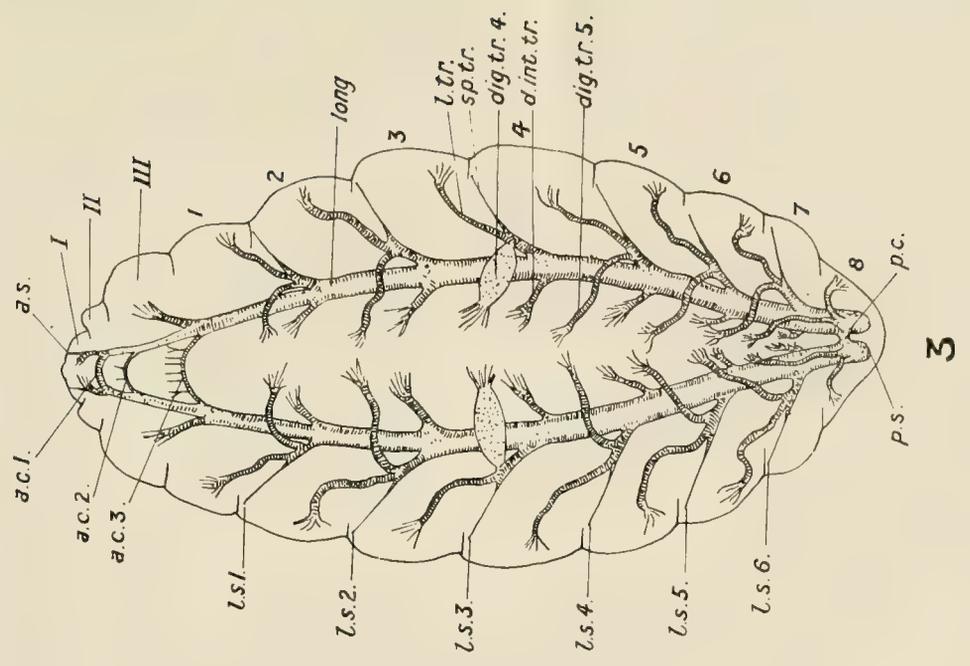
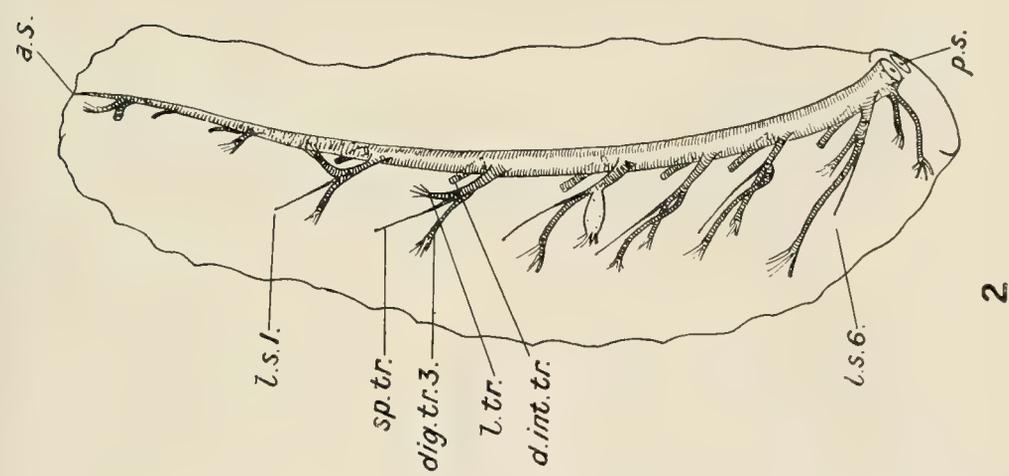
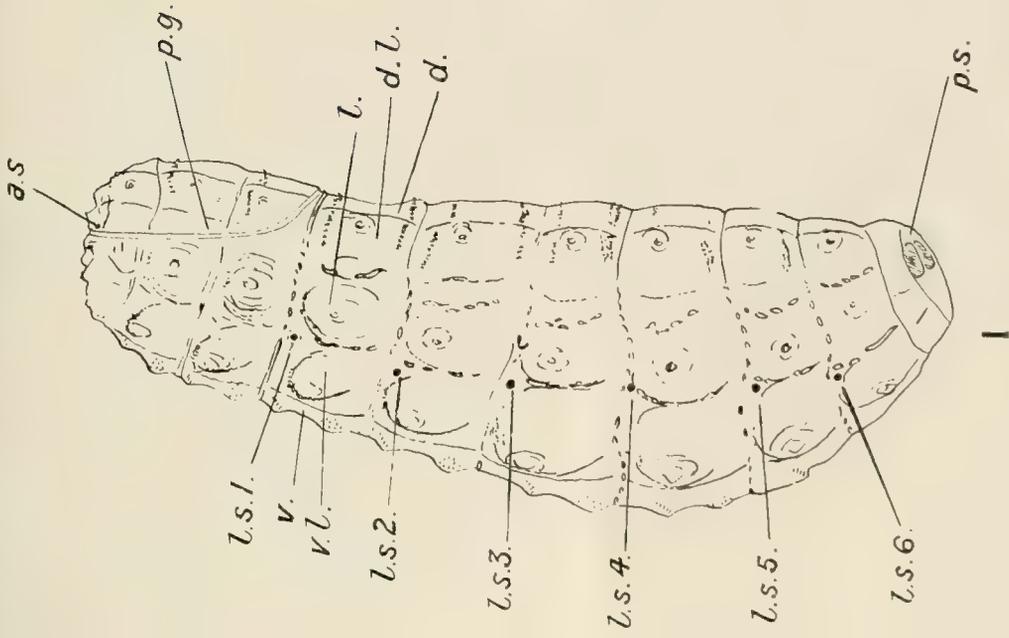
19. *Hypoderma bovis*. Fourth-stage larva. Portion of front extension of longitudinal trunk bounding anterior spiracular trachea, showing sudden transition from part plugged with chitinous core (*ct. 1*) to open tube (*tr.*) with normal spiral thickening. $\times 200$.
20. Portion of right longitudinal tracheal trunk (*long.*). $\times 30$.

Lettering as in fig. 3.

PLATE XIII.

21. *H. bovis*. Fourth-stage larva. Photograph showing piece of body-wall with posterior lateral spiracle (*l. sp.*) connected with air-tube system by solidified trachea. $\times 40$.
22. Photograph of part of longitudinal trunk with branches of fourth abdominal segment in connection with the third lateral spiracle. $\times 15$.

(Photographs by H. Pattison.)

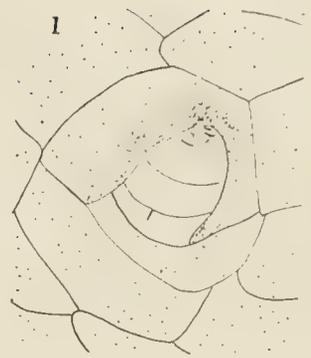
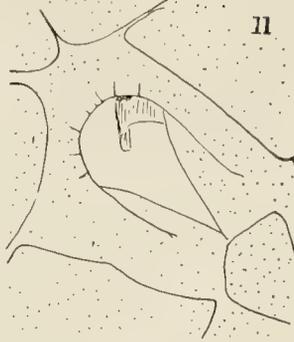
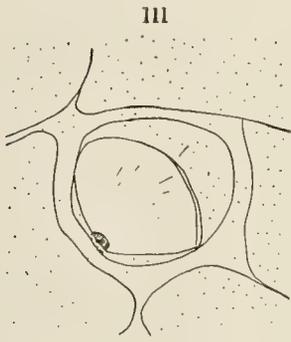


CARPENTER AND POLLARD—TRACHEAL SYSTEM AND LATERAL SPIRACLES OF THE LARVA OF HYPODERMA.

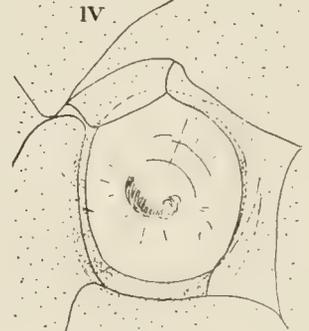
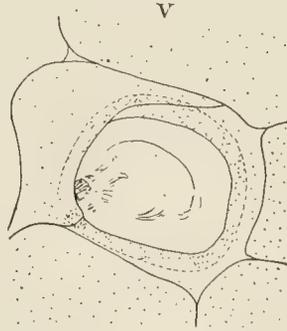
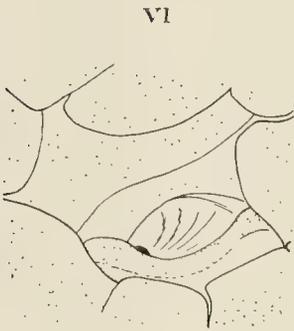
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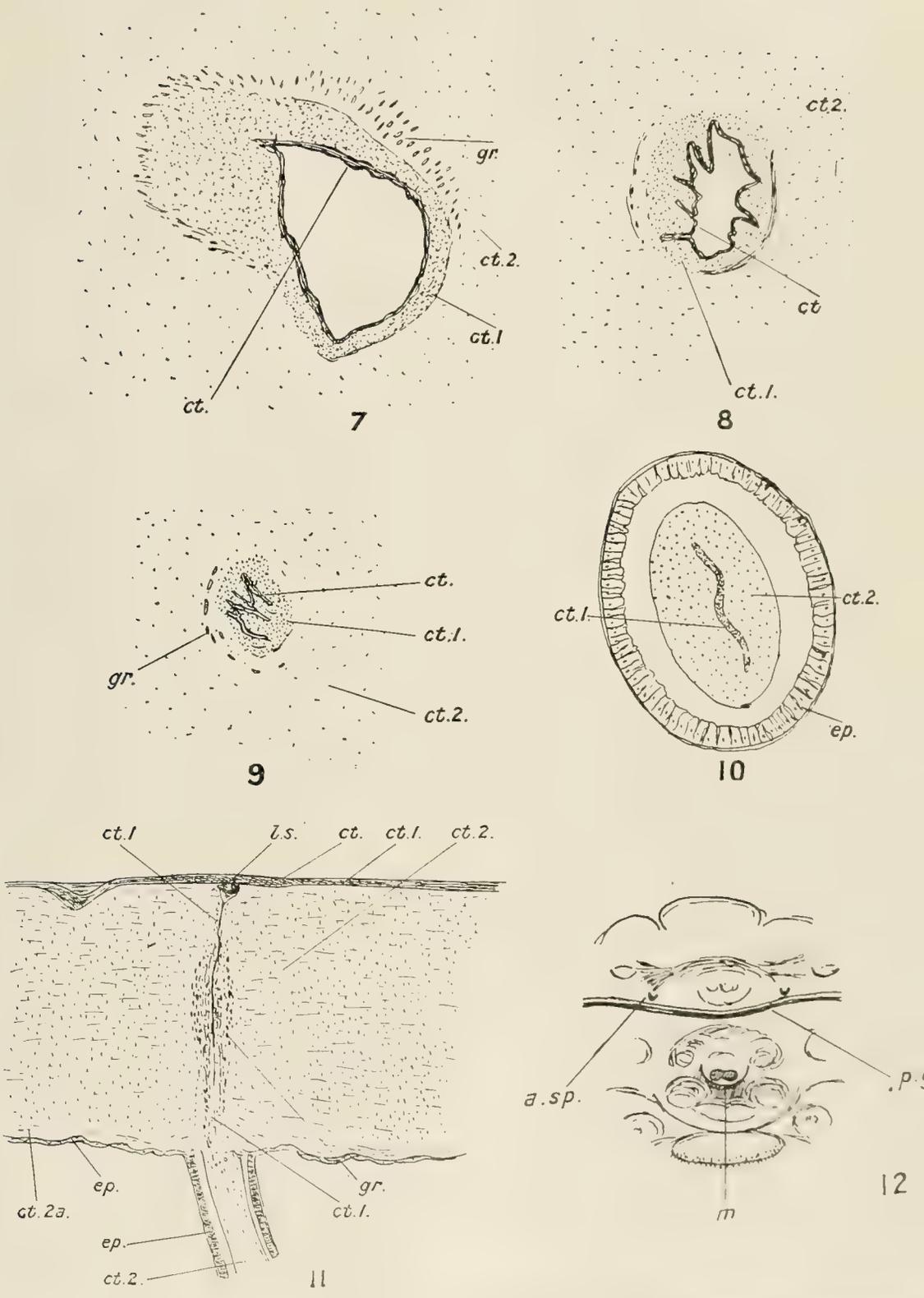
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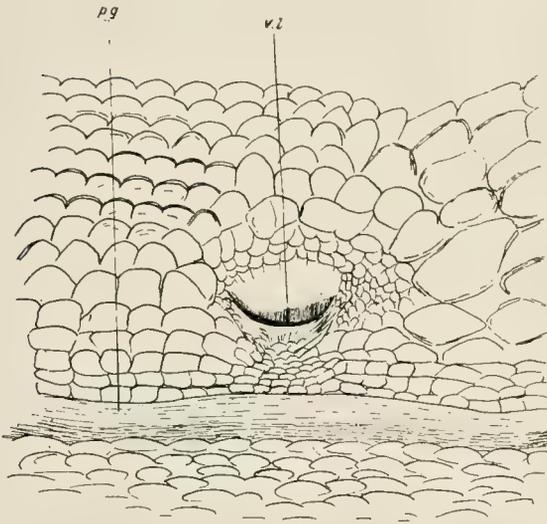
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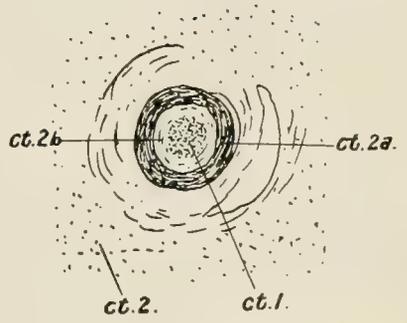
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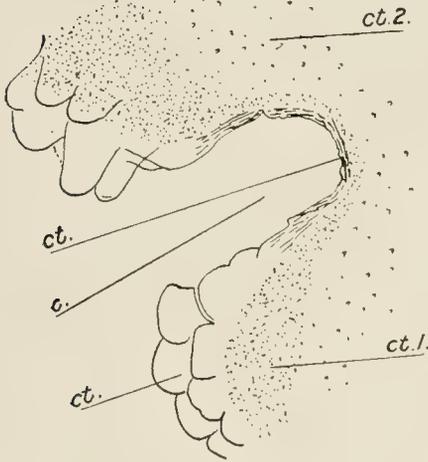
CARPENTER AND POLLARD—LATERAL (figs. 7-11) and ANTERIOR (fig. 12) SPIRACLES OF THE LARVA OF HYPODERMA.



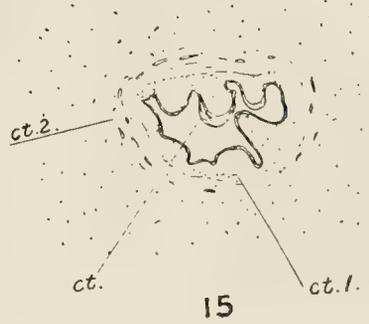
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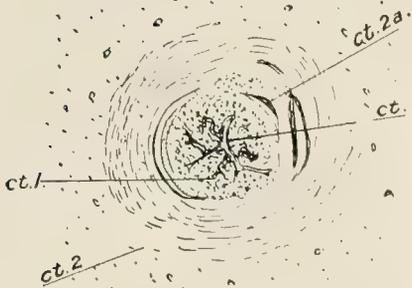
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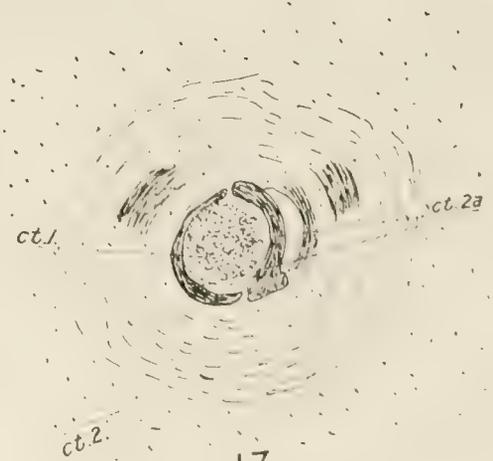
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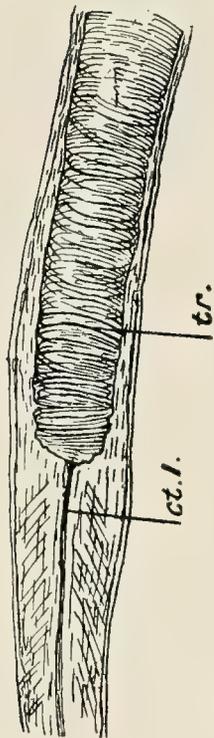


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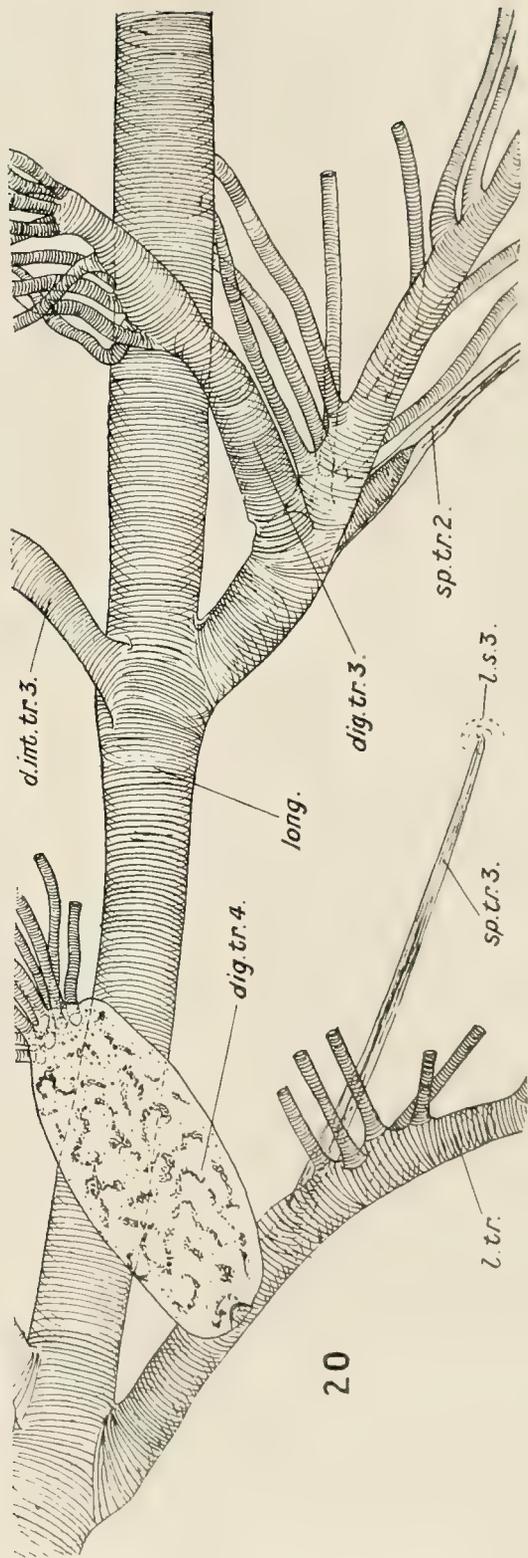


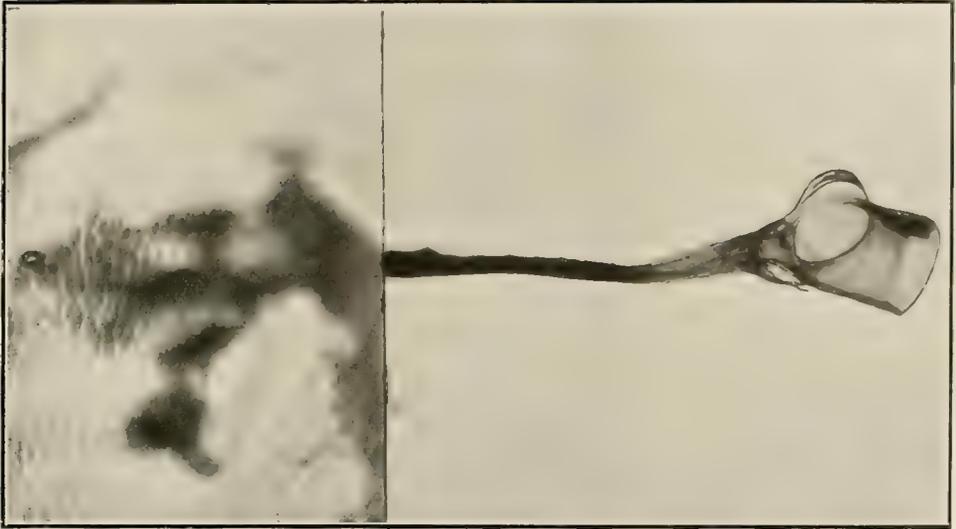
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V.

SYNTHESES OF SOME NEW SUBSTANTIVE DYES DERIVED
FROM BENZIDINE-SULPHONE.

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Read APRIL 22. Published AUGUST 13, 1918.

SINCE the compounds obtained by coupling naphthols and amines with the tetrazo derivatives of benzidine are amongst the most important of the direct cotton dyes, any further investigation of substances of this type is likely to prove of interest and importance.

The present paper deals with a number of dyes of the benzidine type, obtained by coupling hydroxy and amino compounds with the tetrazo derivative of benzidine-sulphone-disulphonic acid.

The preparation of benzidine-sulphone-disulphonic acid is described by P. Griess and C. Duisberg (Ber. 22, p. 2459), who state that it combines, when tetrazotised, with naphthols and naphthol-sulphonic acids, yielding purple to violet dyes, and with naphthylamines and naphthylamine-sulphonic acids, forming red or bluish-violet colouring matters. References also occur in Patent literature (Friedlander I, p. 495, and II, p. 408, and Baeyer & Co., D. R. P. 27,954 and 51,497) to red to blue dyes obtained by coupling the above-mentioned tetrazo compound with α - and β -naphthylamines, and with Schäffer's, "R" and "G" acids. None of the dyes mentioned, however, seem to have been isolated in a pure condition, nor does it appear that any effort was made to determine their constitution and chemical properties.

The various colouring matters described in this communication were obtained in a pure condition as sodium salts. Repeated efforts to obtain them as crystalline substances were unsuccessful. The coupling of the different hydroxy and amino compounds with the tetrazo derivative took place readily in somewhat alkaline solution, and, as a rule, the coupling was complete after

about twenty-four hours. The yield of crude product obtained was usually almost quantitative. All the compounds mentioned acted as direct dyes towards cotton, and the colours obtained were unaffected by washing. The dyeing was effected by dissolving .15 gram of the dye stuff (3 per cent. on the weight of cotton) in a little warm water, and adding it to 100 c.c. of water containing 2 per cent. of sodium chloride and 2 per cent. of sodium carbonate. To the dye-bath was added 5 grams of the thoroughly washed cotton, and the whole was slowly raised to boiling point, and finally boiled for one hour.

The colours obtained with the different compounds varied over a wide range, as is shown in the following table:—

ADJUNCT.	DESCRIPTION.	COLOUR IN SOLUTION.	SHADE ON COTTON.
Sulphanilic acid, ..	Orange-red powder, ..	Deep red,	Canary yellow.
Dimethylaniline, ..	Dark blue powder, ..	Deep red,	Deep purple.
Naphthionic acid, ..	Dark blue powder, ..	Bright red,	Purple.
α -Naphthylamine, ..	Dark red powder, ..	Deep red,	Navy blue.
β -Naphthylamine, ..	Reddish powder, ..	Deep red,	Violet red.
Salicylic acid, ..	Reddish brown powder, ..	Yellow,	Orange.
Schäffer's acid, ..	Dark blue powder, ..	Deep red,	Light purple.
"R-acid,"	Reddish blue powder, ..	Deep red,	Violet red.
"G-acid,"	Reddish powder,	Deep red,	Pink.
"H-acid,"	Blue powder,	Deep blue,	Light blue.
Pyrocatechin, ..	Dark blue powder, ..	Dark golden,	Light brown.
Resorcin,	Dark purple powder, ..	Light cherry-red, ..	Maroon.
Hydroquinone, ..	Brown powder,	Light amber,	Buff.
Pyrogallol,	Chocolate brown powder, ..	Light amber,	Buff.
Gallic acid,	Dark brown powder, ..	Light brown,	Very light brown.

It will be seen from the above table that the compounds obtained by coupling the tetrazo derivative with hydroquinone, pyrogallol, and gallic acid gave rather poor shades on cotton, whereas most of the other compounds gave good colours. There is a very striking difference in the shades produced when α - and β -naphthylamines are used as adjuncts, the former giving a navy blue and the latter a violet-red colour. On the whole, the amino compounds seem to give bluer colours than the hydroxy compounds.

Apart from the dyeing properties of these tetrazo derivatives, it is possible that they may prove of importance in the chemotherapy of *Spirilla*.

The chemotherapeutic properties of the following dyes of the benzidine series have been examined:—

Naga-red (Benzidine coupled with β -naphthylamine-3-6-disulphonic acid).

Trypan-red (Benzidine - mono - sulphonic acid coupled with β -naphthylamine-3-6-disulphonic acid).

Trypan-blue (Tolidine coupled with amido-H-salt).

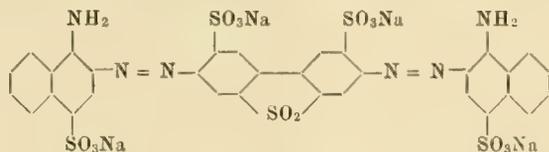
Trypan-red was tested by Vassel (*Comptes Rendus de la Soc. de Biol.*, 62 (1907), p. 414), and recognized as effective in the treatment of diseases due to Spirilla; and Manteufel (*Arbeiten aus dem Kaiserlichen Gesundheitsamt*, 29, No. 2) also recognized the beneficial effect of benzidine dyes. Mesnil's trypan-violet has also been employed in addition to his trypan-blue. An investigation of the chemotherapeutic properties of the dyes mentioned in this paper is at present in progress.

EXPERIMENTAL PART.

Tetrazotisation of Benzidine-Sulphone-Disulphonic Acid.

A solution of 20.3 grams of benzidine-sulphone-disulphonic acid in 150 c.c.s. of water containing 20 c.c.s. of concentrated hydrochloric acid was cooled with ice to 5° C. 15 c.c.s. of concentrated hydrochloric acid were added, and the solution tetrazotised by slowly adding, a few drops at a time, a solution of 7.2 grams of sodium nitrite in a little water. The tetrazo solution was stirred vigorously and the nitrite added until it gave a slight reaction with starch-iodide paper.

1. *Coupling of Benzidine-Sulphonc-Disulphonic Acid with Naphthionic Acid.*

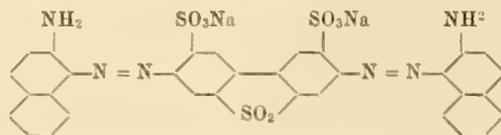


The tetrazotised solution mentioned above was poured into a cold concentrated solution of 75 grams of sodium naphthionate (a large excess to obtain a better yield), and the mixture was stirred mechanically for two days. After the first half-hour's stirring, a solution of 35 grams of sodium carbonate was added, a few drops at a time, so that the whole was used up by the end of the second day. Next day the colouring matter was heated to 80° C., and the mixture saturated with common salt. The colouring matter, which separated on cooling, was filtered and dried. The mass was purified for analysis

by dissolving in hot dilute alcohol, and filtering while hot. On cooling, it separated out, and was filtered and dried. It is a dark blue amorphous powder, easily soluble in water to a purple red solution. The compound dyed cotton directly a purple shade.

1837 substance gave 13.2 c.c. moist nitrogen at 11° C. and 756 mm. P.,
 corresponding to N = 8.52,
 $C_{32}H_{15}N_6Na_4S_5O_{14}$ requires N = 8.73.

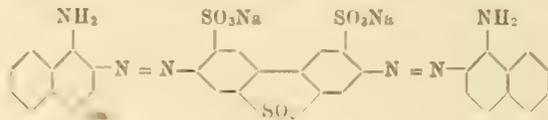
2. *Coupling of Benzidine-Sulphone-Disulphonic Acid with β -Naphthylamine.*



A cold solution of 44 grams of β -naphthylamine in a mixture of 600 c.c.s. of water and 30 c.c.s. concentrated hydrochloric acid was prepared, and into this was poured the tetrazotised solution from 20.3 grams of benzidine-sulphone-disulphonic acid. The mixture was stirred mechanically for two days, and after the first half-hour's stirring a solution of 50 grams of sodium carbonate was added slowly, so that the whole was added by the end of the second day. After standing overnight, the colouring matter was heated to 80° C., and the mixture saturated with common salt and cooled, when the precipitated colouring matter was dried and ground. It was purified from dilute alcohol, from which it readily separated, and was dried at the pump. The pure substance is a reddish amorphous powder, which dissolves in water, giving a deep-red solution. The substance dyed cotton directly a violet red.

1608 substance gave 14.6 c.c.s. moist nitrogen at 13° C. and 770 mm. P.,
 corresponding to N = 10.87,
 $C_{32}H_{20}N_6Na_2S_3O_6$ requires N = 11.0.

3. *Coupling of Benzidine-Sulphone-Disulphonic Acid with α -Naphthylamine.*

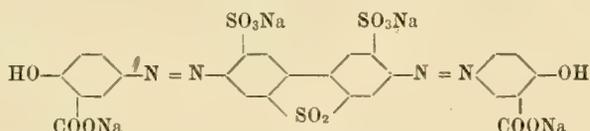


As in the preceding preparation, the tetrazotised product of 20.3 grams benzidine-sulphone-disulphonic acid was poured into a cold solution of 44 grams α -naphthylamine in a mixture of 600 c.c.s. of water, with 30 c.c.s. HCl, and the mixture stirred by means of a turbine for two days. After

stirring for half an hour, a solution of 50 grams of sodium carbonate was added slowly, drop by drop, so that by the end of the second day the entire solution was used up. The colouring matter was separated as described above, and dried. It was purified from dilute alcohol, and separated as a dark red powder, giving a deep red solution in water. The pure dye stuff acted on cotton directly, giving a navy blue shade.

·0918 substance gave 8·5 c.cs. moist nitrogen at 14° C. and 760 mm. P.,
 corresponding to $N = 10\cdot89$,
 $C_{32}H_{20}N_6Na_2S_3O_8$ requires $N = 11\cdot0$.

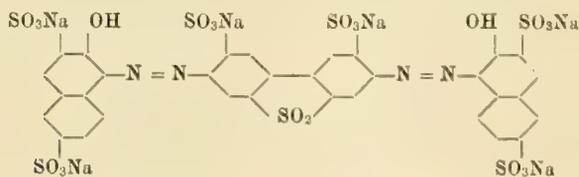
4. *Coupling of Benzidine-Sulphone-Disulphonic Acid with Salicylic Acid*



A solution of 16 grams of salicylic acid in 100 c.cs. of cold water was prepared and added to 6·5 grams sodium carbonate. The tetrazotised solution of benzidine-sulphone-disulphonic acid was poured into this mixture, and stirred mechanically for two days. After the first half-hour's stirring a solution of 30 grams of sodium carbonate was slowly added, at such a rate that the whole was used up by the end of the second day. After standing overnight, the colouring matter was precipitated by the addition of common salt after heating to 80° C. on the water bath. It was filtered and purified by separation from hot dilute alcohol. The substance is a reddish-brown amorphous powder, which gives a yellow solution in water, and dyes cotton directly an orange shade.

·1253 substance gave 7·2 c.cs. moist nitrogen at 17° C. and 760 mm. P.,
 corresponding to $N = 6\cdot67$,
 $C_{26}H_{12}O_{14}Na_4N_4S_3$ requires $N = 7\cdot07$.

5. *Coupling of Benzidine-Sulphone-Disulphonic Acid with "R-Acid"*
 (*β-Naphthol-3·6-Disulphonic Acid*).



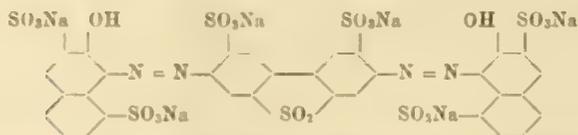
The tetrazotised solution of 20·3 grams of benzidine-sulphone-disulphonic

acid was slowly added to a solution of "R-salt," which was prepared by dissolving 40 grams of "R-salt" in 400 c.c.s. of water, adding 10 grams of caustic soda, with 5 grams of sodium carbonate, and cooling to 15° C. During the addition the whole was stirred mechanically, and the stirring was continued for five hours afterwards. Next day the colouring matter was heated to 80° C., and the solution saturated with common salt, when the colouring matter was precipitated and filtered. It was purified by dissolving in hot water, filtering, and cooling. The compound separated easily on cooling the solution, and was filtered and dried.

·2344 substance gave 9·7 c.c.s. moist nitrogen at 16° C. and 769 mm. P.,
 corresponding to N = 4·80,
 $C_{22}H_{14}N_4O_{22}S_7Na_6$ requires N = 4·79.

The compound when pure is a reddish-blue powder, which dissolves in water to a deep-red solution, and dyes cotton directly a violet red.

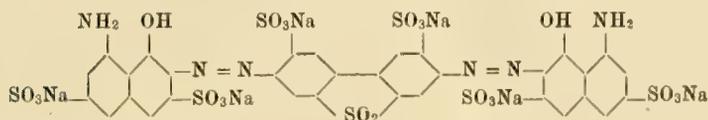
6. *Coupling of Benzidine-Sulphonic-Disulphonic Acid with "G-Acid"*
 (*β-Naphthol-3·8-Disulphonic Acid*).



Benzidine-sulphonic-disulphonic acid (20·3 grams) was dissolved in 150 c.c.s. of water and tetrazotised. The tetrazo solution was slowly added to the "G-salt" solution, which was prepared by dissolving 40 grams of "G-salt" in 400 c.c.s. of water, adding 10 grams of caustic soda, with 5 grams of sodium carbonate, and cooling to 15° C. During the addition the mixture was stirred mechanically, and the stirring was continued for five hours afterwards. After standing overnight, the mixture was heated to 80° C., and the colour precipitated by saturation with common salt. The colouring matter was filtered and dried. The compound was purified by heating with dilute alcohol and filtering, when it separated out on cooling. It is a reddish amorphous powder soluble in water to a deep-red solution, and acts on cotton as a direct dye, giving a pink shade.

·2420 substance gave 10·3 c.c.s. moist nitrogen at 16° C. and 768 mm. P.,
 corresponding to N = 5·0,
 $C_{22}H_{14}N_4O_{22}S_7Na_6$ requires N = 4·79.

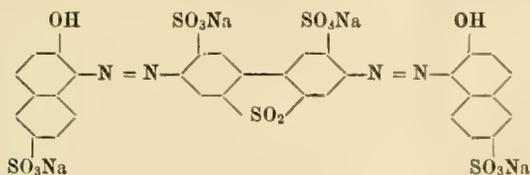
7. *Coupling of Benzidine-Sulphone-Disulphonic Acid with "H-Acid"*
 (1 Amino-8-Naphthol-3-6-Disulphonic Acid).



The tetrazotised solution of benzidine-sulphone-disulphonic acid was added slowly, with constant stirring, to a solution of "H-acid," which was prepared by dissolving 40 grams of "H-acid" in 450 c.cs. of water, and adding 40 grams of sodium carbonate, the mixture being cooled to 15° C. When all was added, the mixture showed an alkaline reaction. The stirring was maintained vigorously for five hours afterwards, when the liquid was heated to 80° C., saturated with common salt, and filtered. It is a deep blue amorphous powder, giving a deep blue colour in alkali solution and red in acid solution. It was purified by separation on cooling from hot dilute alcohol. The substance dyes cotton directly a light blue.

1880 substance gave 10.8 c.cs. moist nitrogen at 16° C. and 760 mm. P.,
 corresponding to N = 6.67,
 $C_{32}H_{16}N_6O_{22}Na_6S_7$ requires N = 7.01.

8. *Coupling of Benzidine-Sulphone-Disulphonic Acid with Schäffers Acid*
 (β -Naphthol-6-Monosulphonic Acid).



A solution of Schäffers acid was prepared by dissolving 27 grams of the acid in 200 c.cs. of water containing 35 grams of sodium carbonate, and cooling the mixture to 50° C. The mixture was stirred vigorously by means of a turbine, and the tetrazotised solution from 20.3 grams of benzidine-sulphone-disulphonic acid was slowly added; the stirring being maintained for five hours afterwards. On standing overnight the colouring matter was heated to 80° C., and precipitated by the addition of common salt. It was then filtered and dried. The compound was purified by heating with water and a little alcohol, then filtering and allowing to cool when the dye stuff

separated out. This process was repeated a number of times in order to obtain the compound pure for analysis.

·1940 substance gave 9·4 c.es. moist nitrogen at 16° C. and 762 mm. P.,

corresponding to N = 5·66,

$C_{32}H_{16}O_{16}S_2Na_4N_4$ requires N = 5·80.

The pure compound is a dark-bluish amorphous powder which gives a deep-red solution in water, and dyes unmordanted cotton a light-purple shade.

9. *Coupling of Benzidine-Sulphonic Acid with Pyrocatechin.*



The benzidine-sulphonic acid (22·3 grams) was tetrazotised in the usual manner after which it was added to a cold solution of 30 grams of sodium carbonate with constant stirring. 12 grams of Pyrocatechin, dissolved in a little water, were added immediately, and the stirring continued for a day. After standing overnight the solution was heated on a water-bath to 80° C., and the colouring matter precipitated by the addition of common salt, when it was filtered at the pump, dried, and ground. It was purified as before by repeated separation, on cooling, from hot dilute alcohol.

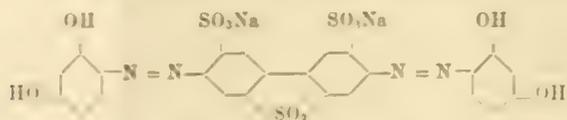
·1586 substance gave 10·8 c.es. moist nitrogen at 16° C. and 763 mm. P.

corresponding to N = 7·90,

$C_{24}H_{14}O_{12}N_4Na_2S_2$ requires N = 8·10.

The pure substance is a dark-bluish amorphous powder soluble in water to a dark-brown solution, and dyed cotton directly a light-brown.

10. *Coupling of Benzidine-Sulphonic Acid with Resorcin.*



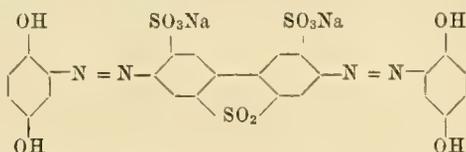
The method adopted was similar to that used for Pyrocatechin. 22·3 grams of benzidine-sulphonic acid were dissolved in 150 c.es. of water, and tetrazotised with a concentrated solution of 7·2 grams of sodium

nitrite. This tetrazotised solution was added to a cold solution of 30 grams of sodium carbonate, the mixture being stirred vigorously during the addition. A solution of 12 grams of resorcin, in a little water, was added immediately, and the stirring continued for about 8 hours, when the mixture was allowed to stand overnight. It was then heated to 80° C., and the colouring matter precipitated by the addition of common salt, when it was filtered and dried. It was repeatedly purified from dilute alcohol.

·2374 substance gave 15·6 c.cs. moist nitrogen at 16° C. and 765 mm. P.,
 corresponding to N = 7·80,
 $C_{24}H_{14}O_{12}N_4Na_2S_3$ requires N = 8·10.

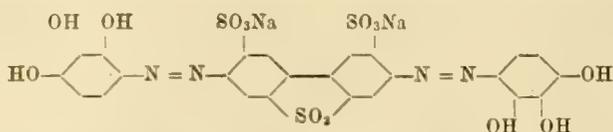
The pure compound is a dark-bluish amorphous powder, dissolving in water to a light cherry-red solution, and dyes cotton directly a beautiful maroon shade.

11. *Coupling of Benzidine-Sulphone-Disulphonic Acid with Hydroquinone.*



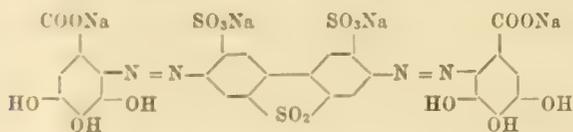
The benzidine-sulphone-disulphonic acid (22·3 grams) was dissolved in 150 c.cs. of water, and tetrazotised in the usual manner with 7·2 grams of sodium nitrite. The tetrazotised solution was added to a cold solution of 30 grams of sodium carbonate, the mixture being stirred mechanically, and 12 grams of hydroquinone, dissolved in a small quantity of water, was added immediately. After stirring the mixture vigorously for eight hours, it was left standing overnight. It was then heated on a water-bath to 80° C., and, having been maintained at this temperature for half an hour, common salt was added when the precipitated colouring matter was filtered and dried. The dye-stuff is a brown sandy-coloured amorphous powder giving a light amber-coloured solution in water. It was purified by separation on cooling from hot dilute alcohol, and acted on cotton as a direct dye giving a buff shade.

·1850 substance gave 12·3 c.cs. moist nitrogen at 15° C. and 768 mm. P.,
 corresponding to N = 7·96,
 $C_{24}H_{14}O_{12}S_3Na_2N_4$ requires N = 8·10.

12. *Coupling of Benzidine-Sulphone-Disulphonic Acid with Pyrogallol.*

The method adopted was similar to that for the previous dihydroxyl compounds. The benzidine-sulphone-disulphonic acid having been tetrazotised and added with constant stirring to a cold solution of 30 grams of sodium carbonate, the solution of pyrogallol (21 grams) was added immediately. During the addition the mixture was stirred vigorously, the stirring being continued for eight hours afterwards. On standing overnight, the mixture was heated to 80 C., and saturated with common salt, when the colouring matter was precipitated. It was filtered at the pump, and purified for analysis by repeated separations on cooling from hot dilute alcohol. The purified compound is a chocolate-brown amorphous powder, giving a light amber solution in water. It dyes cotton directly a buff shade.

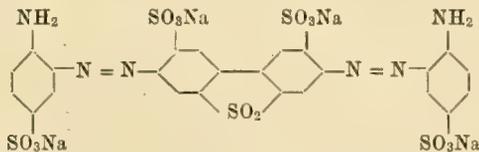
1030 substance gave 6.7 c.c.s. moist nitrogen at 15°C. and 767 mm. P.,
 corresponding to N = 7.70,
 $C_{21}H_{14}O_{11}N_4Na_2S_2$, requires N = 7.73.

13. *Coupling of Benzidine-Sulphone-Disulphonic Acid with Gallic Acid.*

Gallic acid (21 grams) was dissolved in 100 c.c.s. of water, and the solution obtained by tetrazotising 20.3 grams of benzidine-sulphone-disulphonic acid was added with constant stirring, which was maintained mechanically for two days. After the mixture had been stirred for half an hour a solution of 35 grams of sodium carbonate was added, a few drops at a time, so that the whole was used up by the end of the second day. After standing overnight the mixture was heated to 80 C. and saturated with common salt when the dye-stuff was precipitated. It was purified by repeated separations, on cooling from hot dilute alcohol, and formed a dark-brownish amorphous powder soluble in water to a light-brown solution. The colouring matter dyes cotton directly a very light-brown.

·2774 substance gave 15·2 c.cs. moist nitrogen at 16° C. and 761 mm. P.
 corresponding to N = 6·35,
 $C_{26}H_{12}O_{18}Na_4N_4S_3$ requires N = 6·54.

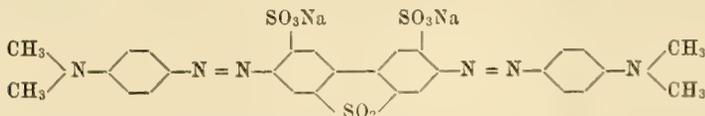
14. *Coupling of Benzidine-Sulphone-Disulphonic Acid with Sulphanilic Acid.*



The tetrazotised solution of the benzidine-sulphone-disulphonic acid (20·3 grams) was poured into a cold concentrated solution of 58 grams of sulphanilic acid to which 35 grams of sodium carbonate had been added, and the mixture stirred mechanically for two days. After the first half-hour's stirring a solution of 20 grams of sodium carbonate was slowly added so that the whole was used up by the end of the second day. On standing overnight the mixture was heated on a water-bath to 80° C., and the colouring matter precipitated by the addition of common salt, when it was filtered and dried. The compound was purified by bringing it quickly into solution in hot water, in which it was easily soluble to a deep-red solution, which, on cooling, deposited the dye-stuff as a deep orange-red amorphous powder. It was hardly soluble in cold water. In spite of successive purifications the substance was not obtained in a crystalline condition. The compound dyes cotton directly a canary-yellow shade.

·1640 substance gave 13·5 c.cs. moist nitrogen at 17° C. and 770 mm. P.,
 corresponding to N = 9·68,
 $C_{24}H_{14}O_{14}N_6Na_4S_5$ requires N = 9·74.

15. *Coupling of Benzidine-Sulphone-Disulphonic Acid with Dimethylaniline.*



The dimethylaniline (37 grams) was cooled in ice in a large beaker, and into it was poured, with constant stirring, the solution obtained by tetrazotising, in the usual manner, 20·3 grams of benzidine-sulphone-disulphonic acid. The mixture was stirred vigorously for two days. After stirring for half an hour a solution of 35 grams of sodium carbonate was

slowly added, drop by drop, at such a rate that the total quantity was used up by the end of the second day. The mixture on standing overnight was heated on a water-bath to 80° C., saturated with common salt, and maintained at this temperature for half an hour. The precipitated colouring matter was filtered and purified by repeated separations, on cooling, from hot dilute alcohol.

·1624 substance gave 16·2 c.cs. moist nitrogen at 16° C. and 764 mm. P.,

corresponding to N = 11·68,

$C_2H_{24}O_5N_6Na_2S_3$ requires N = 11·76.

The dye-stuff is a dark-bluish amorphous powder soluble in water to a deep-red solution. It gives direct on cotton a fine deep-purple shade.

VI.

ON THE NITRO DERIVATIVES OF DIPHENYLAMINE.

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University College, Dublin.

Read APRIL 22. Published AUGUST 13, 1918.

THE study of the products formed by the action of nitric acid on diphenylamine, beset as it is by many experimental difficulties, is rendered all the more tedious by the existence in the chemical literature of discrepancies with regard to the polynitro derivatives of the base.

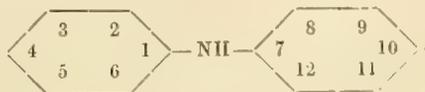
Thus 4-nitro-diphenylamine¹ is described by O. N. Witt (Ber. d. Dtsch. Chem. Ges. xi (1878), p. 757) as *orange* leaves melting at 132°C., by Irma Goldberg (D. R. P. 187870) as *orange-red* leaves melting at 133°C., by E. Bamberger (Ber. d. Dtsch. Chem. Ges. xxxi (1898), p. 580) and F. Ullmann (D.R.P. 193448) as *yellow* crystals.

Pieryl-aniline is described as *red* prisms by Clemm (Ber. iii (1870), p. 126), and as *orange* needles by E. Bamberger and Müller (Ber. d. Dtsch. Chem. Ges. xxxiii (1900), p. 108).

Similarly for 2, 4, 8, 10-tetranitro-diphenylamine Hager (Ber. d. Dtsch. Chem. Ges. xvii (1884), p. 2629) gives the melting-point as 180°C., A. Pictet and E. Klein (Arch. d. Sciences phys. et nat., Genève (4) xvi (1903), pp. 191-212) as 197°C., Gnehm and Wys (Ber. d. Dtsch. Chem. Ges. x (1877), p. 1319) as 192°C., and P. Juillard (Bull. Soc. Chim., Paris (3) 1905, pp. 1172-1190) as 199°C.

For the removal of the discrepancies with regard to the properties of the nitro-derivatives, and for the establishing of the constitutions of the latter

¹The numerical nomenclature of the diphenylamine derivatives discussed in this communication is based on the formula



where doubt existed we have deemed it necessary to prepare, in a pure condition, some of the more important of these nitro derivatives in a manner which would leave no doubt as to their constitutions.

We have, in addition, attempted the preparation of some hitherto unknown nitro derivatives of diphenylamine in the hope that a study of their properties may enable us to detect them if present, even in small quantities, amongst the substances formed by the action of nitric acid, at low temperatures and concentrations, on diphenylamine.

The various methods which have been recommended for coupling aromatic amines with the halogen derivatives of aromatic nitro bodies have been examined by us, and we have found that in general the best results are got by the method of Ima Goldberg (D.R.P. 185663, 187870; cf. Ber. d. Dtsch. Chem. Ges. xl (1907), pp. 4541-4546), in which a nitrobenzene solution of the components is heated for several hours with anhydrous potassium carbonate and cuprous iodide, or traces of copper and potassium iodide. In this way we obtained 4- and 3-nitro-diphenylamines which had been previously prepared by I. Goldberg (*loc. cit.*) and the hitherto unknown 3.10-dinitro-diphenylamine, but attempts to prepare 3.9-dinitro-diphenylamine by this method were unsuccessful.

2.4.8.10-Tetranitro-diphenylamine, which frequently occurs amongst the nitration products of diphenylamine, had not been previously obtained by direct coupling of a nitro-amine with the halogen derivative of an aromatic nitro-body. We obtained it by Goldberg's method from 2.4-dinitro-aniline and 2.4-dinitro-bromo-benzene, a synthesis which removes any doubt that may have existed as to the constitution of the compound. We did not, however, succeed in effecting the combination of picryl chloride and 2.4-dinitro-aniline, by which we hoped to effect a synthesis of 2.4.6.8.10-pentanitro-diphenylamine.

Although basic amines, such as aniline, combine easily with the nitro-derivatives of bromo-benzene, nitro-derivatives of the amines do not interact so easily with nitro-derivatives of the halogen compound, and in some cases we were unable to isolate any pure product of the reaction. Since, in some cases, it has been observed that a nitro group may be replaced by an amine residue more easily than a halogen atom, we examined the behaviour of β - and γ -trinitro-toluenes in reactions such as those we were studying.

γ -Trinitro-toluene interacts easily in alcoholic solution with *m*- and *p*-nitranilines forming well-crystallised derivatives of 5-methyl-diphenylamine, and a small amount of a crystalline product formed by the action of β -trinitro-toluene on *m*-nitraniline is probably derived from the same base.

We also examined the action of the oxyacids of nitrogen on some nitro-

derivatives of diphenylamine which are not usually met amongst the products of the action of those acids on the base.

3-Nitro-diphenylamine was converted by nitrous acid into its nitroso derivative, and from the latter by the action of nitric acid in the cold a crystalline compound, which melted at 184°C ., and was apparently a trinitro-diphenylnitrosamine, was obtained.

On the other hand, 2,4,9-trinitro-diphenylamine was converted by isoamylnitrite in acetic acid solution into a crystalline substance melting at 190°C ., the analysis of which agreed more closely with that required for a tetra-nitro-diphenylamine than with that for a trinitro-diphenylnitrosamine. A similar treatment of picryl-aniline yielded two compounds, one of which melted at 236°C ., and was probably 2,4,6,8,10,12-hexanitro-diphenylamine, and the other melted at $193\text{--}194^{\circ}\text{C}$., and seemed to be 2,4,6,8,10-pentanitro-diphenylamine.

EXPERIMENTAL.

A. *Mono-Nitro-Diphenylamines.*

1. *4-Nitro-diphenylamine* $\text{O}_2\text{N} \cdot \text{C}_6\text{H}_4 \cdot \text{NH} \cdot \text{C}_6\text{H}_5$.

We obtained this substance in a manner similar to that by which it had been previously prepared by Goldberg (*loc. cit.*). From the parent substances—acetanilide and *p*-nitro-bromo-benzene—utilised by us in the reaction, the nitro-diphenylamine was formed in good yield. It was purified by crystallisation from alcohol and carbon tetrachloride. From the latter solvent it separated in large, beautiful, iridescent, yellow plates, which became opaque on standing, or more rapidly on being heated. When dry it melted at $133\text{--}134^{\circ}\text{C}$., and was found to be identical with the product formed by the action of alcoholic potash on 4-nitro-diphenylnitrosamine. According to Goldberg it should give a blue colouration with concentrated sulphuric acid. We found, however, that its solution in concentrated sulphuric acid was colourless, and became intensely violet on addition of sodium nitrite. When warmed with alcoholic potash it formed a blood-red coloured solution.

2. *3-Nitro-Diphenylamine* $\text{O}_2\text{NC}_6\text{H}_4 \cdot \text{NH} \cdot \text{C}_6\text{H}_5$.

We obtained 3-nitro-diphenylamine melting at 112°C . by the method described by Goldberg (*loc. cit.*), and converted it by means of nitrous acid into 3-nitro-diphenylnitrosamine. To a well-cooled solution of 4 g. of 3-nitro-diphenylamine and 3 g. of hydrochloric acid (sp. g. 1.19) in a little alcohol a solution of 3.3 g. of sodium nitrite in 6 cc. of water was added slowly with

constant stirring. The colourless precipitate was filtered, washed free from salt by water, and then washed with a little alcohol and ether. The pure substance, the yield of which was about 80 per cent., consisted of colourless needles melting at 89-90° C., and gave on analysis the following results :—

0.1368 g. substance gave 20.4 cc. moist nitrogen at 22° C. and
764 m.m.p.

corresponding to N 17.0
C₁₂H₉O₂N₃ requires N 17.3.

3-Nitro-diphenylnitrosamine consists of colourless, acicular crystals, which are readily soluble in acetone or chloroform, and sparingly in alcohol or acetic acid. Its solution in concentrated sulphuric acid had a violet colour.

B. Dinitro-Diphenylamines.

3. *2,4-Dinitro-diphenylamine* (O₂N)₂C₆H₂NH . C₆H₅.

Following the method of Clemm (Ber. d. Dtsch. Chem. Ges. iii (1870), p. 128) we obtained 2,4-dinitro-diphenylamine by the action of aniline on 2,4-dinitro-chlorobenzene. The product after being washed with dilute hydrochloric acid, was re-crystallised from alcohol and chloroform. It consisted of long orange-red needles, melting at 156-157° C., which were soluble in acetone or glacial acetic acid, slightly in ether or carbon tetrachloride, sparingly in alcohol, and readily in chloroform or benzene.

With alcoholic potash it formed an orange-red solution which became blood-red on being warmed, and with concentrated sulphuric acid it gave a nearly colourless solution which became brown on addition of a trace of sodium nitrite.

2,4-Dinitro-diphenylnitrosamine. To a solution of 1 g. of 2,4-dinitro-diphenylamine in 60 cc. of glacial acid, 2 cc. of isoamyl nitrite were added, and the mixture was allowed to remain in a cold room for a few days. The solution, which was at first orange in colour, gradually became much lighter in colour, with simultaneous separation of a pale yellow solid.

After addition of water the solid was filtered and washed, first with water, afterwards with alcohol. When re-crystallised from chloroform it melted at 149-151° C., and gave on analysis the following results :—

0.1029 g. substance gave 16.2 cc. moist nitrogen at 14° C.
and 759 m.m.p.

corresponding to N 19.2
C₁₁H₇N₃O₂ requires N 19.4.

2,4-Dinitro-diphenylnitrosamine consists of sparingly soluble, pale yellow prisms, which were coloured red by concentrated sulphuric acid, in which they dissolved, forming an orange-yellow solution.

In another experiment, which was carried out at a somewhat higher mean temperature (ca. 18° C.), the reaction proceeded differently. 2,4,8,10-Tetranitrodiphenylamine separated slowly. When collected and purified, it gave on analysis the following results:—

0.1221 g. substance gave 21.8 cc. moist nitrogen at 20° C. and
760 m.m.p.

corresponding to N 20.0
C₁₂H₇O₈N₅ requires N 20.1.

4. *3,10-Dinitro-Diphenylamine* O₂N . C₆H₄ . NH . C₆H₄ . NO₂.

A solution of 6 g. of *p*-nitro-bromo-benzene and 4 g. of *m*-nitraniline in nitro-benzene was heated with 2 g. of dry potassium carbonate, traces of copper dust and potassium iodide to gentle boiling under a reflux condenser for twenty hours. The nitro-benzene was distilled in a current of steam, and the dark-coloured, tarry residue was extracted with boiling acetic acid. The dinitro-compound, which was precipitated by addition of water to the acetic acid solution, was purified by means of alcohol, and crystallised from chloroform. When dry, it softened at 205° C., melted at 210–212° C., and gave on analysis the following results:—

0.1052 g. substance gave 14.6 cc. moist nitrogen at 17° C.
and 766 m.m.p.

corresponding to N 16.2
C₁₂H₉O₄N₃ requires N 16.2.

3,10-Dinitro-diphenylamine consists of pale yellow crystals, which are soluble in chloroform, readily in acetone, and sparingly in cold alcohol.

Its solution in alcohol gave a violet red colouration with potash, and that in sulphuric acid, which was colourless, was not affected by addition of sodium nitrite.

C. *Trinitro-Diphenylamines.*

5. *2,4,6-Trinitro-Diphenylamine* (O₂N)₃ C₆H₂NHC₆H₄.

2,4,6-Trinitro-diphenylamine, which consists of scarlet red prisms, melting at 178° C., was obtained by the action of picryl chloride on aniline or acetanilide (Clemm, *loc. cit.*).

6. *2,4,9-Trinitro-Diphenylamine* $(\text{O}_2\text{N})_2\text{C}_6\text{H}_3\text{NHC}_6\text{H}_4\text{NO}_2$.

According to Austen (Ber. d. Dtsch. Chem. Ges. vii (1874), p. 1250) 2,4,9-trinitro-diphenylamine melts at 189°C ., and according to Willgerodt (Ber. d. Dtsch. Chem. Ges. ix (1875), p. 1178) it melts at $194\text{--}195^\circ\text{C}$.. We obtained it by heating to $170\text{--}180^\circ\text{C}$., for ten hours, an alcoholic solution of 2,4-dinitro-bromo-benzene and *m*-nitraniline with sodium acetate and cupric oxide. It consists of pale brown, platy crystals, which are difficultly soluble in alcohol, acetic acid, or chloroform, and nearly insoluble in carbon tetrachloride. It melted at $193\text{--}194^\circ\text{C}$. (uncorr.).

Its solution in concentrated sulphuric acid had a faint yellow colour which was not affected by addition of a trace of sodium nitrite.

7. *2,4,9-Trinitro-5-Methyl-Diphenylamine* $(\text{O}_2\text{N})_2\text{CH}_3\text{C}_6\text{H}_2\text{NHC}_6\text{H}_4\text{NO}_2$.

Was formed by heating 1 g. of γ -trinitro-toluene with an equal weight of *m*-nitraniline in alcoholic solution for two hours. The compound which separated was filtered and re-crystallised from alcohol. It melted with slight decomposition at 199°C ., and gave on analysis the following results;—

0.1672 g. substance gave 26.2 cc. moist nitrogen at 19°C .
and 764 m.m.p.

corresponding to N 18.1

$\text{C}_{13}\text{H}_{10}\text{N}_4\text{O}_6$ requires N 17.6.

2,4,9-Trinitro-5-Methyl-Diphenylamine consists of glistening dark-yellow prisms which are sparingly soluble in most organic solvents, excepting acetone, in which they are moderately soluble. Its solution in alcoholic potash has an orange-red colour, while that in sulphuric acid (conc.) is faint yellow, and remains almost unchanged on addition of a trace of sodium nitrite.

8. *2,4,10-Trinitro-5-Methyl-Diphenylamine*

was prepared by a method similar to that just described, from γ -trinitro-toluene and *p*-nitraniline after heating for thirty hours. After re-crystallisation from a mixture of acetone and alcohol it melted with slight decomposition at 210°C ., and gave on analysis the following results:—

0.1051 g. substance gave 16.6 cc. moist nitrogen at 23°C .
and 760 m.m.p.

corresponding to N 17.9

$\text{C}_{13}\text{H}_{10}\text{O}_6\text{N}_4$ requires N 17.6.

2.4.10-Trinitro-5-Methyl-diphenylamine consists of glistening straw-coloured, prismatic needles, which are only slightly soluble in most organic solvents, excepting acetone.

The crystals were turned red by contact with concentrated sulphuric acid, in which they dissolved, forming a faintly yellow-coloured solution which remained apparently unchanged on addition of a crystal of sodium nitrite.

9. *2.6.9-Trinitro-3-Methyl-Diphenylamine*
 $(\text{O}_2\text{N})_2(\text{CH}_3)\text{C}_6\text{H}_2\text{NH} \cdot \text{C}_6\text{H}_4\text{NO}_2.$

A substance which is probably 2.6.9-trinitro-3-methyl-diphenylamine was obtained in small quantity by prolonged heating of an alcoholic solution of β -trinitro-toluene and *m*-nitraniline. It consists of glistening, straw-coloured, prismatic needles, melting with slight decomposition at 199° C., and sparingly soluble in most organic solvents. Its amount was insufficient for analysis.

D. *Tetranitro-Diphenylamines.*

10. *2.4.8.10-Tetranitro-Diphenylamine* $(\text{O}_2\text{N})_2\text{C}_6\text{H}_3 \cdot \text{NH} \cdot \text{C}_6\text{H}_3(\text{NO}_2)_2.$

The symmetrical tetranitro-diphenylamine was obtained in a poor yield by heating 3 g. of 2.4-dinitro-bromobenzene and 2 g. of 2.4-dinitro-aniline¹ in nitro-benzene solution with 2 g. of anhydrous potassium carbonate, traces of copper dust, and potassium iodide for several hours to a temperature of about 160° C. The residue left after distilling the nitro-benzene in a current of steam solidified on cooling. It was filtered, washed with alcohol, and re-crystallised a few times from glacial acetic acid. Prepared in this way it consisted of brownish prisms which melted at 199–200° C. A mixture of it with an equal amount of the symmetrical tetranitro-diphenylamine obtained by the direct nitration of diphenyl-nitrosamine also melted at the same temperature.

11. *2.4.6.9-Tetranitro-Diphenylamine* $(\text{O}_2\text{N})_3\text{C}_6\text{H}_2 \cdot \text{NH} \cdot \text{C}_6\text{H}_4\text{NO}_2.$

Picryl-*m*-nitraniline was obtained by Austen (*loc. cit.*) by boiling an alcoholic solution of picryl chloride with *m*-nitraniline. We obtained it by a similar method, and found that it consisted of short yellow prisms melting at 210° C. (corr.)—a temperature slightly higher than that (205°) given by Austen.

It is not identical with the tetranitro-diphenylamine (MP 190° C.) obtained by the prolonged action of isoamyl nitrite and air (see below) on 2.4.9-trinitro-diphenylamine.

¹ Dinitro-aniline can be conveniently prepared, in almost quantitative yield, by allowing a solution of dinitro-bromo-benzene in alcoholic ammonia to remain in a stoppered flask for a few days at the ordinary temperature.

12. *2,4,6,10-Tetranitro-Diphenylamine* $(\text{O}_2\text{N})_2\text{C}_6\text{H}_2\text{NH} \cdot \text{C}_6\text{H}_4\text{NO}_2$.

Picryl-*p*-nitraniline has been previously obtained by Austen (*loc. cit.*) and by Wedekind (Ber. xxxiii (1900), p. 432) by boiling picryl chloride with an alcoholic solution of *p*-nitraniline.

The specimen which we obtained by this method consisted of golden-yellow lozenge-shaped prisms, melting at 222°C ., which were slightly soluble in alcohol, ether, benzene, chloroform, or carbon tetrachloride, somewhat more soluble in acetic acid, and soluble in acetone.

It gave a red colouration with cold 5 per cent. aqueous alkali, and formed a yellow-coloured solution in concentrated sulphuric acid.

E. *Action of Nitric Acid on 3-Nitro-Diphenyl-Nitrosamine.*

To a solution of 1.2 g. (1 mol.) of 3-nitro-diphenyl-nitrosamine in 50 cc. of glacial acetic acid 0.8 cc. (slightly less than 3 mols.) of nitric acid (sp. g. 1.42) was added, and the mixture was allowed to remain 5 weeks at the room temperature. As no solid separated during the reaction, water was added, and the solid, which now separated, was filtered, washed, and dried. On repeated crystallisation from acetone and chloroform yellow prismatic needles were obtained, which softened about 179°C ., and melted with decomposition at $184\text{--}185^\circ\text{C}$. An analysis of the substance indicated that it was a *trinitro-diphenyl-nitrosamine*:—

0.1021 g. substance gave 19.6 cc. moist nitrogen at 24°C .
and 746 m.m.p.

corresponding to N 21.2

$\text{C}_{12}\text{H}_7\text{N}_5\text{O}_7$ requires N 21.0.

The *trinitro-diphenyl-nitrosamine* consists of yellow prismatic needles which were sparingly soluble in alcohol, were readily soluble in acetic acid or chloroform, and very soluble in acetone.

It gave a blood-red colouration with alcoholic potash.

F. *Action of Nitrous Acid on 2,4,9-Trinitro-Diphenylamine.*

With a view to identifying of the trinitro-diphenylnitrosamine, described above, an attempt was made to obtain the nitrosamine of 2,4,9-trinitro-diphenylamine by the action of isoamyl nitrite on an acetic acid solution of the latter. The reaction, however, proceeded very slowly, and the product finally isolated in very small quantity was apparently a *tetranitro-diphenylamine*.

0.6 g. of 2,4,9-trinitro-diphenylamine was dissolved in 120 cc. of glacial acetic acid, and to the solution 2 cc. of isoamyl nitrite was added. The solution,

which at first was amber-coloured, gradually became paler, and a small quantity of a brownish solid very slowly separated. After four weeks water was added, and the solid was filtered, and washed with small quantities of water, alcohol, ether, and chloroform. After several purifications from alcohol and acetone it was finally obtained as yellow crystals, which melted at 190° C., and gave on analysis the following results:—

0·0701 g. substance gave 12 cc. moist nitrogen at 18° C.

and 76½ m.m.p.

corresponding to N 19·9

$C_{12}H_7N_5O_8$ requires N 20·1.

Owing to the small amount of substance obtained in the reaction, we were unable to carry out the analysis with a larger quantity than that mentioned.

The *tetranitro-diphenylamine* consists of yellow prisms, which are only slightly soluble in alcohol, soluble in chloroform, and readily soluble in acetone.

With alcoholic alkali it formed a blood-red coloured solution.

G. *Action of Nitrous Acid on Picryl-Aniline.*

To 7 g. of picryl-aniline, and rather less acetic acid than that required to completely dissolve it, 12 cc. of isoamyl nitrite was added, and the mixture was allowed to remain at the room temperature for four weeks.

A small quantity of a yellow crystalline solid separated. After re-crystallisation of the solid it melted at 236° C., and probably consisted of 2.4.6.8.10-hexanitro-diphenylamine.

The substance contained in the acetic acid filtrate was precipitated by addition of water, and, after repeated crystallisation from acetone and chloroform, it consisted of yellow prisms melting at 193–194° C. An analysis which was made showed it to be a pentanitro-diphenylamine, very probably 2.4.6.8.10-pentanitro-diphenylamine, for which P. Juillard (*loc. cit.*) gave 193° C. as the melting-point:—

0·1484 g. substance gave 28·0 cc. of moist nitrogen at 20° C.

and 757 m.m.p.

corresponding to N 21·5

$C_{12}H_6N_6O_{10}$ requires N 21·3.

In conclusion we wish to express our thanks to Nobel's Explosives Company for a grant in aid of this investigation, and to Mr. Rintoul, the Manager of the Research Section of that Company, owing to whose suggestion the work was undertaken.

VII.

ON CERTAIN ACTINIARIA COLLECTED OFF IRELAND BY THE
IRISH FISHERIES DEPARTMENT, DURING THE YEARS
1899-1913.

By T. A. STEPHENSON,

Demonstrator in Zoology, University College of Wales, Aberystwyth.

(PLATES XIV-XX.)

(COMMUNICATED BY R. SOUTHERN, B.Sc.)

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INTRODUCTION.

THE collection of Sea Anemones with which the present paper is concerned has been made by the Fisheries Branch of the Department of Agriculture and Technical Instruction, Ireland, between the years 1899 and 1913. Mr. C. L. Walton M.Sc., of this College, consented at first to identify the contained specimens; but the collection is a very large one, and Mr. Walton was unable to give to it the necessary time, on account of circumstances which subsequently arose. He therefore handed the specimens over to me, and for some time I have given them my attention.

The notes which follow do not deal with more than half the collection at most; but as I shall be unable to deal with the remainder for some time, I am publishing the results so far. I should like to say that the descriptions which follow are not intended to present an exhaustive study of the species with which they deal - circumstances have not permitted that; but I hope they will be found to give what is essential for identification and general purposes. My original intention was merely to identify the Anemones; but several of them proved to be new species, and some of them to be so interesting, that it seemed a pity not to publish some account of them. The microscopical part of the work is based for the most part rather on a limited number of selected sections than upon large series, as I have found the latter to be unnecessary for the present purpose. In staining sections of Actinaria I find the Haematoxylin-Eosin method (see 48,¹ p. 2) the most generally

¹ Numbers in brackets refer to papers in the bibliography at the end of the paper.

useful. But another way which is sometimes very valuable for nematocysts is to stain first for a very short time (not more than half a minute) with methylen blue; then wash quickly in water, stain for an equally short time with picro-saürefuchsin, dehydrate, and clear as rapidly as possible. I have only actually used this method once, but it then stained thick-walled sting-cells deep blue, spirocysts vivid purple, and the protoplasm pale purple—the spirocysts being much more clearly visible than otherwise.

With regard to the Plates, I have drawn them as far as possible in pure black and white to avoid expense; and it must consequently be remembered that this gives to many of the illustrated structures a harder and more definite appearance than they actually have in sections; and this applies, of course, in lesser degree to whole specimens.

Finally, I wish to offer my most hearty thanks to Prof. G. C. Bourne, F.R.S., Prof. H. J. Fleure, D.Sc., Dr. E. J. Allen, F.R.S., and Mr. C. L. Walton, M.Sc., for willing help concerning various points, which they have given me during the course of my work. I should say that Mr. Walton had provisionally identified some of the specimens before I made a start with them, and I am pleased to acknowledge the help which this gave me.

DESCRIPTION OF SPECIES.

Sub-order ACTINIARIA.

I. ACTINIINA M. Edw.

Family **ILYANTHIDAE** Gosse.

Actiniina with the aboral extremity of the body rounded, so that there is no pedal disc. No acontia.

I am using the term Ilyanthidae here, as before, as a general heading, with certain sub-divisions, but hope to enter into the relationships of the contained forms in another place.

Sub-family **HALCAMPOMORPHINAE** Carlgren.

Ilyanthidae with the sphincter endodermal or absent.

Group A. **PEACHEAE.**

Halcampomorphinae with 10 pairs of mesenteries only, of which either only 6 pairs or all the 10 pairs may be perfect. Conchula present or absent.

Peachia Gosse, 1855.

Siphonactinia, Dan. and Kor. 1856.

Peachiae with only 6 pairs of perfect mesenteries, and with a conchula and 20 tentacles, which are not knobbed.

1. *P. hastata* Gosse.

Two specimens. Clxxxii. Bonn. 11. viii. 1920. Port Island Bay; shore collection.

There is no need to describe these specimens: the number of tentacles and arrangement of mesenteries refer them with certainty to the genus *Pechia*. It is a little more difficult to speak certainly as to species, because the conchula is not very well preserved, and it is in any case a structure which may lose some of its characteristics after the animal's death. But although it has three more or less distinct primary lobes, these are again subdivided, though not deeply; and it approaches much more nearly the conchula of *P. hastata* than that of *nodata* or *reijholla*. I may add that I have kept living specimens of *P. hastata*, and that the conchula of that species might well shrink in spirit so that it presented the form shown in the specimens under discussion.

Eloactis Andres.

Form in which all the 10 parts of mesenteries are well developed and perfect. There is no conchula and there are no distinct adhesive suckers on the body. Tentacles, 20, with knobbed apices.

2. *E. mazeli* Jourdan.

One specimen. S.R. 1171. 19 v. 1911. Eel-trawl. 287-354 fathoms. 46 miles W. $\frac{1}{2}$ N. of Tearaght Light. Lat. N. $51^{\circ} 54' 30''$: Long. W. $11^{\circ} 51' 30''$.

Miss O. M. Eves has already described the anatomy of this species (45), so I need add nothing.

Family **ENDOCOELACTIDAE** Carlgren.

Articulated with thin or thick, sometimes cartilaginous body-wall, without spines or boss, and usually with spiracles in the ectoderm of the body-wall and gastrovascular. Arrangement of mesenteries quite different from the normal Actinian type, going to the development of the second and third orders of mesenteries in the endoderm. In consequence of this the arrangement of tentacles is very different from the normal type. (Among others 10 tentacles of the first type border immediately on those of the second.) Sex organs present on all the stronger mesenteries including the digestive mesenteries. Two basal muscles absent, base present. (Carlgren, *invertebr.* See 48, p. 14.)

Carlgenia n. gen.

Endocoelactidae with 6 pairs of macromesenteries bearing circumscribed retractor muscles, filaments, and most or all of them gonads. There are also representatives of 3 orders of micromesenteries; of these the first order consists of 4 pairs, developed in the 4 lateral endocoels, and these 4 pairs have the character of directives, i.e. their longitudinal muscles face away from each other; these 4 pairs run down the whole length of the body, and just reach the actinopharynx at its upper end, but they bear neither developed gonads, filaments, nor retractor muscles. There are other small micromesenteries entirely confined to the uppermost part of the body.

I have founded the above genus for a small but extremely interesting form which is present in the collection. In a paper (8) on *Porponia* and related genera, Carlgren made a suggestion which would account for the descent of the 10-rayed forms contained in the Endocoelactidae from a 6-rayed form, by the appearance of 4 pairs of secondary mesenteries with the character of directives, one in each of the *endocoels* of the 4 lateral pairs of primary mesenteries, instead of, as usual, in *all* the exocoels. The above-mentioned form presents so interesting a confirmation of this idea, that I propose to honour it by conferring upon it the name of the distinguished zoologist whose work in connection with Actiniaria is so well known.

3. **C. desiderata**, n. sp.

(Pl. XIV, fig. 1; Pl. XVI, fig. 27; Pl. XIX, fig. 1; Pl. XX, figs. 2, 8, 9.)

Four specimens. SR. 504. 12. ix. 07. Trawl. 627-728 fathoms: from *Lophohelia*.

I have been unable at present to work out the detailed anatomy of this form as closely as I could wish, but it is so distinct a species that I think the details which follow will be found to be sufficient for identification; I hope to publish fuller details at a later date.

The specimens were taken from *Lophohelia*. They are small (the largest measuring, in total length, about 2 cm.), and do not present any striking external features. (Pl. XIV, fig. 1.)

Pedal disc present, small, not much exceeding the column. Body not far from cylindrical, inclined to be rather wider above than below, soft in texture. There is a slight marginal parapet and fosse, and sometimes the former is a little notched. The whole surface is wrinkled and somewhat corrugated, but as far as I can see there are no actual verrucae. The whole animal is pale-brown in spirit, with darker shades on throat, disc, and tentacle bases.

Tentacles fairly short, stiff, moderately slender; one medium-sized specimen had 38 of them, of rather irregular sizes, the inner on the whole larger than the others. Another specimen had 41. I have not yet worked out exact details as to relationship between tentacles and mesenteries, but judging from the development of mesenteries in the specimen sectionized, the number of tentacles would reach about 68 in the fully grown animal. The throat is rather wide, and the oral disc consequently narrow.

There is no trace of a sphincter. The longitudinal musculature of the tentacles and radial musculature of the disc are entirely ectodermal (Pl. XX, figs. 2 and 8), and not very strongly developed. The mesenterial filaments have ciliated lobes. The upper part, at any rate, of the bodywall ectoderm presents an interesting and characteristic feature. It possesses localized batteries of thick-walled nematocysts: these batteries vary in size and density, but often form an almost solid mass of sting-cells. Between the various batteries the ectoderm typically has these sting cells sparse or almost absent. (Pl. XVI, fig. 27.) The bodywall ectoderm also contains a moderate, though not large number of spore-cysts, and the bases of the supporting cells are distinctly thickened.

There are 6 pairs of macromesenteries, arranged on the usual hexactinian plan i.e. there are 2 pairs of directives, and 4 ordinary lateral pairs. These macromesenteries all bear very strong circumscribed retractor muscles and mesenterial filaments; and in the larger of two sectionized specimens 10 of the 12 bore well-developed testes: these could not be seen on the other 2, which were damaged, but they may have been present. One specimen showed a curious and presumably accidental feature—one of the macromesenteries had the retractor almost entirely suppressed on the part of the mesentery just above the level of the enterostome: but it was well developed both above and below that level. Beside the circumscribed retractor, the macromesenteries (which are, of course, all perfect) have rather feeble parietal muscles, which die off gradually into a fringe of processes between them and the retractor (Pl. XIX, fig. 1).

In each of the four lateral *out-cores* is found a pair of micromesenteries (i.e. mesenteries with no developed filament, retractor, or gonad). These run down the whole length of the body, from oral disc to base, but are quite narrow most of the way, bearing simply parietal muscles, whose processes cannot be said to be better developed on one face than on the other, though there seems to be a tendency towards a slightly better development on the side facing the adjacent macromesentery than on the other. But at the very top, just below the oral disc, these mesenteries become just broad enough to reach the actinopluteus (and so are perfect), and have there a distinct longi-

tudinal musculature on that surface of the mesentery facing the adjacent macromesentery, though it can hardly be spoken of as a retractor. Pl. XX, fig. 9, shows the arrangement of mesenteries on one side of the animal (note that there is 1 actinopharyngeal groove only), and Pl. XIX, fig. 1, shows the muscular portion of a macromesentery and the whole of the adjacent micromesentery at a fairly low level.

There are, apart from the larger micromesenteries, representatives of two cycles (apparently incomplete cycles) of smaller ones, confined entirely to the underside of the oral disc, and developed of course in the endocoels formed by the macromesenteries with the primary micromesenteries.

There is one question which is naturally raised by this species—Is it not simply a young form of some species of *Halcurias*, and therefore not entitled to generic distinction? Of course this may be so; but I incline to think that the form is really not very far from adult, and is entitled to generic distinction, for the following reasons.

The largest specimen investigated (and not much larger than the others) possessed well-developed testes; and although a small animal, was not much smaller than, for instance, *Halcurias pilatus*, if at all. Then, if the 4 pairs of micromesenteries are to become macromesenteries—and a great deal of development, above all the specialization of a great retractor muscle, is necessary for the accomplishment of this (a condition which would be required to convert the form into a *Halcurias*)—one would expect them to be more advanced than they are by the time that the animal has reached its present size and has acquired gonads and tertiary mesenteries. So I have thought it best to erect a new genus for the species, which will stand unless it should be proved in some way that the young *Halcurias* resembles *Carlgrenia*.

Family **BOLOCERIDAE** McMurrich.

Actiniina with well-developed base and basilar muscles. Sphincter endodermal, variously developed, or absent; if present, may be diffuse or circumscribed. Usually numerous mesenteries perfect. Tentacles attached to the oral disc by a very short thin-walled neck, and usually provided each with a sphincter muscle above the neck, by means of which the neck may be torn, in which case the tentacle is lost.

Bolocera Gosse.

Boloceridae with well-developed endodermal sphincter-muscle, which is diffuse. Tentacles with well-developed sphincters. Numerous perfect mesenteries (i.e., more than 6 pairs).

I have narrowed the above definition so that it excludes *B. pollens* and *B. norvegica*. It does not seem to me justifiable to include in one and the same genus species which have a diffuse, and species which have a circumscribed, sphincter; or species which have six, and others which have twelve or more, perfect mesenteries. *B. pollens*, which has an extremely strong and peculiar circumscribed sphincter, should go to a distinct genus, and might be called *Leipsicerus*¹—a possibility which McMurrich has already (32) foreshadowed. *B. norvegica*, Pix, which is a minute but sexually mature species, with only six pairs of perfect mesenteries, can hardly be included in *Bolocera*. It agrees with *B. bimaculata* in having only six pairs of mesenteries, but whether they have enough else in common, our knowledge of *norvegica* is not complete enough to show. But it must either go to *B. bimaculata* or to a new genus.

The genus *Bolocera* as thus limited, will contain:—*B. tuediae*, the type; *B. leipsicerus*; *B. bicoloratus*; *B. affinis*; *B. multicauda*; *B. multipora*; *B. pannosa*; *B. occidua*; *B. brevicornis*.

I have seen and kept two living specimens which agree perfectly, except for unimportant colour variation, with Gosse's description of *Bolocera eques*, which seems to have been considered a doubtful species. Although I have not yet fully investigated these specimens, I may say that the species *eques* is really an *Urticina* (Tuedia) with weak verrucae, circumscribed endodermal sphincter, and non-deciduous tentacles. It is not, I think identical with *Urticina eques*, the common shore species, but may perhaps be so with *Urticina (Tuedia) norvegica*. I hope to go further into that question later, but my present point is that it is not a *Bolocera*.

4. *B. tuediae*, Gosse.

(Pl. XIV, fig. 2; Pl. XX, figs. 1, and 3-6.)

(*Actinia tuediae*, Johnst.; *Anthea tuediae*, Johnst. and others.)

SR. 338. 13. v. 06. Trawl. 291-330 fms. Lat. N. 51° 28' 30". Long. W. 11° 39'. 1 specimen.

SR. 330. 9. v. 06. Trawl. 415-374 fms. Lat. N. 51° 16'. Long. W. 11° 37'. One specimen, which has lost nearly all its tentacles.

The anatomy of this species has not hitherto been described and its position therefore has remained a little uncertain. I find in the present collection 2 specimens which I think may be certainly identified as *B. tuediae*, from the descriptions of Gosse, Johnston, and Cooks. Mr. O. L. Walton, who has seen living specimens of both this species and of *B. leipsicerus* in the North Sea, agrees with me in this respect.

¹ λείπω, to release, and κίρας, a horn. This is founded, like the name *Bolocera* itself, on the habit of shedding the tentacles.

In studying the anatomy of these specimens, however, I find that it presents a close similarity to that of *B. longicornis*, and consequently the question arises as to whether the two species are really distinct. Carlgren (1893) has already suggested the possibility of their identity. And, moreover, there are two specimens in the present collection which I cannot, in their preserved state, and from external characters, definitely refer to either one species or the other.

Nevertheless, I am inclined to think that, in spite of these facts, the two species are distinct, for the following reasons:—When preserved, closely related species of Actiniaria lose their external distinctive characters to a large extent, when there would be no difficulty at all in distinguishing them if they were alive—for instance, from examination of hundreds of specimens in their natural haunts, of *Sagartia nivea* and *S. venusta*, I have not the least doubt that they are distinct species; but if they were preserved, it would be difficult, if possible, to distinguish them. Mr. C. L. Walton, who has seen *B. tuediac* and *B. longicornis* alive, assures me that in that condition they are quite distinct. With regard to anatomy, one would not expect striking differences in two species which had, possibly, not long diverged from a common origin; and my specimens of *B. tuediac* show just enough difference to support the idea that it is not identical with, though near, *longicornis*.

I do not wish to speak positively on the subject until I have seen the two species alive and healthy, but for the present I prefer to keep them separate. I will therefore describe the external appearance of my specimens, and note how they differ in structure from *B. longicornis*. They differ in one respect from Gosse's description. He says there are only 3 cycles of tentacles; but that is not very important, and there are different ways of reckoning the cycles. So, as he does not give the number in each cycle, we may pass this over, although my specimens have more than 3 cycles.

External Characters.—(i) The specimen figured in Pl. XIV, fig. 2:—

Greatest diameter of oral disc and tentacles, 9 cm. Length of one of the longest tentacles, 3.9 cm. Height of column, 4.3 cm. Diameter of mouth, 3.8 cm.; of column at middle, 5.3 cm.; of pedal disc, 3.3 cm.

Pedal disc well developed, but of considerably less diameter than the oral disc. Substance of pedal disc and column similar, rather soft; the regular radial striations of the pedal disc go straight on over its margin, and run up the column. Column widening from below upwards, fairly thin-walled, and not stiff. It has longitudinal striations, and transverse wrinkles and furrows, due no doubt to contraction, so that its surface has a somewhat papillose appearance in parts, though there are no real warts or suckers. The margin forms a very slight rim, but it is of the tentaculate type. The prominent

and apparently non-retractile tentacles leave a fairly wide clear space round the mouth, with its finely ridged lip; the inner ones are large, and are attached to the disc by a narrow neck, above which they suddenly swell out bulbously, then gradually taper off to a blunt point. Round the "neck," and below the swollen part, is distinctly visible a circular suture, and this is the "line of breakage" of the tentacle. Some of the tentacles are neatly broken off at this point, and in these the tentacular sphincter (which lies just above the neck, and is thrown off with the tentacle) is clearly visible as a thin circular veil, projecting across the lumen of the tentacle, and almost blocking it. The tentacles are stiff, thick-walled (in their present state of contraction), self-supporting, and distinctly longitudinally fluted. They are a good deal smaller in proportion to the size of the body than in typical specimens of *B. longirostris*, at any rate. Outer tentacles much smaller than inner. Radii of oral disc not well marked, save among the tentacles. Two actinopharyngeal grooves. Whole animal flesh-coloured in spirit, actinopharynx darker. Tentacles in 5 cycles—12 + 12 + 24 + 48 = ca. 60 = ca. 156.

(ii) The other specimen is similar, but has lost nearly all its tentacles, and has the body more puffed out and the wall, in consequence, thinner and more flaccid. The oral disc moreover, has the same diameter as the pedal. These are only differences which a living specimen would be able to alter constantly. Tentacle-scars in *about 4* cycles.

Structure.—Specimen (i) has 77 pairs of mesenteries, of which 45 pairs are perfect. The development is somewhat irregular—the first 3 cycles are perfect in varying degrees, the primary mesenteries being joined to the actinopharynx throughout its length, the secondaries running down it less far, the tentacles still less, the rest do not reach it at all, and this 4th imperfect cycle is not yet fully formed. In one sector of the animal specially examined, the primaries appear sterile, the secondaries have small gonads, and the other mesenteries are very fertile.

Specimen (ii) has also 77 pairs of mesenteries in 4 cycles (13p. + 13p. + 25p. + 26p. = 77). The first 3 cycles are perfect to a varying extent, and here the 4th-cycle mesenteries also just reach the actinopharynx. (I have shown previously that in *B. longirostris* also, the last cycle may or may not be perfect.) Primaries sterile at any rate some of them, the others fertile. The mesenterial development is irregular, some of the 3rd-cycle mesenteries on one side of the body being no larger than 4th-cycle ones on the other, and the 4th cycle being incompletely formed. Both internal and external stomata are present.

(iii) It is interesting to note that in a specimen of this species from the

North Sea, described by C. L. Walton (56), there were also 77 pairs of mesenteries, and about 127 tentacles, some having been thrown off. It is curious that three specimens of this species should all have 77 pairs of mesenteries only, and suggests that possibly that is about the maximum to be attained in this case.

(iv) Through the kindness of Dr. E. J. Allen I have been able to examine externally another North Sea specimen identified as *B. tuediae*, as regards external characters. This agreed exactly in all essentials with the specimen I have described as (i) above, but had even smaller (proportionately) and blunter tentacles; they were in four cycles only—12, 12, 24, 48; but the whole specimen was smaller than (i).

Musculature.—For convenience of reference I will number the three specimens with which I have to deal according to the order in which they are above mentioned. (i) is the specimen in Pl. XIV, fig. 2. (ii) is the other Irish specimen, without tentacles. (iv) is the North Sea specimen borrowed from Plymouth.

A. Sphincter.—I have figured four sphincters in Pl. XX. Figs. 1, 5, and 6 are from different specimens of *B. tuediae* (on slightly different scales); fig. 7 is from an Irish *B. longicornis*. Fig. 1 is from specimen (i), fig. 5 is from specimen (ii), and fig. 6 is from (iv). The sphincter is, of course, endodermal, fairly strong, diffuse, with high, fine, much-branched processes, even tending sometimes to anastomosis. It is difficult to be definite in speaking of the differences between *tuediae* and *longicornis*, and of course the sphincters of the different specimens of *B. tuediae* vary considerably among themselves, but one may say that (a) all the *tuediae*-sphincters are of one type; (b) the *tuediae* sphincter has a tendency to be shorter and proportionately broader and rather more definite than in *B. longicornis* (cf. fig. 7), even though this difference is less marked in the "Terra Nova" *longicornis* than in our northern form.

The *tuediae* sphincter has a tendency to produce "humps" of mesogloea at different points in its course, but these may be present or absent, and may vary in position from the top end of the sphincter (see fig. 5) to the bottom end (fig. 6), even in the same specimen at different parts of the margin. And the presence of these "humps" does not seem directly dependent on the insertions of outer tentacles. The type of sphincter, therefore, seems distinct from the type figured by Kwietniewski for *B. kerguelensis*, and by McMurrich for *B. pannosa* (see 28 and 30), for instance. In these latter the mesogloea at the upper end of the sphincter sends out a kind of twig of mesogloea, which is larger and more branched than the others. In *B. tuediae*, the "humps" at various levels are hardly of this nature, and may perhaps be due to mere contraction of the wall.

B. Mesenteries.—On comparing sections of *B. tudian* with the sections of my "Terra Nova" *longicornis*, I find that the mesenteries might be described in almost the same terms for both; but the processes of the muscle-pennon are rather more numerous, more crowded, finer, and some of them rather differently branched, in *tudian* than in *longicornis*; and the parietobasilar muscle of the former is rather the stronger. The nature of a typical *tudian* mesentery is shown in Pl. XX, fig. 4. In different mesenteries the parietobasilar muscle varies, usually forming a distinct free fold. Sometimes one partner in a mesenterial pair is considerably larger than the other.

C. Tentacles.—The tentacular longitudinal musculature of *tudian* (Pl. XX, fig. 3) does not seem essentially different from that of *longicornis*.

One question remains: Is the European *B. tudian* identical or not with the American *B. longicornis* described by Verrill as *B. tudian*? I cannot give a definite answer. But Prof. McMurrich has favoured me with a sketch of the splanchnium of the American form, and though on the whole quite like the European it has more of an upper "twig" than my specimens show. Sections of a section of this specimen included representatives of at least 4, possibly 5, cycles of mesenteries, gonads only on those of the last cycle but one.

Further research with more material is really required before we can state to what extent the splanchnium, for instance, may vary in one and the same species.

5. *Bolocera longicornis* Catlgren. (Pl. XX, fig. 7.)

1. SR. 172. Nov. 5, 1904. 54 miles W. by N. $\frac{1}{2}$ N. Nly. of Tearaght Light. Lat. N. $52^{\circ} 2'$; Long. W. $12^{\circ} 8'$. 454 fathoms. Tow-net on trawl. 1 young specimen.

2. SR. 327. May 8, 1906. 60 miles W. $\frac{1}{4}$ N. of Tearaght Light. Lat. N. $51^{\circ} 46'$; Long. W. $12^{\circ} 14' 5''$. 560-800 fathoms. Trawl. 1 specimen.

3. SR. 506. Sept. 12, 1907. Lat. N. $50^{\circ} 34'$; Long. W. $11^{\circ} 19'$. 661-672 fathoms. Trawl. 1 specimen.

4. SR. 1242. Aug. 14, 1911. 56 miles W. $\frac{1}{2}$ S. of Great Skellig. Lat. N. $51^{\circ} 27'$; Long. W. $11^{\circ} 55'$. 1 specimen, with 1 *Aerimastax*. 550-590 fathoms. Trawl.

5. SR. 1699. Aug. 20, 1913. 51 $\frac{1}{2}$ miles W. $\frac{1}{2}$ N. of Great Skellig. Lat. N. $51^{\circ} 30'$; Long. W. $11^{\circ} 51'$. 479-500 fathoms. Trawl. 2 specimens.

The next 3 records must be put down as *B. longicornis* (C.).

6. SR. 171. Nov. 5, 1904. 48 miles N. W. by W. $\frac{1}{4}$ W. of Tearaght Light. Lat. N. $52^{\circ} 7'$; Long. W. $11^{\circ} 58'$. 397 fathoms. Trawl. 22 specimens, all very natural with practically all tentacles left, and nearly all turned inside out.

7. SR. 188. Feb. 3, 1905. 50 miles W. $\frac{3}{4}$ N. of Tearaght Light. Lat. N. $51^{\circ} 53'$; Long. W. $11^{\circ} 59'$. 320–372 fathoms. Trawl. 2 specimens without tentacles, with several *Artinauge richardi*.

8. SR. 502. Sept. 11, 1907. Lat. N. $50^{\circ} 46'$; Long. W. $11^{\circ} 21'$. Trawl. 447–515 fathoms. 5 specimens, with most of the tentacles gone.

I having nothing further to add to the history of this species.

Family **CRIBRINIDAE** McMurrieh.

“Actiniina with an adherent base. The column usually more or less verrucose and frequently with acrorhagi at the margin; these, however, never being ramose or frondose. Sphincter endodermal, circumscribed. Usually more than the first cycle of mesenteries perfect. No acontia.” (McMurrieh, 32.)

URTICINA Ehrenberg.

Cribrinidae without acrorhagi, but with definite verrucae which are not arranged in definite vertical rows as in *Cribrina*, but are irregularly scattered over the surface. Numerous (more than six) pairs of perfect mesenteries. Longitudinal musculature of tentacles mesogloal.

6. **U. coriacea** Cuvier.

(For synonymy of this species and genus see Carlgren, 1893, p. 58.)

1. W. 131. March 11, 1910. Blacksod Bay, Feorinyeeo Bay, North. Shore collection. 2 specimens.

Anthopleura Duch. and Mich.

Cribrinidae with definite acrorhagi containing batteries of nematocysts. Verrucae present, and arranged in definite vertical rows. Numerous perfect mesenteries. Longitudinal musculature of the tentacles ectodermal.

7. **A. alfordi** Gosse.

(*Aegeon alfordi*, Gosse, 1865.)

1. St. vii. February 28, 1899. Ballynakill, vii. Coastguard Bay. Shore collection. 8 specimens.

2. March 3, 1899. On the Bar, Fahy Bay. 1 specimen.

This species has already been described by Miss O. M. Rees (47), and I have very little to add. One of my specimens has produced a small lateral bud which has developed tentacles. I can state that the large tooth-like marginal verrucae are truly acrorhagi in that they contain a battery of nematocysts. There is one point in which I should like to add to Miss Rees' description. My sections show the character of the sphincter to be, typically,

rather different from the case shown in her fig. 11, which was made under difficulties, as the specimen was not well preserved, and is, I think, exceptional. When more typically shown it is not a strong sphincter, if we compare it, for instance, with the powerful muscle of *Epiactis nova-zealandica* (48, Pl. VI, fig. 3) and it is more attached to the wall than Miss Rees' figure indicates—not merely by a narrow pedicel, but by a broader area of attachment.

Family **PARACTIDAE**¹ R. Hertwig.

Actinina with well-developed base and basilar muscles. Sphincter mesogloéal. Acontia absent.

Sub-family **ACTINOSTOLINAE**¹ Carlgren.

Paractidae in which, in the younger cycles of mesenteries, the individual mesenteries of each pair are unequally developed, exactly according to the following rule:—The larger mesentery of each pair (i.e. the older) has its longitudinal retractor muscle turned towards the nearest mesentery-pair of the next oldest cycle.

Actinostola Verrill.

Actinostolinae with smooth or tuberculated bodywall, which may be very thick. The oral disc may be more or less undulated in outline. Margin tentaculate. Tentacles numerous in more than two cycles, with or without basal swellings of mesogloea on the aboral side. Longitudinal musculature of tentacles and radial musculature of oral disc entirely embedded in the mesogloea. Numerous perfect mesenteries, the primaries at least, and usually more, sterile. Pennons diffuse.

8. **A. atrostoma** n. sp.

(Pl. XIV, figs. 5, 7, 8; Pl. XV, fig. 7; Pl. XVI, figs. 11, 12, 16–20;
Pl. XVII, figs. 1–4, 6–8, and 17.)

1. *SR.* 487 and 489. 4 large specimens.

SR. 487. Sept. 3, 1907. Lat. N. 51° 36'; Long. W. 11° 57'.
Trawl. 540–660 fathoms.

SR. 489. Sept. 4, 1907. Lat. N. 51° 35'; Long. W. 11° 55'.
Trawl. 720 fathoms.

¹ I should like to state here that in this paper I am only using the families Paractidae and Sagartidae, the subfamilies Actinostolinae and Paractinae, and the genera *Cymista* and *Actinostola* as these families and genera are at present understood *provisionally*. I have been working for some time on a scheme for a somewhat different grouping of all the genera at present contained in the families Paractidae and Sagartidae, and hope to publish it shortly. But as it is not convenient to enter here into the long discussions involved, I am retaining the present classification in the meantime.

2. SR. 1242. Aug. 14, 1911. 56 miles W. $\frac{1}{4}$ S. of Great Skellig. Lat. N. $51^{\circ} 27'$; Long. W. $11^{\circ} 55'$. 550-590 fathoms. Trawl. 1 young specimen with a Bolocera.

3. One large specimen, with no label.

Measurements.—(i, *Largest specimen.* Diameter of oral disc and tentacles, 12 cm.; of mouth, 5.3 cm.; of pedal disc, 4.5 cm.; height of column, 7.5 cm.; length of a large tentacle, 2 cm.

(ii) *Smallest specimen.* Diameter of oral disc and tentacles, 6 cm.

External characters.—Pedal disc in all cases much smaller than oral disc, so that the body is cup-shaped. Pedal disc flat or hollow, round or irregular, much cockled, more or less radially striate. Form of body variable according to state of expansion or distortion. (See Pl. XIV, fig. 5.) Limbus well marked; margin tentaculate, the outer tentacles, which are mere knobs, passing into it. Bodywall very thick and hard, thickly covered in its upper part, in all cases, with irregular tubercles and prominences. In some cases these extend almost to the limbus, getting smaller and less marked as they approach it; in others the lower part of the body is almost smooth. In the largest specimen the oral disc is widely expanded, and is purely oval in shape. In the other cases, where it is more or less folded up, it forms a deep cup, and its outline is rather irregular or wavy, though not definitely lobed. Disc very broad, thin-walled. Radii distinct, corresponding to the larger tentacles, not reaching the mouth, and clearly transversely striated. Mouth large, with prominent lip, and always two well-marked actinopharyngeal grooves. The tentacles (Pl. XIV, figs. 7, 8; Pl. XV, fig. 7) are arranged in 5 cycles—on the plan 6, 6, 12, 24, 48, 96 = 192, this formula sometimes being departed from in small details. In the largest specimen part of a 6th cycle has appeared. The twelve innermost tentacles stand out clear on the disc, and the others are arranged between them in 12 little wedges, the apices of the wedges pointing toward the mouth. Inner tentacles much larger than the outer, and here and there one or more tentacles are aborted, making the size rather irregular. Each tentacle is provided with a hard whitish swelling of the mesogloea on the outer side at the base, very well marked where best developed. The tentacles themselves are thick-walled, provided with distinct terminal pores, and are longitudinally and transversely wrinkled.

The body is creamy white except in the smallest specimen, in which it has a pinkish tinge. In four specimens, the disc and soft parts of the tentacles are a rich deep purple-brown; in another the colour dies off to paler greyish-brown on the tentacles. The largest specimen is a lighter grey-brown, but looks as if it may have originally been darker. The internal parts of the body are in all a deep rich brown, except for the pale yellow gonads. The

animal as a whole presents a superficial resemblance to Hertwig's *Polysiphonia tuberosa*, but the tentacular plan, as well as other details, is quite different.

Structure.—(i) *Mesenteries.* I carefully dissected three specimens. There are five cycles of mesenteries, and faint traces of the beginning of a sixth in the largest specimen. The first two cycles are quite perfect, the third-cycle mesenteries run less far down the actinopharynx, and the fourth cycle is only just perfect. Total, 96 pairs; arrangement, hexamerous. First two cycles sterile, third with a few gonads, fourth and fifth very fertile. Small oral stomata are present, but no marginal ones. In two specimens, the fourth-cycle mesentery-pairs all had one individual quite clearly larger than the other, and in those of the fifth cycle the difference in size in each pair was extremely marked. The inequality in all cases, and with no exceptions, followed the rule laid down for this genus by Catlgren in 1893, and which is given above in the definition of the sub-family. In the third specimen, the smaller partner of each fifth-cycle pair was too small to be seen with the naked eye; but by microscopic examination I satisfied myself that, at any rate in the piece of the animal examined, the smaller partner was really there in the right position, but had not yet grown out beyond the endostem, so no doubt the rule prevailed here as in the other two specimens. The inequality of the mesenteries is not confined to the fourth and fifth cycles, but is less marked in the others.

Sections of a sector of the animal reveal the following details:—

With Cycle.—The smaller partner in each pair has or has not a filament, but it has a small parietal muscle, although no gonad or definite retractor. The larger partner has a large gonad and filament, with a fringe of stout longitudinal muscle-processes on the endocœlic face, and a streak of transverse muscle on the other.

The fourth-cycle mesenteries bear large gonads, but the muscular portion of one partner much exceeds that of the other. They have a parietal muscle, tending to be differentiated into parietobasilar and longitudinal halves, and a distinct diffuse pennon, which ceases abruptly at its distal edge. As the body-wall is approached its processes become gradually lower and stout instead of slender, branched, and tree-like. The mesogloea of the mesenteries, here and in the older cycles, is well developed.

The third-cycle mesenteries have the whole of the endocœlic face of their muscular part occupied by a diffuse pennon, whose processes start immediately at the body-wall, and rapidly become high. It tapers at both ends, the highest part being nearer the distal side than the proximal. In its best-developed part the mesogloea of the mesentery is produced into rather

regular mounds, round which the slender branched processes of the pennon are arranged. (Pl. XVII, fig. 6.)

The exocoelic surface is fringed by a straight line of transverse fibres, except for a short distance close to the body-wall where there is a parieto-basilar muscle, with short, rather stout processes. It may end as a distinct fold or not. It seems, as it grows, to enclose in the mesogloea of the mesentery little spaces containing remnants of endoderm, and these are fringed with muscle fibres.

The larger mesenteries differ from these only in size.

(ii) *Sphincter*.—Well developed, moderately long and strong. (Pl. XVII, fig. 4.) It lies immediately against the endodermal side of the mesogloea throughout its length, and, except at its widest point, only occupies a small proportion of the thickness of that layer. The widest point is near its upper extremity, and from that it tapers off very slowly and gradually downwards. The lower portion is a clearly defined band, which passes directly into the endodermal circular muscle of the body-wall on its inner side. This part is clearly and beautifully reticular in structure (Pl. XVII, fig. 17), except towards its outer edge, where it tends to become looser, and so alveolar. The meshes of the network are fine and very clear. In some sections there is a definitely reticular inner band next to the endoderm throughout the length of the sphincter; but in all cases either the outer part alone, or else the whole width of the muscle, splits, as it goes upwards, into slightly radiating, sub-parallel vertical layers, separated more or less from each other by clear mesogloea. These layers are alveolar in structure, and not very definitely bounded (Pl. XVII, fig. 3), but they vary in width and clearness of definition in different sections.

(iii) *Disc and Tentacles*.—The radial musculature of the disc is well developed, and entirely embedded in the mesogloea. It varies considerably, however, in sections taken from different parts of the disc. One set of sections shows it as an almost continuous band of varying width (Pl. XVII, fig. 8) near the middle of the mesogloea. The outlines of the band are not very distinct, and sometimes it is broken up into large clumps, sometimes split into two different bands. It is either "alveolar" or "reticulo-alveolar" in structure, the alveoli on the whole being small. The band is slightly interrupted above the insertions of some of the mesenteries, not perceptibly above others. Then in other sections it is much better developed, definitely reticular in structure, with very large meshes (see Pl. XVII, fig. 7, and note that it is on approximately the same scale as fig. 8), and is sharply interrupted over the insertions of some of the mesenteries. In still other sections the meshes are intermediate in size. Unfortunately these three sets of

sections got mixed; but I am inclined to think that the larger meshes represent the outer, the smaller the inner, part of the disc.

In the tentacles the longitudinal musculature is also entirely mesogloal, and runs in a narrow, almost straight band through the mesogloea, fairly near the endoderm. (Pl. XVII, figs. 1, 2.) It is better developed in some places than in others, and sometimes more wavy than others. In structure it is alveolar, sometimes tending to be reticular, and is often only a single chain of alveoli. These latter vary a good deal in size, some being fairly large. At the bases of the tentacles, where the sections pass through the basal swelling (Pl. XVII, fig. 1), it is seen that as the band of muscle reaches the swelling it thins out rapidly, so that at the back of the swelling it is reduced to practically nothing. The mesogloea of the tentacle is thicker than either of the other layers, and its outer side is much folded, in consequence of the surface-wrinkles, and of course the ectoderm follows its outline. The basal swelling has a coating of ectoderm; but it gets thinner and thinner as the back of the swelling is reached, and there it is very low and poor.

(iv) *General histology.*—The specimen sectionized is a male. Well-developed ciliated lobes are present in the mesenterial filaments, and have their nuclei mainly concentrated in the inner parts; the glandular lobes contain many coarsely granular gland-cells. The whole endoderm in this species is rather particularly interesting, and contains elements of unusual appearance whose detailed study must be left for the present. Among other things, there are objects which appear to be large and curious parasitic algal cells with a shining test and possibly a spiral thickening in the wall.

The tentacle-ectoderm is well developed, with scattered pigment and very numerous spirocysts which, though not very broad, are long—often nearly as long as the depth of the ectoderm. Nerve-layer distinct. Gland-cells present in the inner part; also a few of the presumed parasitic algae. The ectodermal margin of the mesogloea appears to have a feeble fringe of muscle fibres, quite distinct and apart from the real longitudinal musculature; but I cannot be certain about this point. The ectoderm contains narrow, thick-walled enidæ, longer than those found in the body-wall. The ectoderm of the body-wall is low, not pigmented, with small scattered nuclei. A good many quite short, rather narrow, thick-walled enidæ (Pl. XVI, fig. 11) are present, and one sees even, very rarely, a spirocyst—though these may have stuck to the ectoderm surface accidentally, coming from some other part. There are numerous large, transparent, apparently glandular cells with fine granules which absorb eosin.

(v) The only other species of the genus *Actinostola* beside this one, which have basal swellings to the tentacles, are *A. Carlsbergi*, Wass., and *A. intermediæ*,

Carlgr. *A. Carlgreni* differs in various small ways from *A. atrostoma*—it has a different sphincter, stronger tentacle-musculature, and other differences—see Wassilieff 1908. Carlgren gives no figures of *A. intermedia* (10), but judging from his description, and from comparison with his figures of other species to which he refers, it would seem that the sphincter, disc-radial-musculature, etc., present numerous slight but sufficient differences; moreover, in *A. intermedia*, the longitudinal musculature of the tentacles is better developed in the outer basal parts than in the inner. This is exactly the opposite in *A. atrostoma*.

Sub-family **PARACTINAE**¹ Carlgren.

Paractidae in which the two mesenteries of one and the same pair, in the younger cycles, are either equally developed, or, if any inequality occurs it shows considerable irregularity, or does not follow the *Actinostola*-rule exactly.

Cymbactis¹ McMurrich.

Paractinae with thick smooth body-wall, without verrucae, collar, cuticle, or true capitular ridges (though the upper part of the column may be thrown, in strong contraction, into ridge-like folds). Margin tentaculate, not lobed. Tentacles simple or somewhat thickened at the base, in more than two cycles, their longitudinal musculature mesogloal. Sphincter simple. More than six pairs of mesenteries perfect. Pennons diffuse.

I have been obliged to extend this definition even more than before, to include the rather curious form described below.

9. **C. Gossei**, n. sp.

(Pl. XIV, figs. 10, 11; Pl. XVII, figs. 5, 9, 14.)

SR. 335. May 12, 1906. Lat. N. $51^{\circ} 12' 30''$ - $51^{\circ} 17' 30''$; Long. W. $12^{\circ} 18'$ - $12^{\circ} 16'$. Trawl. 893-673 fathoms. 1 specimen (with several *Actinernus aurelia*).

Measurements.—Diameter of mouth of basal cavity, 3.6 cm.; of column, 6.5 cm. at greatest; height of specimen (contracted), ca. 5.5 cm. Depth of basal cavity, ca. .7 cm.

External characters.—The body is almost spherical, having the appearance of an apple with a broad base, the tentacles and upper part of the body being completely introverted. The body-wall is thick throughout, and of hard and firm texture. At the limbus it becomes much thinner, and the edge of the

¹ See foot-note on p. 118.

limbus is drawn inwards on all sides, so that it forms a perfectly smooth circular rim, the diameter of the circle being much less than that of the body. This encloses a shallow basal cavity (see Pl. XIV, fig. 10), whose diameter is larger inside than at the mouth. The pedal disc itself, which, of course, forms the inner wall of the cavity, is very thin and membranous, and the mesenterial insertions show through it. In the upper part of the body the wall increases in thickness, and at its thickest may be as much as .8 cm. The whole upper portion is introverted, and when such a thick, solid substance is squeezed together by such strong contraction, it naturally falls into folds and creases; these might be termed "capitular ridges"; but I am inclined to think, since they are of extremely variable size, and absolutely without any regular arrangement, that they are merely contraction folds and would very likely vanish if the animal were expanded. They are solid mesogloea. The tentacles are in three apparent cycles at the disc margin, and the outer ones pass directly into the folds of the body-wall, so that there is no definite margin. The tentacles are short, stumpy, and of very irregular sizes; the mesogloea of the lower half is very thick and stiff, especially on the outer side, and the upper part is flaccid and much more thin-walled, often with a somewhat capitate lip. (Pl. XIV, fig. 11.)

They are peculiarly arranged—the outer ones are much mixed up with the marginal contraction-folds, and the inner ones are just free from the margin. The plan of arrangement, apart from minor irregularities, seems to be $36 + 36 + 72 = 144$ (+ 7 odd ones). The oral disc is smooth and firm, with a slight radial ridge for each tentacle, which does not reach the mouth. Lip prominent. Two well-developed actinopharyngeal grooves. Colour in spirit, white, disc and oesophagus tinged brown.

Structure.—(1) *Mesenteries.* These are arranged on the plan $18p. + 18p. + 36p. + 72p. = 144p.$, but there are actually 19 pairs in the second cycle, which causes a little irregularity—apart from which the plan is almost exactly carried out. 36 pairs are perfect.

The last cycle mesenteries are very small, and alone bear visible gonads. Small oral, but no marginal stomata, are present. A certain amount of inequality in the development of the mesenteries occurs; but altogether, as many pairs have the partners equal (to the naked eye at all events) as unequal, and when one partner is larger than the other it is sometimes the *wrong* partner that is larger—i.e. it violates the rule which obtains in *Actinostelia*. The fourth-cycle mesenteries bear male gonads, but have no musculature to speak of. The rest of the mesenteries are thin. Those of the third cycle are fringed along the endocoelic side with short, simple, or slightly branched longitudinal-muscle processes, which do not attain the

distinction of a pennon. The larger mesenteries (1st and 2nd cycles) have a similar fringe in their proximal part, but in the distal part it rises gradually, till it forms a feeble pennon, with moderately high processes, which are never much branched, and often simple. It ends abruptly, and leaves a narrow non-muscular part behind the filament. (Pl. XVII, fig. 14.)

Here and there a little muscle is embedded in the mesogloea. The parieto-basilar muscle, at the level of my sections, is weak, and extends over the greater part of the opposite surface of the mesentery to the pennon. Its distal ending varies, even in two mesenteries of the same pair—it may taper away, or form a slight hump, or even a small free fold provided with a few little stumpy processes.

(ii) *Sphincter*.—Fairly large. It must be very strong to be able to contract enough to close up such a stiff animal. It is long (Pl. XIV, fig. 10, shows its position), and lies throughout against the endoderm. It is at its best development about the middle, being very irregular above on account of the folds into which the wall is thrown, and their continuity with the tentacle-bases. Below it rapidly narrows into a long tail. This lower part is cleanly marked off from the rest of the mesogloea, and is reticular (Pl. XVII, fig. 9) in structure, the meshes being often large, with a tendency to transverse elongation, and fine. From about the middle upwards the reticular structure becomes gradually alveolar, more and more mesogloea intervening between the muscle-cavities. The upper part is poorly and irregularly developed, the scattered cavities varying very much in form. In addition to a tendency to transverse elongation of the cavities, there is a distinct but vaguely marked vertical layering. One can hardly tell where the body-wall ends and the tentacle-bases begin.

(iii) *Disc and Tentacles*.—The radial musculature of the disc is much better developed in the sections I have than the longitudinal musculature of the tentacles. It forms a well-defined band of varying width, embedded in the mesogloea, and at its best not occupying more than about $\frac{1}{3}$ of the width of the mesogloea. It lies sometimes about the middle, sometimes near the ectodermal side of the mesogloea. Where best developed the muscle cavities are close enough together to give the band a reticular structure, but in the thinner places the cavities are more scattered, and the band is only one or two cavities deep. It is usually interrupted or thinned out above the insertions of larger mesenteries. The mesogloea of the tentacles is extremely thick, especially at the base, where it is almost equally thick all round in some places. The mesogloea longitudinal muscle (Pl. XVII, fig. 5) is very feeble, especially near the base, where it lies near the ectodermal surface, often as a single row of cavities. Even in the thin part of the tentacle it seems better developed on the inner than the outer side.

(iv) *General histology*.—The ectoderm, as far as the portions which I sectionized are concerned, seems to have almost entirely vanished, so that I can say nothing about it. The mesenterial filaments have well-developed ciliated lobes, which, in a simple trefoil, are similar in size and shape to the glandular lobe, and when large are folded. The glandular lobes contain a fair number of narrow, medium-sized, blunt-ended, thick-walled cnidae, and a few coarsely granular gland cells.

v) *Cambractis gossei* is distinguished from other species in the genus by the curiously thickened bases to the tentacles, and also by differences in its sphincter and mesenteries and disc-radial-musculature, for the details of which reference should be made to the descriptions of several species given by other authors. (30 and 57.)

I have named it after P. H. Gosse, because, as far as I am aware, no Actinian bears the name of the well-known zoologist whose "Actinologia Britannica" was really the foundation of the serious study of Actinaria.

Stomphia Gosse.

Parotinae 7, with body-wall of varying thickness, devoid of verrucae, collar, pores &c. Tentacles disc, and sphincter simple. Numerous perfect mesenteries with diffuse pennons. Longitudinal muscles of tentacles mesogloal. More than two cycles of tentacles.

10. *S. churchiae* Gosse.

1. B. 19. May 3, 1905. Nymphæ bank. 41-42 fathoms. 15 miles off Mine Head. 1 specimen.

2. S.R. 1368. May 6, 1912. 12 miles S. by W. $\frac{1}{2}$ W. of Chicken Rock Light. Lat. N. 53° 50'. Long. W. 4° 51'. Dredge. 45 fathoms. 4 specimens.

Carlgren has already fully described a single specimen of this species (6), so I will merely note one or two points with regard to the five further specimens in this collection. The mesogloal sphincter agrees well with Carlgren's figures (Tab. IX, figs. 2 and 3); the mesenteries also agree essentially, though in my specimen the mesentery contains rather less mesogloea, and the processes of the pennon are proportionately higher—probably a merely individual variation.

One of my specimens has the tentacles 16 + 17 + 33; another has them 16 + 16 + 32; a third 13 + 15 + 31 (here two primary tentacles are absent, if not three, and the whole of that sector of the disc is aborted); the fourth, 16 + 15 (one absent but its radius present); two of the primary 16 aborted + 32, and the 10th 15 + 15 + 31. From this it would seem that an octamerous plan—16, 16, 32—is typical of the species, though not always carried out

quite exactly. Carlgren's specimen had 6 - 12 - 18 - 36; and Gosse gives 6 - 6 - 12 - 36.

In two dissected specimens, one had 16 pairs of perfect mesenteries, the other had 1 extra perfect unpaired mesentery. Both had a cycle of moderate-sized imperfect pairs alternating with the perfect ones, and a last cycle, consisting mainly of small unpaired mesenteries, only well developed near the base, and sometimes with a still smaller partner. After careful investigation of the whole of these two animals, I cannot at all satisfy myself that the rule which prevails in connexion with the smaller mesenteries of *Actinostola* is carried out with any definiteness. It does hold good for some sectors of the animal, but is not, as far as I can tell, general. It seems to me too imperfect, here, to warrant the inclusion of the genus in the *Actinostolinae*.

Actinernus Verrill.

Paractinae, with pedal disc of variable extent—it may be broad, or so reduced as to be practically absent; or it may be concave, secreting a cuticle and enclosing mud. Column with a smooth wall, which is sometimes so thick that it forms a jelly-like coating to the body, so that the general form may resemble that of a Scyphozoan. Tentacles arranged in two cycles only, at the extreme margin of the oral disc; they all have aboral basal swellings of mesogloea, which are continuous with the body-margin, at least in the case of the outer ones. Longitudinal muscles of the tentacles and radial muscles of the disc entirely ectodermal. Oral disc wide, sometimes lobed. Only six pairs of perfect mesenteries, with weak, diffuse retractors.

The species which have hitherto been described under the generic name *Actinernus* are four in number. The type is *A. nobilis*, Verrill, and it is unfortunate that its anatomy is unknown. Carlgren (8), from an external examination of a specimen of it, is inclined to think that it may really be a *Porponia*. A description will be found below of an anemone which I believe to be identical with the second species described—*A. saginatus*, Verrill, 1882. This is certainly not a *Porponia*, since it has the normal mesenterial arrangement, only six pairs of mesenteries perfect, and a mesogloecal sphincter. The anatomy of *A. plebeius*, McMurrich, 1893, brings it into line with *A. saginatus*, and I am now able to describe a new species (*A. aurelia*), with the same essential structural features. The anatomy of *A. sp.*, Haddon, 1888, is unknown.

If it should prove in the end that *A. nobilis* is a *Porponia*, some readjustment of names may be necessary; but in any case, *A. saginatus*, *plebeius*, and *aurelia* go together and form one good genus. McMurrich (1893)

suggested that *Polysiphonia tuberosa*, Hertwig, might be an Actinernus; but it is really quite a distinct form, and more related to Actinostola, as I hope to show in another place.

11. *A. saginatus* Verrill.

(Pl. XV, figs. 4 and 9; Pl. XVI, figs. 1-10; Pl. XVIII, figs. 2-7 and 10.)

Helga cxx. Aug. 24, 1901. 77 miles W.N.W. of Achill Head. 382 fathoms. 1 specimen.

Measurements.—Diameter of the basal fissure when opened, 1.7 cm.; of contracted oral disc, .55 cm.; of expanded disc and tentacles, 11.3 cm.; length of basal fissure, 7.4 cm.; of mouth, 4 cm.; of a large tentacle, 2.7 cm.; height of column, 6 cm.

External characters.—Pedal disc formed into a long, deep, and narrow crack, which embraces a long spine belonging to some other animal. Consequently the pedal disc is as long as the diameter of the body, but not nearly as wide, its edges wrap themselves round the spine, and meet each other, but do not fuse save at one end. The body is whitish, and perfectly shapeless, the oral disc and tentacles being partly incurved and hidden. Its wall forms a soft, thick, jelly-like coat, like the test of an Ascidian, which is smooth but for irregular pits and furrows. The margin is continuous with the basal swellings of the outer tentacles. The long, slender tentacles, tapering gradually to a point and the disc, are pale salmon. The tentacles are stiff enough to support themselves, and the rather thin disc has, as usual, radii corresponding to the tentacles, which do not reach the wide mouth, with its soft lips. As the animal is preserved the disc is intoded, but it can be opened out, and it then exceeds the column, and, though not truly circular in outline, is only rather irregularly wavy, not definitely lobed. The tentacles are 137 in number, and are arranged in two alternating cycles only (sixty-eight marginal, the rest non-marginal) at the extreme edge of the disc, even the inner ones communicating more or less with the margin. It seems to me that in this case it would be imagination to divide the inner tentacles into more than one cycle. They are all, allowing for the undulate outline of the disc, approximately on one level, and all sub-marginal. All the tentacles have basal swellings of mesogloea (Pl. XV, fig. 9), which vary in size in individual cases, but are on the whole larger on the outer than the inner ones. The tentacles themselves are rather uneven in size, a few being aberrant, but are on the whole sub-equal. (For general appearance, see Pl. XV, fig. 4.)

Structure. (1) *Mesenteries*.—Only six pairs of mesenteries are perfect, and even these are not all equally so. There are five cycles (sixty-seven pairs), and

mesenteries of all cycles, save the primary, are fertile; the last (fifth) cycle is not fully formed. There seem to be oral, but no marginal stomata. There is a tendency towards one mesentery of a pair being larger than its partner in the younger cycles, but it is not well or clearly developed, and in the majority of pairs it would not be possible to say which was the larger, by dissection at any rate. Sections of a sector show that the first three cycles bear weak pennons, the fourth and fifth being reduced to little more than reproductive septa. The mesenteries are very thin, and all have a slight thickening of the mesogloea, and a parietal muscle where they join the body-wall. (Pl. XVIII, fig. 10.)

(a) *A typical directive mesentery.*—The parietal muscle has the processes on the longitudinal-muscle side larger, fewer, and more branched than on the other. Most of the mesentery is very feebly muscular, though there are short, stout processes on the endocoelic side. But as the edge of the mesentery which joins the actinopharynx is reached, a weak diffuse pennon appears, its processes becoming higher and higher till they abruptly end at the juncture. They are very stout and little branched, and crowded, so that they have a somewhat "reversed" appearance (*cf.* Pl. XVIII, fig. 3) (*i.e.*, as if the processes projected from endoderm to mesogloea, instead of the reverse, which is really the case).

As to the rest of the mesenteries, the parietal muscle is always better developed on the same face of the mesentery that has the pennon than on the other. The greater part of the mesentery is thin, and feebly muscular, the second and third cycles bearing a feeble pennon at the distal border (at the level sectionized), which occupies only a small proportion of the muscular surface, and tapers at both ends, typically more abruptly distally. The processes are short and stout, and not much branched, giving almost the "reversed" appearance referred to above. The parieto-basilar muscle, at the level sectionized, is weak, and has no free edge, but fringes almost the whole muscular part of the mesentery, often rising into lobe-like processes.

(ii) *Sphincter.*—Mesogloea, rather weak. (Pl. XVIII, fig. 6.) It is narrow throughout, widest somewhat below the top, the upper part being mixed up with the tentacle-bases, and so variable in different sections. At its lower end it lies close to, but never in contact with, the endoderm, from which it is separated throughout by a band of mesogloea; above, it approaches the ectodermal surface of the mesogloea. It ends rather abruptly, both above and below—below the muscle bundles become fewer, smaller, and more scattered; above (Pl. XVIII, fig. 5) the terminal bundles are distinct. In structure it is alveolar, the fibres to a large extent being arranged in little rings of variable shape and size as to detail. Throughout the greater part of

the sphincter the alveoli are very small (Pl. XVIII, fig. 2), and are arranged some singly, some in clumps of varying size, loosely or compactly. But at the uppermost end of the sphincter the alveoli are larger and close together, so that the clumps form networks. The sphincter does not exhibit vertical or transverse layering.

(iii) *Oral disc and tentacles.*—The radial musculature of the disc is entirely ectodermal, and is not much different from the tentacle-musculature. The tentacles have thick but variable mesogloea and high ectoderm, which, however becomes poorer on the thickened outer side of the tentacle, especially at the base. The entirely ectodermal longitudinal musculature forms a dense fringe round the edge of the mesogloea, varying in width in different parts. The processes are fairly stout and not greatly branched, are moderately high in general, and snowed and rather moss-like in appearance. (Pl. XVIII, figs. 4 and 7.) The musculature almost dies away on the aboral side of the tentacle as the base is approached, and at the back of the basal swelling is hardly present.

(iv) *General histology.*—(a) *Ectoderm.* In sections of the actinopharynx this is very high, and is crowded with large granular gland-cells; there are also other gland-cells, rather like a mass of small bubbles in appearance, which consist, and a fair number of moderately long and narrow thick-walled neurocysts, and even a spirocyst here and there. The tentacle ectoderm is crowded with spirocysts of all sizes, the largest being unusually big. There are also thick-walled blunt-ended canals, longer and more cylindrical than those of the mesenterial filament. Nuclei are most plentiful in the middle of the ectoderm. There are a large number of gland-cells of a peculiar sort which I have not seen elsewhere. (Pl. XVI, figs. 5, 30.) The body of the cell is stained pale-pink with eosin and it contains black hæmatoxylin-stained granules which are scattered, often few and very large. It has quite a different appearance from the usual granular gland-cell. There are also present gland-cells of another type which absorb eosin with avidity, and become dull brownish-red; these contain no black granules, and most often do not stain with hæmatoxylin. The ectoderm of the body-wall is much lower than that of the tentacles, but is well and evenly developed; it has scattered nuclei, and thick-walled canals (shorter and proportionately broader than those in the tentacles) are plentiful, especially at the margin, where they are crowded. Gland-cells of a type intermediate between those of the tentacles and the common sort are found, but are not conspicuous; there are also eosinophilous areas. (b) *Endoderm.* The mesenterial filament-canal has rather narrow stems to the three lobes, and a good deal of mesogloea in each lobe. The ciliated lobes are often folded

and have nuclei throughout, but especially in their inner parts. The glandular parts of the filament have more ordinary granular gland-cells than anything else, and also a few non-granular ones. They contain thick-walled enidae, irregularly distributed, variable in size and form, but typically fairly short, broad, boat-shaped, and blunt at the ends. Here and there a spirocyst (indigenous?).

(v) The above-described specimen presents no essential feature which warrants its separation from Verrill's *A. saginatus*; the only difference is that his specimen had a mud-clasping base, but, as I shall show under *Actinauge richardi*, that is a non-constant character. My specimen does not widely differ externally from *A. nobilis*, but that seems to have a definitely lobed disc, and the colour of *saginatus* agrees better with my specimen than does that of *nobilis*.

12. *A. aurelia* n. sp.

"Aurelia" from its general external resemblance to a jellyfish.

(Pl. XV, fig. 1; Pl. XVI, figs. 21, 28; Pl. XVII, figs. 10-13, 15, 16, and 18; Pl. XVIII, fig. 1.)

1. S.R. 335. May 12, 1906. Lat. N. $51^{\circ} 12' 30''$ – $51^{\circ} 17' 30''$; Long. W. $12^{\circ} 18'$ – $12^{\circ} 16'$. 893–673 fathoms. Trawl. 6 specimens.
2. S.R. 335. (See 1.) 4 specimens.
3. S.R. 497, 499. Sept. 10, 1907. 775–795 fathoms. Trawl.
S.R. 497. Lat. N. $51^{\circ} 2'$; Long. W. $11^{\circ} 36'$.
S.R. 499. Lat. N. $50^{\circ} 55'$; Long. W. $11^{\circ} 29'$. 666–778 fathoms.
 Sept. 11, 1907.

Measurements—(i) *A large specimen.* Diameter of oral disc, 10 cm.; thickness of body-wall in a thick place, 1.3 cm.

(ii) *Smallest specimen.* Diameter of oral disc, 7 cm.

External characters.—The entire *facies* of this animal is so unusual, that I found it difficult, at first, to believe that it really was a sea-anemone, and not a Scyphozoan. It may be thought that an animal so distinct in aspect from most other Actiniaria should be placed in a genus apart; and at one time I was inclined to think so. But comparison of the specimens with *A. saginatus*, and the fact that in all essential anatomical characters they resemble that species, have convinced me that it would be unwise to separate them.

The pedal disc is present in all cases, but is extremely reduced and insignificant; it forms a little pit or hollow with inturned edges, whose mouth is often completely closed. (Pl. XV, fig. 1.) It contains traces of

dirt and mucus, and is sometimes radially striate. In the case in which it is best developed, its diameter and depth amount only to about 1·7 cm. It is quite thin-walled, thus differing completely from the body-wall. The body is practically shapeless, its form when best preserved being that of a wide dish with a short thick stem. In all cases the dish-like part is bi-lobed, the two halves folding up against one another rather like the two valves of a lamelli-branch. Reference to the half of an animal which is represented in Pl. XV, figs. 1 and 2, will make it clear that the two halves of the animal are flat—fig. 1, as seen from the side (fig. 2), becomes much narrower. The thickness of the body-wall is rather uneven, but in the most regular cases it increases gradually from the edge of the pedal disc upwards, the maximum thickness being reached about the margin; and this latter is so thick and unwieldy that it rolls inwards over the tentacles and almost hides them. In one case the mesogloea here was 1·3 cm. in thickness; it is soft and jelly-like and whitish. Margin continuous with tentacle bases. No verrucae, capitular ridges, etc. Body-surface more or less wrinkled, sometimes torn and damaged. The flat oral disc is very wide, and since it is so large and the tentacles are reduced the animal, when opened out, looks like the under-side of a mushroom. Disc, tentacles, and actinopharynx are deep purplish-black. Disc thin-walled, mouth fairly large, not widely gaping; lips prominent. Actinopharynx ridged. Tentacles entirely marginal, very small for the size of the animal—how they can be of any particular use to it, is difficult to imagine. They are short, slender, soft, tapering, acuminate. Each one is connected with the margin of the body by a thick white bridge or lump of mesogloea, which is developed on its aboral side at the base. The tentacles are arranged regularly in *ten cycles only*, the bridges of the outer cycle being usually better developed than those of the inner. The size of the tentacles and the development of the bridges vary to some extent in different parts of the rather uneven disc, and in most specimens some tentacles are missing—perhaps torn off. But the inner tentacles are submarginal, and seem to be on a level, so that one can trace no complicated arrangement such as is found in *Porporea*, etc. In three specimens whose tentacles I counted, the respective numbers were about 225, 260, and 275—that is, the total numbers. The disc is not many-lobed as in *A. zebbia*, but its curious way of folding seems to be a permanent character in consequence of which it is bi-lobed.

Structure.—(1) *Mesenteries*. These are arranged in six cycles, the sixth not fully formed; here and there one finds a pair even of a seventh cycle. Only the first four cycles are at all large, and only the six primary pairs are perfect, two of them being apparently directives. In consequence of the enlargement of the oral, and reduction of the pedal disc, and the general flattening of the

body, the coelenteron is a good deal restricted. The primary mesenteries are sterile; mesenteries of cycles 2, 3, 4 are fertile; those of 5 are some of them, those of 6 are rarely, fertile. Two actinopharyngeal grooves. Mesenteries of all cycles bear filaments. I can see no marginal stomata in the perfect mesenteries, but small oral-stomata are present. In the young cycles, each pair for the most part has one mesentery better developed than its partner. In the majority of cases this inequality follows the rule which prevails in *Actinostola*, but still there are a number of instances in which the inequality is either too slight to be detected by dissection, or else is developed contrary to rule. The mesenteries are normally developed, not on the type of the Endocoelactidae. They are flaccid, with weak musculature. Sections of a sector taken at a fairly high level show the following details. The perfect mesenteries have a few short and simple or slightly branched processes on either side where the mesentery leaves the body-wall, better developed on the side which bears the retractor-muscle than on the other. These soon die out; but about the middle of the surface of the mesentery is a low, weak pennon, tapering at both ends. Its best processes are fairly high and moderately branched; they are stout, but variable. Sometimes their appearance is fairly ordinary (Pl. XVIII, fig. 1), while sometimes they contain so much mesogloea that they give something like the "reversed" appearance which I have described as characteristic of *Leptoteichus insignis* (48). (Pl. XVII, fig. 16.) The medium-sized mesenteries are similar, the musculature becoming weaker cycle by cycle; the longitudinal muscle processes hardly deserve the name "pennon," and are confined to a small part of the mesentery immediately behind the gonad or filament. (Pl. XVII, figs. 12, 13, 14, 15.) The smallest mesenteries have parietal musculature only. Although the pedal disc is so small, distinct basilar muscles are present.

(ii) *Sphincter*.—Very small and weak for the size of the animal, and weaker than in *A. Saginatus*. It forms a narrow band in the mesogloea (Pl. XV, fig. 1) a little below the uppermost rim of the body, and lies close to the endoderm, although separated from it throughout by a narrow mesogloea strand. It is of fairly uniform width throughout, tapering off below and ending bluntly above. In transverse section the fibres are arranged in small alveoli and clusters, and these aggregated into clumps of larger and various size (Pl. XVII, figs. 10, 11); but it can hardly be described as a clearly "alveolar" sphincter. The fibres are a good deal mixed up with dark pigment-granules.

(iii) *Tentacles and oral disc*.—Tentacular longitudinal muscles entirely ectodermal. In the distal part of the tentacle it forms a very narrow fringe of very short, quite stout, stumpy processes round the edge of the mesogloea (Pl. XVII, fig. 18), many of them not much longer than wide, simple or a

little branched. Sometimes, where the surface is thrown by wrinkles into ridges and furrows, the musculature is best developed on the ridges. Sections through the basal part of tentacles show that the musculature is as before on the aboral face, but it gradually thins out and weakens as the great mesogloecal swelling of the aboral side is reached, and at the back it vanishes altogether. The radial musculature of the oral disc is stronger than the tentacular muscle, but entirely ectodermal.

(v) *General Histology.*—The endoderm is deeply pigmented throughout, except as regards the gonads and in part at any rate the ciliated lobes of the filaments. The tentacle ectoderm has a fairly narrow, well-marked nerve layer, and the usual battery of fairly large spirocysts. It contains pigment granules, but they are far fewer than in the endoderm. The mesenterial filament-trifolds have large, well-developed ciliated lobes, with the nuclei especially concentrated in the inner parts: these, when the larger ciliated lobes become folded, form a curious pattern (Pl. XVI, fig. 28). The glandular lobes contain coarsely granular gland-cells which are round, oval, or elongate; and also large long narrow, canoe-shaped, thick walled nematocysts. Ectoderm of actinopharynx high and pigmented. Even the mesogloea, in some parts, seems to have scattered pigment granules in its matrix.

(vi) This species is distinguished from other members of the genus by (a) the extreme reduction of the base and enlargement of the oral disc, which is always bilobed and folded double one half against the other. (b) The character of the mesenterial musculature distinguishes it from *A. Phebeius* and *A. acuminata*, as do also the character of its sphincter and other details.

Family **SAGARTIIDAE**¹ Gosse.

Actinidia with well-developed base and basilar muscles. Sphincter mesogloecal in all genera but one. Acontia present. Cinclides present or absent.

Sub-family **SAGARTIINAE** Verrill.

Sagartiinae with soft body-wall, possessing cinclides but no cuticle; sphincter present, mesogloecal; more than six pairs of perfect mesenteries, of which the six pairs of primary mesenteries are fertile except for the directives in some cases. Suckers may or may not be present.

CEREUS Oken.

Heliactis Thompson.

Sagartiinae with the upper part of the body and the wide oral disc capable of much exceeding the lower part, tentacles very numerous, disc sometimes

¹ See foot-note on p. 118.

undulate in outline; upper part of body provided with adhesive suckers. Mesenterial musculature strong, retractors diffuse. Cinclides scattered. Margin tentaculate.

13. *C. pedunculatus* Penn.

(*Sagartia bellis* Ellis and Solander, &c.)

St. VII. Feb. 28, 1899. Ballynakill. Coastguard Bay. Shore collection. 9 specimens. (Also one small specimen of another species.)

It may be of interest to record that the one specimen which I sectionized is hermaphrodite. Well-developed ova and testes are present at the same level in one and the same mesentery.

Sub-family **METRIDIINAE** Carlgren.

Sagartiidae with six (rarely a few more) pairs of perfect mesenteries, which are sterile; one or more siphonoglyphes; body-wall relatively thin, without a cuticle; cinclides present; sphincter mesogloal.

Calliactis Verrill.

Metridiinae with body of typical more or less cylindrical form, sometimes with a widely expanded base; wall smooth, except for the cinclidal tubercles in some species; cinclides in horizontal rows at the base of the column. Six pairs of perfect mesenteries. No collar. Disc not lobed, though sometimes a little undulated in a living animal. Longitudinal musculature of tentacles ectodermal or meso-ectodermal. The species are usually commensal with hermit crabs.

14. *C. rondeletii* D. Ch.

(*Sagartia parasitica* Couch, &c.)

R. 1. March 18, 1904. Trawl off Dungarvan. About $5\frac{1}{2}$ miles S.S.E. of Helvieck Head. 27-28 fathoms. Six specimens.

Four of the specimens are attached to one Gastropod shell; one is on another shell, and the last is loose.

Adamsia Forbes.

Metridiinae in which the smooth column is short and flat, and modified into two great lobes, which completely enclose a gastropod shell inhabited by a hermit crab; the lobes unite where they come in contact, and give the body a ring-like form. The pedal disc secretes a tough cuticle. Cinclides in one or several horizontal rows near base of column.

15. *A. palliata* Boh.

1. Helga, RT. iii, 1. LXXXVIII. July 8, 1901. D. Dredge. 40 miles W.N.W. of Cleggan Head. 78 fathoms. 9 specimens.

2. SR. 185. Jan. 30, 1905. 70 miles S.W. of Fastnet. Lat. N. $50^{\circ} 20'$; Long. W. $10^{\circ} 20'$. $82\frac{1}{2}$ fathoms. Dredge. 1 specimen.

3. XLIV d. Bofin. July 5, 1899. Off mouth of Bofin Harbour. 20 fathoms. 1 specimen.

4. SR. 178. Nov. 16, 1904. Dredge. $74\frac{1}{2}$ fathoms. 3 specimens (and 1 *Actinocyclus richardi*). 40 miles N.W. by W. $\frac{1}{4}$ W. of Cleggan Head. Lat. N. $53^{\circ} 36' 30''$; Long. W. $11^{\circ} 15' 30''$.

Sub-family **CHONDRACTINIINAE** Haddon.

"Sagartiidae with only six pairs of perfect mesenteries, which alone of the well-developed mesenteries are sterile; two gonidial grooves and two pairs of directives, body-wall usually thick, with a cuticle, and often nodulated; cinchides absent (?); acontia rarely emitted, and then by the mouth only; strong mesoglocal sphincter muscle" (Haddon, 1898, p. 458.) Rarely a few more mesenteries than the six primary pairs are perfect.

Chondrodactis Wassilieff.

Chondractiniinae with tough cartilaginous body-wall, variable in different species, but which may be very thick; it may bear irregularly arranged rounded or pointed tubercles. No cuticle (invariably?). If there is any division of the column into scapus and capitulum, it is indistinct; the "capitulum" may have irregular ridges. The oral disc may be entire or bilobed, with the two lobes curled inwards at the edges, and folded up against each other. There are never more than two cycles of tentacles present, and these are at the extreme margin of the oral disc, and all communicate more or less with the margin by means of thickenings of mesogloea on their aboral sides. Six pairs of mesenteries or a few more perfect, with more or less diffuse retractors. Longitudinal musculature of tentacles ectodermal, radial musculature of oral disc sometimes meso-ectodermal.

This genus was erected by Wassilieff (57) for three Japanese species. I find in the present collection three more species which undoubtedly belong to the same genus, but which cannot be referred to any of the hitherto described species.

16. *C. coccinea*, n. sp.

(Pl. XVI, figs. 22-26 and 41; Pl. XVIII, 8, 9, 11, 12, 17, 18.)

SR 188. Feb. 3, 1905. 50 miles W. $\frac{1}{4}$ N. of Terraght Light. Lat. N. $51^{\circ} 53'$; Long. W. $11^{\circ} 59'$. 1 specimen.

Note on label:—"Disc and tentacles, colour vermilion; column white."

Measurements.—Diameter of pedal disc, 4 cm.; of column at narrowest, 3.2 cm.; of oral disc and tentacles, 6.7 cm.; height of column, 4.8 cm.

External characters.—Pl. XVI, fig. 41.) The pedal disc forms a wide cup, with an even, oval rim slightly indrawn over it. It is filled with a mixture of dirt and cuticle. Limbus well defined. The column slopes gradually inwards from the base up, being narrowest just below the disc: but at the top it suddenly widens out, so that its circumference at the margin is much greater than at the base. The lower part has a moderately thick, tough, flaccid, quite smooth wall, without visible cinclides. The wall of the expanded upper part is thicker, and is thrown into irregular transverse folds, covered with solid nodules or tubercles of various sizes. These are numerous, but with no very definite arrangement, and not equally developed on all sides of the animal; on the whole, they increase in size from below upwards. Margin tentaculate, irregular. Tentacles rather short, rather thin-walled and flaccid, moderately slender, tapering, bluntly pointed. They are not fluted, but have delicate transverse and longitudinal striations. All of them have a swelling of solid mesogloea on the outer side at the base, not quite equally developed all round the disc. They are arranged in two alternating marginal cycles only, $72 - 72 = 144$. Oral disc greatly expanded, thin-walled, and flaccid, with radial ridges which correspond to the tentacles, but do not quite reach the mouth. Lips prominent, showing the ridges and the two grooves of the actinopharynx.

Structure.—(i) *Mesenteries.* There are six pairs of perfect mesenteries, and two additional unpaired perfect mesenteries, belonging to the second cycle. These two are symmetrically disposed about the long axis of the body, and their retractor muscles face one of the pairs of directives, on either side of which they occur. There are five cycles—6p. + 6p. + 12p. + 24p. + 31p. Last cycle incompletely developed and very small. No gonads were visible on dissection, but sections of a sector show young ova in mesenteries of the third cycle. Acontia are present, but they are rather small. In structure they show differences from the mesenterial filament of almost exactly the same nature as those described under *C. pulchra*. The perfect mesenteries, as seen in sections of a portion of the body at the level of the actinopharynx, contain on the whole a good deal of mesogloea. Where each mesentery leaves the body-wall, its mesogloea is thick, and sends out on each side of it a few fairly large and moderately branched stout processes. Pl. XVIII, fig. 8, which give the genuine "reversed" appearance—as if, that is, the processes were projecting the wrong way, from endoderm into mesogloea: of course this is only apparent. These processes are more numerous and better developed

on the side of the mesentery which does not bear the pennon. They soon die out, and on the retractor-side of the mesentery are followed by a wavy fringe of fibres, gradually rising into processes, which finally form a fairly strong pennon (Pl. XVIII, figs. 9 and 12). Typically this ends rather abruptly, distally, and is succeeded by another fringe of insignificant processes.

The pennon processes are fairly high and branched, so stout that they are very close together, and give the "reversed" appearance very markedly. It will be noted from the figure that they look just as if they were projecting *into* the mesogloea—which is left white and not shaded. The second and third cycle mesenteries have a fringe of longitudinal muscle processes which has hardly the distinction of a pennon; and they have larger parietal muscles than the primaries. Those of the fourth cycle have practically nothing but a large parietal muscle, and those of the last cycle have parietal muscles only.

(E) *Splanchnium*.—Moderately strong, not long or large. Its outline is irregular, since it follows the ectodermal and endodermal surface-fissures caused by wrinkles. It is separated throughout from the endoderm, but comes very close to the ectoderm in some places. It tapers off into a "tail" below, and ends as a broader one above, being broadest in central parts. In structure it is not distinctly "alveolar", but the fibres are arranged in clusters and in distorted, crushed, and flattened cavities, and these form with each other larger clumps which tend to be arranged in transverse and longitudinal lines, and are best developed above.

(H) *Radial disc and radiatae*.—The radial musculature of the disc is partly ectodermal, partly embedded in the mesogloea. It has a rather peculiar character (Pl. XVIII, figs. 17, 18). The muscle-layer is very thick and strongly developed in those parts of the disc which bridge the space *between* the part of mesenteries (fig. 17), but in the radii between the two mesenteries of one pair, as soon as the muscle-layer reaches the mesentery, it thins out gradually, so that, when this is most marked, it has thinned away almost to nothing about the middle of the radius. The thinning is more marked between two mesenteries of a large pair than between two of a small pair. In fig. 17, *x* and *y* are two mesenteries forming a large pair, and *z* is one partner of a smaller pair. In its thick parts the layer is to a considerable extent embedded in the mesogloea, the fibres forming clumps and even little rings (fig. 18). The thicknesses of the three layers in the tentacles varies according to state of inflation, &c., but of course the mesogloea is excessively developed in the basal swellings, which have a thin but regular ectodermal coating. The longitudinal musculature is ectodermal (Pl. XVIII, fig. 11), borne on short, stout, practically unbranched processes, and is low but continuous round the basal swellings.

iv *General histology.*—The ectoderm of the tentacles has the usual battery of large spirocysts; but it varies in thickness a good deal, and of course when a tentacle is much distended the ectoderm is very thin, and then there is not room for the spirocysts, and they have to lie sideways in it. There are long, narrow, blunt-ended, thick-walled cnidae, with a light "keel" or a dark central streak (probably the spiral thread). These are plentiful in the basal swellings, also in the tips of the tentacles. There are numerous large, irregular or rounded finely granular gland-cells, and smaller ones not visibly granular. The body-wall ectoderm, where it remains, is less well developed than that of the tentacles; it contains thick-walled cnidae like those of the tentacles.

The mesenterial filament-trefoils have well-marked ciliated lobes, usually larger than the short glandular ones, and they stain very deeply. The glandular parts contain many coarsely granular gland-cells of various forms and sizes, many of them elongate; also long, large thick-walled nematocysts in the large glandular-filament, but much smaller needle-like ones in the trefoils.

17. *C. pulchra* n. sp.

(Pl. XIV, fig. 4; Pl. XVI, figs. 13–15; Pl. XVIII, figs. 13–16.)

Three specimens in an unlabelled jar.

Measurements.—(i) *Largest specimen.* Diameter of oral disc and tentacles, 3·8 cm.; of column at its widest, 4·4 cm.; of lower part of column, 2 cm.; length of pedal disc, 3·5 cm.; breadth of pedal disc, ·9 cm.; height of column, 3·4 cm.

(ii) *Smallest specimen.* Diameter of oral disc and tentacles, 1·6 cm.

External characters.—In all cases the pedal disc is elongated in the line of the axis of the actinopharynx and its grooves. It is modified for attachment to cylindrical objects, which in this case are spines of an Echinoderm. It has a well-marked edge, and is thin and membranous, seemingly with no cuticle, although in one case much of the outer layer of the spine has stuck to the anemone. Column approximately the same shape in all, much exceeded by the pedal disc in one axis, exceeding it in the other. The pedal disc is rolled round the spine, its opposite edges meeting, but not fusing. Lower part of column cylindrical and pillar-like, upper part expanding suddenly and considerably exceeding it (Pl. XIV, fig. 4), and then curving inward again a little to the margin of the oral disc. The wall is tough and hard, rather thin below, but quite thick in the upper part. Lower part almost smooth or finely papillate, upper part with numerous prominent pointed tubercles, of various sizes and irregular arrangement. These attain their best development a little below the margin, the uppermost rim being almost smooth. They are

not equally developed on all sides of the same animal. Margin tentaculate. No visible cinclides. Colour in spirit—body whitish; disc and tentacles buff. Disc fairly wide, thin-walled; mouth slightly gaping, raised, with two inconspicuous actinopharyngeal grooves. Radii prominent, corresponding to the tentacles. Tentacles short and small, slender or fairly stout, tapering and pointed or blunt and stumpy, with basal mesogloecal thickenings on the aboral side in all cases. The swellings are sometimes very marked, sometimes inconspicuous or almost absent; they are least conspicuous in the smallest specimen, and practically absent from the tentacles of its inner cycle. The tentacles are arranged in two marginal cycles only; their size is rather irregular, and here and there very small ones are hidden between larger ones which seem to have developed at their expense. In the largest specimen the arrangement is 72 + 72 + 144; the medium-sized one has less than 120 altogether.

Structure.—(i) *Mesenteries.* The specimen dissected had six pairs of perfect mesenteries and two unpaired perfect mesenteries of the second cycle, disposed as in *C. coccinea*. Acentia well developed, and present on mesenteries of all cycles; filaments also present on all cycles. The perfect mesenteries have large oral but no marginal stomata. No visible gonads. In all there are five cycles of mesenteries—the first four regularly developed—6p. + 6p. + 12p. + 24p.—the fifth very small, and, in dissection, only visible in the lowest part of the body, and on the underside of the oral disc. In sections taken about the level of the enterostome, these mesenteries are visible as merely small parietal muscles with few processes, hardly projecting beyond the endoderm. A typical section of a third-cycle mesentery shows thick mesogloea (Pl. XVIII, fig. 14); on each side of the mesentery as it leaves the body-wall, arise a few moderately stout processes, the mobile ones fairly high and branched on the endocoelic side of the mesentery, weak on the other. Succeeding these processes, on the endocoelic face is a fringe of very low ones for some distance, and these suddenly rise in height to form a well-developed diffuse pennon. It is of fairly even width throughout, dying off suddenly at both extremities, and has processes which, although fairly stout, hardly give the "reversed" effect which prevails in *C. coccinea*; they are high and well branched. The opposite surface of the mesentery to the pennon has a straight edging of fibres. The above remarks apply in general to other third-cycle mesenteries, the exact form of the pennon varying in different cases. The fourth-cycle mesenteries resemble those of the third cycle, but the pennons are narrower and less well-developed. The largest mesenteries have stronger pennons than any of the others, and these typically end very abruptly at their distal margin (where also the processes reach their highest development), and taper

off towards the body-wall. Here, the processes may be sufficiently stout to give the "reversed" appearance. The musculature of the exocoelic face of the mesentery is weak; no free fold is formed (at the level sectionized at any rate), though there is sometimes a fringe of stumpy processes. (For mesenteries see Pl. XVIII, figs. 13, 14.)

(ii) *Sphincter*.—This is separated throughout from the endoderm by a narrow strip of mesogloea which widens out at the top. It almost entirely fills the narrower parts of the rest of the mesogloea just below the body-margin. The upper extremity is rounded and well defined, and below it tapers off suddenly to a point. Its structure may be termed alveolar, the alveoli being mainly somewhat elongated transversely, often irregular, indefinite, and partly collapsed (probably due to imperfect sections). They are most crowded in the uppermost part, and they thin out and become small towards the side of the muscle nearest to the ectoderm. There is a certain tendency to arrangement in horizontal lines.

(iii) *Oral disc and tentacles*.—The radial musculature of the oral disc is partially embedded in the mesogloea in the places where it is well developed, and it is also similar to that of *C. coccinea* in its peculiar plan of arrangement. That plan is described in detail under *C. coccinea*. The longitudinal musculature of the tentacles is entirely ectodermal, and is well developed. (Pl. XVIII, fig. 16.) It is stronger than in *C. coccinea*, and is supported on short processes of the mesogloea, on which the fibres are arranged in a tufted way, giving a characteristic appearance. The basal swellings of the tentacles have, of course, a prominent development of mesogloea, but the ectoderm and its musculature are poor there, the latter thinning away to very little. Elsewhere the ectoderm is high, the musculature on the average not occupying more than $\frac{1}{4}$ of its thickness.

(iv) *General histology*.—The tentacle ectoderm has a very clear and distinct nerve-layer; the nuclei of the supporting cells are rather large, and very distinct, scattered generally. The spirocysts vary enormously in size, and are often broad; they are not very long, but are very numerous in the outer part of the ectoderm. A few fairly long thick-walled sting-cells, much narrower than the spirocysts, and a fair number of rather small gland-cells are present. The ectoderm of the body-wall, when preserved, varies; at its best it is pretty well developed, with the nuclei mainly concentrated in the inner part, and with numerous gland-cells, of which many are elongate, and reach from the inner surface of the ectoderm to the outer. Also, a few fairly large and broad thick-walled cnidae are present. The epithelium is overlaid in places with patches of dirt and mucus. The endoderm does not present special features—there are well-developed, often folded ciliated lobes to the fila-

ments: very many coarsely granular gland-cells are present in the filament-endothelium, and the glandular parts of the filaments. Here and there one sees a spirocyst, and appearances suggesting the tests of parasitic algae are also to be found. The glandular filament-lobes are provided with numerous thick-walled canals: they are fairly long, hardly narrow enough to be termed needle-like.

The acontia have quite a distinct appearance, in transverse sections, from the filaments: for one thing, they always contain a much larger core of mesogloea than the compound glandular filaments. Again, they have more thick-walled nematocysts, which, in addition, are distinctly longer, narrower, and more pointed at the outer end than those of the filaments. They also have a special development of eosinophilous cells, which have the appearance of bundles of small pink bubbles. There are also many elongate coarsely granular gland-cells.

(19) I have had doubts as to the wisdom of describing *Chondroactis pulchra* as a distinct species from *C. comosa*, because in many respects they resemble one another considerably. In the end, however, I have decided to separate them, taking into account the sum of small differences: these are, of course, more readily apparent after comparative study of the specimens but I hope the figures in Pl. XVIII will show the differences which exist, for instance, between the parietal muscles and the tentacular muscles of the two. Our knowledge of specific characters in Actinaria is hardly sufficient, so far, to enable us to say how much variation one species may show in the details of its structure, so that possibly further light I prefer to consider these two as distinct forms.

Both of them may be distinguished from the three Japanese species, already described by Wassilioff, by a number of differences in form, and in characteristics of spines, mesenterial mesoflature, &c., for which reference should be made to the original descriptions and figures.

18. *C. duplicata* n. sp.

"Duplicata" or "folded double" because of the characteristic method of closing, which is described below.

(Pl. XIV, fig. 6; Pl. XV, fig. 3; Pl. XVIII, figs. 19-21; Pl. XIX, figs. 2-9.)

1. SR. 171. Nov. 5 1904. 48 miles N.W. by W. $\frac{1}{4}$ W. of Tearaght Light. Lat. N. $52^{\circ} 7'$; Long. W. $11^{\circ} 58'$. 337 fathoms. 1 specimen.

2. SR. 212. May 6 1905. 50 miles W. $\frac{1}{4}$ N. of Tearaght Light. Lat. N. $51^{\circ} 54'$; Long. W. $11^{\circ} 57'$. Trawl. 411 fathoms. 3 specimens.

3. SR. 327. May 8, 1906. 60 miles W. $\frac{3}{4}$ N. of Tearaght Light. Lat. N. $51^{\circ} 46'$; Long. W. $12^{\circ} 14' 30''$. Trawl. 550–800 fathoms. 1 specimen.

4. SR. 353. Aug. 6, 1906. Lat. N. $50^{\circ} 37'$ – $50^{\circ} 40'$. Long. W. $11^{\circ} 32'$. 250–542 fathoms. Trawl. 6 specimens.

5. SR. 353. (See 4.) 8 specimens.

6. SR. 353. (See 4.) 5 specimens.

Measurements: (1) *A typical large specimen.*—Greatest diameter of mouth of basal cup, 5.9 cm.; of outside of cup, 7.5 cm.; diameter of middle of column, 3.8 cm.; of upper part of column, 5 cm.; depth of basal cup, ca. 4 cm.; total height of animal, 11.2 cm.; length of a large tentacle, ca. 1.5 cm.

(ii) *Smallest specimen.* Total height, 5.8 cm.

External characters.—The base forms, in all but one of the specimens, a sand or mud-clasping hollow. The one exception has an irregular base with its edges meeting one another, and seems to have clasped a small shell. In the others, the bulbous bases are very various in extent, and in details of development. They are not always of greater diameter than the column, but when best developed they widely exceed it, forming a broad cup with a thin and perfectly smooth wall, and a very sharply defined margin. The orifice of the cup is usually wide, but sometimes quite small. The basal cup has sometimes a very definite lining of cuticle, like thin, soft brown paper—but in other cases there is no trace of lining. The outer sides of these cups—that is to say, the lowest parts of the column—are always smooth or practically so. The column is always higher than wide, typically pillar-like, with broad base, cylindrical middle part, and either slightly or considerably wider upper end (Pl. XV, fig. 3), even though all the specimens are contracted. It has a very hard, firm, cartilaginous consistency, and the wall is very thick as a rule, though it varies a good deal in different cases. In one specimen (S.R. 171), which is aberrant, and has practically no tubercles (and which I refer to this species with a query), it is fairly thin. The body is almost pure white in some cases, but flesh-coloured in most. I can see no trace of cuticle at all, though there are remnants of dirt and mucus in cracks, &c., sometimes. Above the level of the smooth outer surface of the basal cup, the scapus is for the most part covered with tubercles; below, these are rather nodules caused by transverse and longitudinal furrows than tubercles, and tend to be large and indefinite, often somewhat rectangular; above, they are more distinct and rounded. They sometimes have a slight “head,” and vary in size and prominence to a large extent in different cases, being sometimes very large, occasionally almost obsolete: they have as a rule not much tendency to regular arrangement. The narrow submarginal zone of the body is very

slightly marked off from the lower part, as a "capitulum," by the cessation of the scapal tubercles: the line of demarcation is more or less distinct in different specimens. This zone is provided with longitudinal ridges, which may be distinct and crest-like, and may be continuous or broken up by transverse interruptions into tubercles, or may be nearly obsolete; some are large, some divided, some almost invisible, even in different parts of one animal. Although their number is to some extent related to that of the tentacles, there is as a rule no regularity or plan of development at all. All the tentacles possess thickened white aboral swellings of mesogloea, and those of the outer tentacles are continuous with the margin. The oral disc is peculiar: in all cases it is bi-lobed (Pl. XIV, fig. 6, shows one half or lobe of a specimen), rather wavy in outline, and the two lobes, which have their edges more or less inrolled, fold up against each other, to some extent like a pair of fists placed face to face. Often one lobe is larger than, and exceeds the other. This form of the disc is unusual, and since it prevails in all the specimens (of which there are twenty-three certain and one doubtful case), one may fairly assume it to be a constant specific character. So the disc has a much greater diameter in one direction than in the other. In the cases which I examined the axis of folding did not, as a rule, bear any definite relation to the line of the two actinopharyngeal grooves. The disc has extremely—unusually—prominent radii, corresponding in number to the tentacles. The tentacles and disc are usually salmon-colored, the latter with brown flecks and striae across the radii. The tentacles are slender and of medium length, and are situated at the extreme margin of the disc in two cycles only; they are of somewhat uneven size; when most clearly seen, the bases of those of the inner cycle seem to lie approximately on a dead level. Sometimes it seems that some tentacles grow at the expense of others, so that in places tiny ones are found squeezed into a crack between larger ones.—they conform to the two-cycle arrangement, however. Sometimes the tentacles at the angles between the two lobes of the disc are smaller than those between the angles. One specimen had the total number of tentacles about 160. The body-wall, in this species, presents a curious feature: here and there not frequently one sees on the outside a perforation, as if it were the irregular mouth of a large animal; sometimes mesenterial filament protrudes, as through a wound. In order to clear this up, I made a very careful examination of the wall of the greater part of one specimen, removing all the mesenteries and the ectoderm. One could then show that the inner surface of the wall revealed a number of "soft spots"; two or three of these communicated by passages with the exterior, reaching a pulpy tubercle on which they opened. But others were merely soft spots or shallow pits, and did not

reach the exterior. I sectionized two examples of body-wall from another specimen which had not been tampered with, one containing a pit, and the other a channel going right through. Sections show that they are merely rough irregular cavities in the mesogloea, with strands of mesogloea about in them; they have no epithelial lining, only traces and remnants of cells, which *may* have once formed a lining. The question is, are they cinclides? In the first place, it would be very unusual to find cinclides in an animal with such a ponderous body-wall—they are essentially structures typical of a delicate creature. In addition, they seem to me to be too large and too irregular to be considered cinclides, apart from the fact that at best they have only the remains of a lining of epithelium. It is just possible that they might be artificially produced by rough surroundings and food—there were remains of sea-urchin spines in some of the specimens, here and there, for instance. It is also a possibility that they are *vestigial* cinclides. I have already recorded a case of absolutely rudimentary and possibly vestigial acontia in *Leptoteichus insignis*, so that it is not altogether out of the question to suppose that in the case of *C. duplicata* we have remains of what may have been cinclides when the animal was quite young, and have degenerated. At any rate I do not think they are genuine cinclides.

Structure.—(i) *Mesenteries.* A typical specimen showed six pairs of perfect mesenteries, and two extra unpaired perfect mesenteries, disposed as in *C. coccinea*. The plan of arrangement is 6p. + 6p. + 12p. + 24p. + 48p. = 96p.; it is not carried out with exact regularity, but nearly so. The primary mesenteries only are sterile. Acontia are borne on some, at any rate, of the mesenteries of all cycles. I cannot find any mesenterial stomata for certain. I dissected altogether eight specimens, in order to find out, if possible, whether the arrangement of perfect mesenteries and disposition of gonads was constant. In all of these, every mesentery of the six primary pairs was sterile; and in every case there was at least one perfect mesentery over and above the six primary pairs. In four cases there were two unpaired mesenteries of the second cycle perfect, and these were in all four examples disposed one on each side of a pair of directives, and with their retractor-face turned towards the directives. In another case, the arrangement was the same, but in addition the partner of one of these unpaired mesenteries was also perfect. In another, there was only *one* extra unpaired perfect mesentery instead of two. In still another, there were the usual two unpaired perfect ones, and also one unpaired mesentery of the second cycle in one lateral exocoel was perfect. The last case had simply one odd pair perfect in addition to the six primary pairs, so that the arrangement may or may not be bi-laterally symmetrical, and the additional perfect mesenteries may or may not be paired.

Sections of a division of the body above the enterostome-level show the character of the musculature. The fifth-cycle mesenteries hardly project beyond the endoderm, and bear parietal muscles (Pl. XIX, fig. 6), with fairly slender, blunt, well-defined, simple, and branched processes, not more developed on one side than on the other. All the other mesenteries have similar parietal muscles, varying a little in size according to cycle, in the larger mesenteries rather better developed on the endocoelic than on the exocoelic face. At the level of my sections there is no special development of the transverse musculature—simply a straight line on the exocoelic sides of the mesenteries. The fourth-cycle mesenteries are reproductive septa, and their longitudinal muscle amounts to a fringe only, not a pennon: their gonads are immense. The third-cycle mesenteries have diffuse pennons, which die off gradually, in the direction of the body-wall, into a mere fringe of fibres: distally, the pennon dies off more or less abruptly in different cases, but always more rapidly than it does proximally. The processes forming it are stout and very well branched, but not stout enough to give the "reversed" appearance (Pl. XIX, fig. 9).

The perfect mesenteries, as exemplified by the pair sectionized, have fair pennons of peculiar form, whose highest point lies about the middle of the mesentery (Pl. XVIII, figs. 5 and 7). The pennon forms a bulge, as it is supported on a large branching lobe or hill of mesogloea: it is not exactly "diffuse," but not far from it, essentially. Its processes vary in different sections—sometimes they seem to be stout enough to give the "reversed" aspect, sometimes they are hardly so. But they are not of the slender, feathery, or twig-like type.

(ii) *Stomodaeum*.—Strong and well developed. Not specially long, but broad above (Pl. XIX, fig. 3). Below it tapers off regularly and fairly rapidly to a point. It is separated from the endoderm throughout by a wide band of clear mesogloea, and has a fairly clearly defined inner edge. Throughout its upper part it fills most of the thick mesogloea, and at its outer edge it thins away, and comes rather close to the ectoderm. The structure is very characteristic—alveolar, the alveoli frequently lying together closely in groups, as it were very large ones subdivided (Pl. XVIII, fig. 21). These groups and the single alveoli are well separated from one another by mesogloea; they are most densely packed in the upper part and least so in the middle. There is a tendency towards vertical layering, chiefly above, and also to arrangement in horizontal lines, especially in the middle part. In some sections the alveoli at the very top lie so close together that they form a reticular patch.

(iii) *Dorsal tentacles*.—The structure of the oral disc is more interesting than any I have seen (Pl. XIX, fig. 4). It has very high ridges of two sorts, regularly alternating; the smaller and simpler ones bridge the exocoels, the

higher and more complex ones the endocoels. The height and narrowness of the ridges and the depth of the furrows between them make the course of the muscle-layer very sinuous. This layer varies greatly in thickness in different parts, following out very regularly and markedly the rule which prevails in the other two species of *Chondrodactis*, already described, and which will be apparent on reference to the figure. The mesenterial insertions lie just opposite the bottoms of the furrows, and the layer generally shows a slight narrowing opposite these, as well as its other narrowings over the endocoels. In the places where the layer is well developed (on the exocoelic ridges, it is very broad and constitutes a large proportion of the thickness of the disc. Its structure is unusual; it lies altogether outside the mesogloea, between that and the ectoderm. In its thinnest parts, over the middles of the endocoels, it forms a single row of ectodermal processes as usual; but in its better developed parts it is a beautiful, fine network, which appears to be formed by a good deal of anastomosis between very long, branched, ectodermal processes (Pl. XVIII, figs. 19, 20).

In the tentacles (Pl. XIX, figs. 2 and 8), the musculature is ectodermal and well developed. There is a distinct nerve-layer, and spirocysts as usual are present. The tentacles are often longitudinally fluted, and then of course they show, in section, ridges and furrows: the musculature is typically best developed on the former. The ectoderm and musculature are, as usual, reduced on the basal swellings, the mesogloea being enormously developed. Where well developed, the processes are fairly high, but not specially so, and may be simple or branched; they are rather stout, and have a characteristic somewhat tufted and fuzzy appearance.

(iv) The form of the oral disc, and the type of its musculature, as well as most of the other details of its structure, should easily distinguish this species from the rest of the genus.

Actinauge¹ Verrill.

Chondractiniinae with the body always more or less distinctly divided into *scapus* and *capitulum*; wall generally tough and cartilaginous, very thick or very thin according to state of distension, &c.; the scapus is tuberculate, and the tubercles are not usually regularly arranged; they may or may not be tipped with cuticle; at least twelve "coronal" tubercles are recognizable where the capitulum and scapus join, though they may be poorly or irregularly developed, and not different from the other tubercles. The capitulum is nearly always free from cuticle, and is provided as a rule with twelve (or a multiple of twelve) ridges, distinct or feebly developed, and very variable

¹ See foot-note on p. 118.

in form. Tentacles in more than two cycles, the inner ones at least provided with basal swellings of mesogloea on the aboral side, but these swellings are very variable, and may be almost suppressed. Longitudinal muscles of tentacles ectodermal. Retractors diffuse.

19. *A. richardi* Marion.

Chitonactis richardi Marion.

(Pl. XIV, figs. 3 & 9; Pl. XV, figs. 5, 6, 8, 10, 11; Pl. XVI, figs. 29, 31-40.)

1. Helga, R.T. ii, 1. D. June 18, 1901. LXXIII a. 40 miles N.W. by N. of Cleggan Head. 105 fathoms. 11 specimens. Dredge.
2. Helga, R.T. ii, 1. D. (See 1.) 19 specimens.
3. Helga, R.T. iii, 1. D. July 8, 1901. LXXXVIII a. 40 miles W.N.W. of Cleggan Head. Dredge. 78 fathoms. 3 specimens.
4. Helga, R.T. v, 1. D. Aug. 2, 1901. CXIV a. 40 miles S.W. of Cleggan Head. 62½ fathoms. Dredge. 1 specimen.
5. Helga, R.T. iii, 0. D. Sept. 12, 1901. CXXXI a. 50 miles W.N.W. of Cleggan Head. 110 fathoms. 73 specimens.
6. Helga, R.T. ii, 1. D. Sept. 13, 1901. CXXXIII a. 40 miles N.W. by N. of Cleggan Head. 100 fathoms. Dredge. 5 specimens.
7. R.T. iii, 0. July 13, 1903. 50 miles W.N.W. of Cleggan Head. 120 fathoms. Mosquito-net on trawl. 2 specimens.
8. S.R. 44. Aug. 17, 1903. 50 miles W.N.W. of Cleggan Head. 116½ fathoms. Trawl. 1 specimen.
9. S.R. 44. (See 8.) 7 specimens.
10. S.R. 68. Nov. 11, 1903. 50 miles W.N.W. of Cleggan Head. Lat. N. 53° 36'; Long. W. 11° 30'. 126 fathoms. Dredge. 13 specimens.
11. W. 5. March 23, 1904. 3-5 miles S.W. by S. of Great Skellig. 60-65 fathoms. Trawl. 1 specimen.
12. S.R. 107. May 9, 1904. 50 miles W.N.W. of Cleggan Head. Lat. N. 53° 37'; Long. W. 11° 33'. 121 fathoms. 48 crushed and battered specimens.
13. S.R. 145. Aug. 24, 1904. 30 miles W.N.W. of Slyn Head. Lat. N. 53° 24'; Long. W. 12° 29'. 181 fathoms. Dredge. 7 specimens.
14. S.R. 153. Nov. 1, 1904. 70 miles S.W. ½ W. of Fastnet. Lat. N. 50° 24'; Long. W. 10° 31'. 91½ fathoms. Dredge. 1 specimen.
15. S.R. 165 b. Nov. 3, 1904. 39 miles W.N.W. Nly. of Tearaght Light. Lat. N. 52° 6'; Long. W. 11° 44'. 244½ fathoms. Dredge. 2 specimens.
16. S.R. 178. Nov. 16, 1904. 40 miles N.W. by W. ¾ W. of Cleggan

Head. Lat. N. $53^{\circ} 36' 30''$; Long. W. $11^{\circ} 15' 30''$. $74\frac{1}{2}$ fathoms. Dredge. 1 specimen, with 3 *Adamsia palliata*.

17. S.R. 188. Feb. 3, 1905. 50 miles W. $\frac{3}{4}$ N. of Tearaght Light. Lat. N. $51^{\circ} 53'$; Long. W. $11^{\circ} 59'$. 320-372 fathoms. Trawl. 5 specimens, with 2 *Bolocera*.

18. Unlabelled bottle. 2 specimens, on Gastropod shells.

19. Unlabelled bottle. 5 specimens.

The above list includes 205 specimens, taken in seventeen different hauls. Unfortunately I have been unable, up to the time of writing, to investigate the anatomy of this large group of specimens as fully as I hope to do in the end, and consequently the following account will deal with external characters only, for the most part; but when I can, I shall make an account of the anatomy separately.

The anatomy, so far as I have carried it, is somewhat puzzling, but it does not preclude the possibility of all the forms in question belonging to one species, allowing for variation. At all events, all of them belong without doubt to the genus *Actinauge*, and many of them certainly to the species *richardi*; if any cases are doubtful, they are not referable to either of the other known species, but are new forms closely allied to *richardi*. The constancy with which a certain combination of characters, to which I shall refer below, runs through the whole series, is remarkable. I may state, as regards anatomy, that, for instance, there is no essential or first-rate difference as far as structural features are concerned, between the two types illustrated in Pl. XIV, figs. 3 and 9.

Measurements of a typical specimen.—Diameter of mouth of basal cup, 3 cm.; of middle of column, 2.3 cm.; of oral disc and tentacles, 3.5 cm.; total height of animal, 3.7 cm.; depth of basal cup, ca. 1.5 cm.; thickness of wall in middle of a tubercle, .5 cm.; length of a large tentacle, ca. .7 cm.

I. It may be as well, first of all, to give a general description of what may be considered as the typical form; such a form, that is to say, as is figured in Pl. XIV, fig. 3. A specimen identically like the one figured agrees well as far as anatomy (as well as external characters) is concerned, with the figures and description of *A. richardi* given by Haddon. None of my specimens shows quite such markedly prominent capitular ridges as his figure does, but otherwise they agree with the essentials in his description. In this typical form, the base is developed as a sand-enclosing cup or bulb. The column is divided clearly into two parts—the lower and more extensive scapus, which is provided with tubercles, many of which possess cuticle—and the upper and smaller capitulum. The capitulum is free from cuticle, and is smooth in texture.

Where the scapus ends and the capitulum begins there is an uppermost ring of twelve tubercles to be recognized: these, for convenience, may be termed "normal" tubercles, but that does not imply that they are different from the others—simply that they mark the upper limit of the scapus. The tentacles are arranged entirely in five cycles, as a rule regularly developed— $6 + 6 + 12 + 24 + 48 = 96$. The largest are of course the innermost, succeeding cycles becoming smaller, the outermost very small. The tentacles of the three inner cycles are provided with large and definite swellings of mesogloea on the dorsal side at the base. Those of the fourth cycle have rather smaller swellings, and these run outwards like bridges to the extreme margin of the oral disc, and run over the edge of it and down the outside of the capitulum, as ridges of mesogloea; then, since there are twenty-four tentacles in the fourth cycle, and consequently twenty-four ridges at the margin of the capitulum, as the ridges run inwards they converge in pairs, the two indentations or clefts just meeting one another just as they reach one of the normal tubercles, into which the fused ridge merges. This may be differently expressed, as Haldan put it, by saying that there are twelve capitular ridges with a cleft, and run to the bases of the tentacles of the fourth cycle: but, for reasons which will appear, I prefer the former way of stating the case. The tentacles of the fifth cycle are very small and have no basal swellings, though, rarely, their bases are slightly thickened. Reference to Pl. XVI, figs. 29, 38, will help to make this clear.

II. Many of the specimens may be described in the general terms above employed, but I will now endeavour to show how they vary among themselves in lesser ways, and how many of them, although of quite typical appearance, diverge from the above account in minor ways.

The basal cup varies a great deal in its development. Sometimes its cavity is not very large, but all shades of size are to be found, and in some cases it is so large that the coelenteron is much reduced and is small in proportion. The diagrams in Pl. XVI, figs. 39 and 40, show longitudinal sections of two different specimens, in both of which the size of the basal cavity is large in proportion to that of the coelenteron. Other cases are found in which the coelenteron is large, the basal cavity small. The mouth of the pedal cavity also varies greatly, and in many degrees. It may be very wide—almost as wide as the cup itself—or, at the other extreme, it may be small and circular, so that the basal cup is almost closed. When the cup is best developed, it has a thin, tough, membranous wall, smooth outside and in, and with a thin and very sharply defined margin. Often it is full of mud, and when a more or less fully developed surface lining of it; the latter was present in some degree at all times in all the cases which I especially examined with regard to it. It is thin and soft.

The tubercles of the scapus vary both in extent and development. Sometimes they die out before the base is reached, leaving the lower part of the column smooth. In other cases small, low tubercles almost reach the base; every stage and gradation may be found. The tubercles themselves vary greatly in size and form in different specimens: they may be large, prominent, and spiky, or prominent and rounded, or indefinite, or almost obsolete. They often have cuticle developed on them or between them, and there is usually dirt in the cracks between them. The cuticle varies considerably—there may be much or little of it, or practically none. Sometimes the tubercles are densely crowded, sometimes scattered, sometimes intermediate; they may be very low and inconspicuous. It is always possible, however, to distinguish more or less clearly, either exactly or approximately, twelve tubercles which mark the uppermost limit of the scapus—sometimes twelve short rows of them even. These tubercles are not distinctly marked off from the rest, but the others show, as a rule, no definite arrangement; at best they tend to be arranged in vertical and horizontal rows. Even these “coronal” tubercles, although sometimes quite clear, may be very irregularly and indefinitely developed, often merging into the ridges of the capitulum, so that when the latter also are indistinct, the difference between scapus and capitulum is barely recognizable. Sometimes the body is distended, and then it has an extremely thin and flabby (but tough) wall, with the mesenterial insertions showing through it, and the tubercles separated by smooth interspaces. But various grades of thickness are found, and sometimes it is very thick. Many of the specimens are more or less contracted (the capitulum being quite introverted when contraction is complete), but a few are well expanded, with disc displayed, actinopharynx puffed out, and capitulum turned back. (Pl. XV, fig. 5.) Acontia are well developed, and frequently a tuft of them protrudes from the mouth. The general plan of tentacle-arrangement above described is universal—that is to say, the inner tentacles have basal swellings; the fourth-cycle tentacles have swellings which run out over the edge of the capitulum; and the small outermost tentacles have none. But the actual details of the capitulum are peculiarly variable, even on opposite sides of the same specimen, sometimes. On the whole, one can trace a more or less definite connexion between the basal swellings of the fourth-cycle tentacles and the “coronal” tubercles—this varying in distinctness in different cases. (Pl. XVI, figs. 29, 32, 33; Pl. XIV, fig. 3.) Sometimes, however, the ridges are very irregular or indefinite; and the continuity between the tubercles and the fourth-cycle swellings may be nearly absent; the ridges, also, may be irregularly broken up by transverse interruptions into tubercles. In some cases, even, the capitulum may be termed

"smooth," as the swellings of the fourth-cycle tentacles do not join the tubercles of the scapus (they only run a little way down the capitulum)—this being clear in parts of expanded specimens. (Pl. XVI, fig. 30.) Reference to the numerous small areas of capitulum represented in Pl. XVI (figs. 30, 32, 33, 34-37) will perhaps show more clearly how this is. How far any ridges would be present in a living and expanded animal it is difficult to say. Fig. 31 shows how the "coronal" tubercles may or may not be continuous with the next one below them, in the same specimen. The basal swellings of the tentacles vary in development—they may be larger than the tentacle itself, or quite insignificant.

III. We now come to a set of specimens of which Pl. XIV, fig. 9, may be taken as the type. The majority of these (seventy-three specimens) were taken at one haul. Many of them were very young and small. They present a contrast to the kind typified by Pl. XIV, fig. 3, because the base is not a mud-encasing cup, but an adhesive pedal disc, and the capitulum in fig. 9 is hidden. In fact, these specimens have the *facies* of *Hormathia Chamaerentaria digitata*, Muller. It is curious that, as far as I have gone with the collection, not a single specimen of *H. digitata* has turned up. Dr. E. J. Allen, however, has kindly lent me specimens of it from the North Sea for comparison, and also of *H. coronata*, Gosse. One specimen of *dentata* showed very distinct capitular ridges, but absolutely no trace of basal swellings to the tentacles. In the Irish specimens under consideration, however, which must be rather young in all cases which I examined I could clearly trace basal swellings on the inner tentacles, though they were very small and flattened. Sections, also, demonstrate them quite clearly. Moreover, the typical *—*of arrangement—continuity between swellings of fourth-cycle tentacles and "coronal" tubercles—can be traced, though only inauspiciously owing to small size and strong contraction of the specimens. Many of these animals seem to have been attached to shells, and the flat or slightly concave adhesive base may or may not exceed the column. I take it that this difference in the form of the base within the limits of one species is of no importance, and varies simply according to habitat: if the animals live on a muddy bottom, it is natural that they should form mud anchors. If, on the other hand, they live on a stony bottom, or on shells, they develop an adhesive disc; they do not seem to be the kind of anemone that could move far or change its habitat after early youth. Verrill (51) has recorded similar cases, in which anemones of one and the same species develop mud-enclosing bases or adhesive discs, according to habitat. Similarly if some specimens should attach themselves to a cylindrical object, the base would become long and narrow in consequence. One of my specimens seems to have enclosed

almost a whole gastropod shell in its base, including the point. So that although these specimens superficially resemble *H. digitata*, the presence of basal swellings to the tentacles, and the arrangement of the ridges, show them to be really *A. richardi*. In anatomy a typical case shows nothing essentially different from the previously described form of *richardi*. The muscle-pennon of the mesentery is certainly rather like that of *digitata*, but the sphincter is not; and there is no *essential* difference even in the former.

IV. There are other specimens in the collection which form links between the two extremes above described. All sorts of curious bases are represented, which are neither cups nor discs, but intermediate—cups with thick or irregular walls; discs with the edges rolled in; bases in which half is adhesive, half more or less incurled, &c. Some are very battered and irregular. The ridges of the capitulum may be very marked or very faint; the basal swellings of the tentacles are *present* in every case examined, but may be so much reduced that they may be described as “almost absent,” and great care is needed to detect them. On the other hand, they may be larger than the tentacles themselves, and all grades are found. The base, when adhesive, often does not expand much, but in a few cases it is very broad indeed. (For figures showing external appearance of five specimens, see Pl. XIV, figs. 3 and 9; and Pl. XV, figs. 5, 6, 11.)

V. The specimen which I have most hesitation in referring to the species *richardi* (though it is undoubtedly an Actinauge) is the one illustrated in Pl. XV, figs. 6 and 10. There is no other specimen among the 205 with quite such a distinct development of tubercles and accuracy of arrangement of ridges. Here the ridges are formed not only by fusion of basal swellings of fourth-cycle tentacles—the third-cycle tentacles join in, and the ridge is consequently triple. But this is present in some typical specimens, too. This isolated example has all the typical *richardi* features and arrangement of swellings, and it is only the fact that the details of its sphincter and mesenterial musculature do not agree with the others that makes me hesitate. I am inclined to think that further investigation may show that here, too, other specimens will be intermediate, but we shall see.

VI. Specific characters of *Actinauge richardi* as a whole:—

Base a mud-clasping cup or an adhesive disc, or intermediate; scapus more or less tuberculate; cuticle well or poorly developed; coronal tubercles twelve (or approximately); capitular ridges twelve, very variable, and formed by the continuation down the capitulum of the basal swellings of the tentacles of the fourth cycle, sometimes joined by those of the third; they may be practically obsolete; tentacles in five cycles, the outermost cycle without

basal swellings; the four inner cycles have basal swellings, but these may be much reduced; tentacles often streaked longitudinally with brown.

VII. None of my sections shows any trace of cinclides. In order to discover whether there were any, I opened out the greater part of the wall of a specimen which was so distended that it was transparent, removed the mesenteries, and examined it with lens and microscope, by reflected and transmitted light; but no trace of a cinclis could be found. A dozen dissected specimens showed that here six, and only six, regularly developed pairs of mesenteries are perfect; there were no additional ones, as in *Chondrobitis duplicata*. Eight of these specimens, in which the gonads were well developed, showed that all the primary mesenteries were sterile in each case.

VIII. The other species belonging to the genus Actinauge, and which are most related to *A. richardi*, are *A. fastuosa* McM. (= *A. velosa*, var. *coronata*, Verrill), and *A. Verrilli* McM. (= *A. velosa* Verrill). Both of these show quite clear external differences from *richardi*—they have forty-eight capitular ridges (instead of twelve only) and all the tentacles have basal swellings, whereas in *A. richardi* only the four inner cycles have them. To support these differences, there are other anatomical ones.

IX. In conclusion, there is one possibility connected with these 205 specimens which should not be overlooked. It is not impossible that we have here representatives of half a dozen similar species which cannot be distinguished from one another when dead (and perhaps not anatomically), but which would be clearly distinct when alive. The group containing *Sagartia uccinata*, *minute* and so on is one in which the species are distinct enough when alive, but I should not like the task of separating them when dead. Similarly, *Idobucca taylori* and *B. longicauda* (I have Mr. Walton's assurance cannot be confused when alive, but when dead it is a different matter and as I have shown above, their anatomy is very similar. But if this is the case with Actinauge, then there is no means of deciding it except by observation of freshly collected living specimens, so far as I am concerned at present it must be left out of account.

GENERAL NOTE ON CELLS OF THE MESOGLOEA.

It has not seemed worth while to add a special note about the structure of the mesogloea in each species dealt with in the collection of Actinaria above described, because almost the same words would have to be used in each case. In all cases there are amoeboid cells in the matrix of the mesogloea. Whether their form is at all constant in one species or not,

we hardly know at present. When one has sketched a dozen or so of them from one species and a dozen from another, a general difference in aspect is sometimes noticeable between the two selections. But it is too indefinite to state very clearly, and probably their appearance would vary according to the condition of the specimen (whether it had recently had a meal or not, &c.), and the action of the reagents used. I have selected a number of typical examples, and included them in Pl. XVI, to show the extent of their variation. They are probably nutritive amoeboid cells with a secondary nervous function (as I have suggested before—48, p. 3.) The granular ones typical, for instance, of *Chondrodictis pulchra*, strongly suggest granular food-contents (figs. 13-15); those such as are illustrated in figs. 6, 8, 9, possibly contain liquid food in vacuoles. The fact that these cells are often formed into strings or networks (figs. 19, 21, 14) suggests that they communicate with each other and may have a secondarily nervous function. They vary in number in different species to some extent, and are more numerous in some parts of the body than in others, in the same animal. Their forms are almost infinitely variable—unipolar, bipolar, stellate, amoeboid, &c.; they may be granular, mealy, clear, dim, distinct, or indistinct in appearance. Sometimes they lie in clear spaces in the mesogloea. Sometimes they seem to consist of practically nothing but a nucleus. In some cases one may catch them in the act, apparently, of migrating into or out of the ectoderm or endoderm into the mesogloea—which one would expect them to do if they are carrying nourishment. (Pl. XVI, figs. 24, 25, 26.) The matrix of the mesogloea is variable, from being fibrous in appearance to being practically homogeneous, but I am doubtful whether that is of much importance; it must be a good deal affected by reagents sometimes.

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EXPLANATION OF PLATES.

EXPLANATION OF LETTERING AND ABBREVIATIONS.

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|--|---|
| <i>a.</i> actinopharynx. | fourth-cycle tentacle in <i>Actinauge richardi</i> . |
| <i>b.</i> cavity of basal cup. | |
| <i>b. en.</i> body-wall endoderm. | <i>r. m.</i> radial musculature. |
| <i>b. w.</i> body-wall. | <i>s.</i> actinopharyngeal groove (<i>siphonoglyphe</i>). |
| <i>c.</i> "coronal" tubercle. | <i>si.</i> actinopharyngeal groove (<i>siphonoglyphe</i>). |
| <i>c'</i> . coelenteron. | <i>sph.</i> sphincter. |
| <i>c. l.</i> ciliated lobe of mesenterial filament. | <i>t.</i> tentacle. |
| <i>d. d.</i> dorsal directive. | <i>t''.</i> tentacle. |
| <i>ec.</i> ectoderm. | <i>t. b.</i> tentacle base. |
| <i>e. c. m.</i> endodermal circular muscle. | <i>t. m.</i> transverse musculature. |
| <i>f.</i> mesenterial filament. | <i>T.S.</i> transverse section. |
| <i>g. l.</i> glandular lobe of mesenterial filament. | <i>t. sph.</i> tentacular sphincter. |
| <i>l. m.</i> longitudinal musculature. | <i>u.</i> is placed in the mesogloea in Pl. XVIII, fig. 5, to indicate which is the upper extremity of the sphincter. |
| <i>m.</i> mesogloea. | <i>v. d.</i> ventral directive. |
| <i>mes.</i> mesentery. | <i>x-x.</i> indicates two mesenteries belonging to the same pair. |
| <i>m. f.</i> mesenterial filament. | × marks the upper extremity of the sphincter in the single figure of <i>Bolocera longicornis</i> (Pl. XX, fig. 7). |
| <i>n.</i> mesogloea. | <i>y.</i> indicates a single mesentery belonging to a different pair from those marked <i>x-x</i> in Pl. XVIII fig. 17. |
| <i>n. l.</i> nerve layer. | |
| <i>o.</i> oral disc. | |
| <i>obj.</i> objective. | |
| <i>oc.</i> eyepiece. | |
| <i>o. d.</i> oral disc. | |
| <i>p.</i> pennon. | |
| <i>p. bm.</i> parieto-basilar muscle. | |
| <i>p. d.</i> pedal disc. | |
| <i>p. m.</i> parietal muscle. | |
| <i>r.</i> "ridge," or basal swelling of a | |

PLATE XIV

Fig.

1. *Carlyraia desiderata*, n. gen., n. sp. Nat. size. (A medium-sized specimen.)
2. *Bolocera tuediae*, Johnst. Nat. size.
3. *Actinauge richardi*, Marion. Nat. size.
4. *Chondrodactis pulchra*, n. sp. Nat. size.
5. *Actinostola atrostoma*, n. sp. (Medium-sized specimen.) Nat. size.
6. One half of the upper portion of a specimen of *Chondrodactis duplicata*, n. sp., divided vertically so as to show oral disc, position of sphincter, mouth, &c. Nat. size.
- 7, 8. Two single tentacles of *Actinostola atrostoma*, n. sp. Nat. size.
9. *Actinauge richardi*, Marion. Nat. size.
10. *Cyadactis gosseii*, n. sp. One half of a vertically divided specimen, to show general relationship of parts. Nat. size.
11. *Cymbactis gosseii*, n. sp. A single tentacle. Nat. size.

PLATE XV.

1. *Actinostola atrostoma*, n. sp. One half of a medium-sized specimen, vertically divided, to show positions and relationship of parts. Nat. size.
2. View of fig. 1, much reduced, from the side.
3. *Chondrodactis duplicata*, n. sp. Small specimen. Nat. size.
4. *Actinernus saginatus*, Verrill. Nat. size.
- 5, 6. Two contrasted specimens of *Actinauge richardi*, Marion. Nat. size.
7. Single tentacle of *Actinostola atrostoma*, n. sp. Nat. size.
8. Single tentacle of *Actinauge richardi*, Marion. Very slightly enlarged.
9. Single tentacle of *Actinernus saginatus*, Verrill. Nat. size.
10. Half the crown of a contracted specimen of *Actinauge richardi*, Marion. A little enlarged. (The whole of this specimen is shown nat. size in fig. 6.)
11. *Actinauge richardi*, Marion. Nat. size.

PLATE XVI.

Figs. 1-26 inclusive are drawn with oc. 3. Obj. $\frac{1}{7}$. (Oil Imm.)

- 1-4. Cells from mesogloea of tentacle. (*Actinernus saginatus*.)
5. Gland-cell from tentacle ectoderm. (*Actinernus saginatus*.)
- 6-10. Cells from mesogloea of body-wall (at different levels). (*Actinernus saginatus*.)
11. Sting-cells thick-walled from body-wall ectoderm. (*Actinostola atrostoma*.)
12. Sensory (?) cell from body-wall ectoderm. (*Actinostola atrostoma*.)

- 13-15. Cells from mesogloea of body-wall (at different levels). (*Chondrodactis pulchra*.)
- 16-20. Cells from tentacle mesogloea. (*Actinostola atrostoma*.)
21. Cell-chain from tentacle mesogloea. (*Actinernus aurelia*.)
22. Cell from mesogloea of mesentery. (*Chondrodactis coccinea*.)
23. Cell from mesogloea of tentacle. (*Chondrodactis coccinea*.)
- 24-26. Three small areas from the body-wall, at different levels, of *Chondrodactis coccinea*, showing a little ectoderm and mesogloea (24, 25) or endoderm and mesogloea (26), and the included cells.
27. *Carlgenia desiderata*. A small portion of ectoderm and mesogloea from the upper part of the body-wall, showing a battery of thick-walled nematocysts (in black). Oc. 3. Obj. $\frac{2}{3}$.
28. *Actinernus aurelia*. Small portion of the ciliated lobe of a large mesenterial filament. Oc. 3. Obj. $\frac{1}{8}$.
30. Gland-cell from tentacle-ectoderm of *Actinernus saginatus*. Oc. 3. Obj. $\frac{1}{12}$.
- 29, 30a, 31-33. Diagrammatic representations of small portions of the capitulum of different specimens of *Actinauge richardi*. Slightly enlarged.
- 34-37. Exact representations of small portions of the capitulum of several specimens of *Actinauge richardi*. Slightly enlarged.
38. Diagram of relation of tentacles, ridges, &c., in *Actinauge richardi*. (See description of that species.)
- 39, 40. Diagrammatic longitudinal sections of two specimens of *A. richardi*, to show relative proportions of cavity of basal cup and coelenteron-cavity, in two different cases. Slightly reduced.
41. *Chondrodactis coccinea*, n. sp., seen from above. Nat. size.

PLATE XVII.

1. *Actinostola atrostoma*. Transverse section of a tentacle near its base. Very low magnification.
2. " " Exact detail of a small portion of the band of longitudinal musculature shown in the T. S. of a tentacle in fig. 1. The whole width of the band is represented, and the letter *n* is placed in the mesogloea on the endodermal side of it. Oc. 3. Obj. $\frac{2}{3}$.
3. " " Detail of part of the outer side of the sphincter, about the middle of its length. Oc. 3. Obj. $\frac{2}{3}$.
4. " " Diagram showing shape and position of whole sphincter. \times ca. $3\frac{1}{2}$ diams.
6. " " Part of a 3rd cycle mesentery. Obj. $1\frac{1}{2}$.

Fig.

7. *Actinostola atrostoma*. Detail of a small portion of the radial-muscle band of the oral disc. Obj. $1\frac{1}{2}$.
8. " " Part of a T. S. of the oral disc. Obj. $1\frac{1}{2}$. (Note that this is on same scale, approximately, as fig. 7, but represents a different part of the disc.)
17. " " Exact detail of a portion of the whole width of the lower end of the sphincter. Oc. 3. Obj. $\frac{2}{3}$.
5. *Cymbactis gossei*. Transverse section of a tentacle. Low magnification.
9. " " Detail of a small piece of the lower part of the sphincter. Oc. 3. Obj. $\frac{2}{3}$.
14. " " Part of a fairly large mesentery. Obj. $1\frac{1}{2}$.
10. *Actinernus aurelia*. Detail of part of the whole width of the sphincter at its best-developed (but not quite its widest) point. Oc. 3. Obj. $\frac{2}{3}$. (The *dots* here are simply shading, and do not represent muscle fibres in section; some of the larger ones are pigment granules.)
11. " " Part of fig. 10, more enlarged. Oc. 3. Obj. $\frac{1}{3}$. (Smaller dots merely shading, as before.)
12. " " A whole imperfect mesentery of moderate size, to show general proportions. Obj. $1\frac{1}{2}$.
13. " " Parietal muscle of a small imperfect mesentery. Oc. 3. Obj. $\frac{1}{12}$.
15. " " A few processes of the mesogloea of a mesentery. (Not from the pennon itself.) Oc. 3. Obj. $\frac{2}{3}$.
16. " " Part of the whole thickness of a mesentery in the middle of the pennon. Oc. 3. Obj. $\frac{2}{3}$.
18. " " Part of T. S. of a tentacle, to show longitudinal musculature. Oc. 3. Obj. $\frac{2}{3}$.

PLATE XVIII.

1. *Actinernus aurelia*. A few processes from a mesenterial pennon. Oc. 3. Obj. $\frac{1}{6}$.
2. *Actinernus aurelia*. Detail of portion of lower part of sphincter. Oc. 3. Obj. $\frac{2}{3}$.
3. " " Part of pennon of a medium-sized mesentery. Oc. 3. Obj. $\frac{2}{3}$.

Fig.

4. *Actinernus saginatus*. Diagram of part of a T. S. of a tentacle, to show general relations of parts, and, as nearly as I can get it, the general appearance of the muscle-layer under a low power. Oc. 3. Obj. $\frac{2}{3}$.
5. „ „ Detail of the whole width of the upper tail-end of the sphincter. Obj. $1\frac{1}{3}$.
6. „ „ Diagram to show form and position of whole sphincter. Enlarged only a few diameters.
7. „ „ Detail of a small portion of the longitudinal muscle-layer of the tentacle-ectoderm, with its surrounding nerve-layer. Oc. 3. Obj. $\frac{1}{6}$.
10. „ „ Parietal muscle of a fair-sized mesentery. Oc. 3. Obj. $1\frac{1}{3}$.
8. *Chondrodactis coccinea*. Parietal muscle of a directive mesentery. Oc. 3. Obj. $\frac{2}{3}$.
9. „ „ Most of the pennon of a primary mesentery. Obj. $1\frac{1}{2}$.
11. „ „ Part of T. S. of a tentacle. Oc. 3. Obj. $\frac{2}{3}$.
12. „ „ Whole directive mesentery, low magnification.
17. „ „ T. S. of part of oral disc. Obj. $1\frac{1}{2}$.
($x - x$ are a pair of large mesenteries; y is one of a smaller pair.)
18. „ „ Detail of small portion of radial musculature of oral disc. Oc. 3. Obj. $\frac{2}{3}$.
13. *Chondrodactis pulchra*. Parietal muscle (of a smaller mesentery than that figured for *C. coccinea*). Oc. 3. Obj. $\frac{2}{3}$.
14. „ „ Muscular part of a third cycle (?) mesentery. Obj. $1\frac{1}{2}$.
15. „ „ T. S. of acontium. Obj. $1\frac{1}{2}$.
16. „ „ Part of transverse section of a tentacle. Oc. 3. Obj. $\frac{2}{3}$.
- 19, 20. *Chondrodactis duplicata*. Three small portions of detail of radial musculature of oral disc. Oc. 3. Obj. $\frac{2}{3}$.
21. „ „ Detail of a portion of the sphincter, just below its upper end. Obj. $1\frac{1}{2}$.

PLATE XIX.

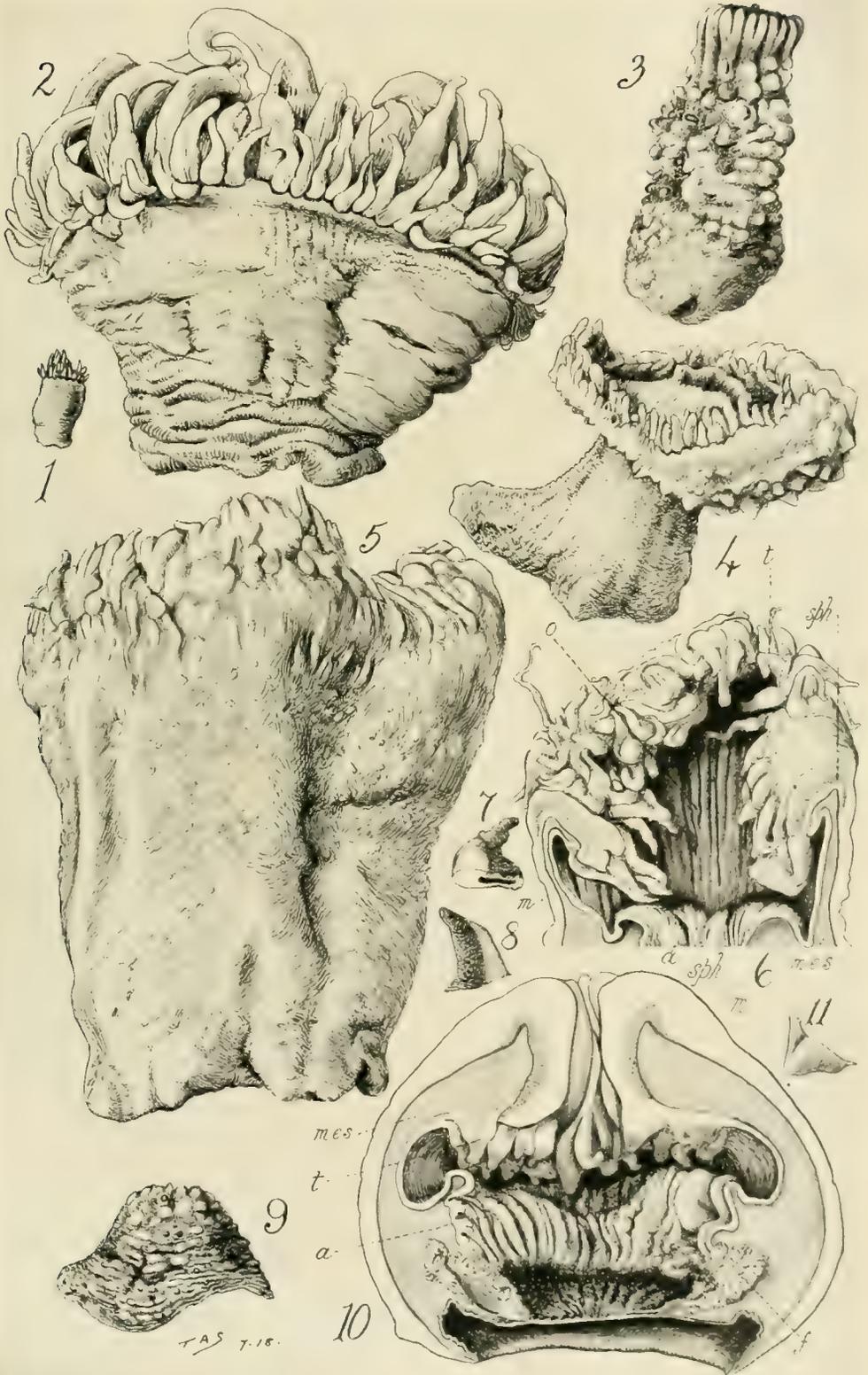
1. *Carlygrenia desiderata*. Muscular part of a macromesentery, and the whole of the adjacent micromesentery. Obj. $1\frac{1}{2}$.

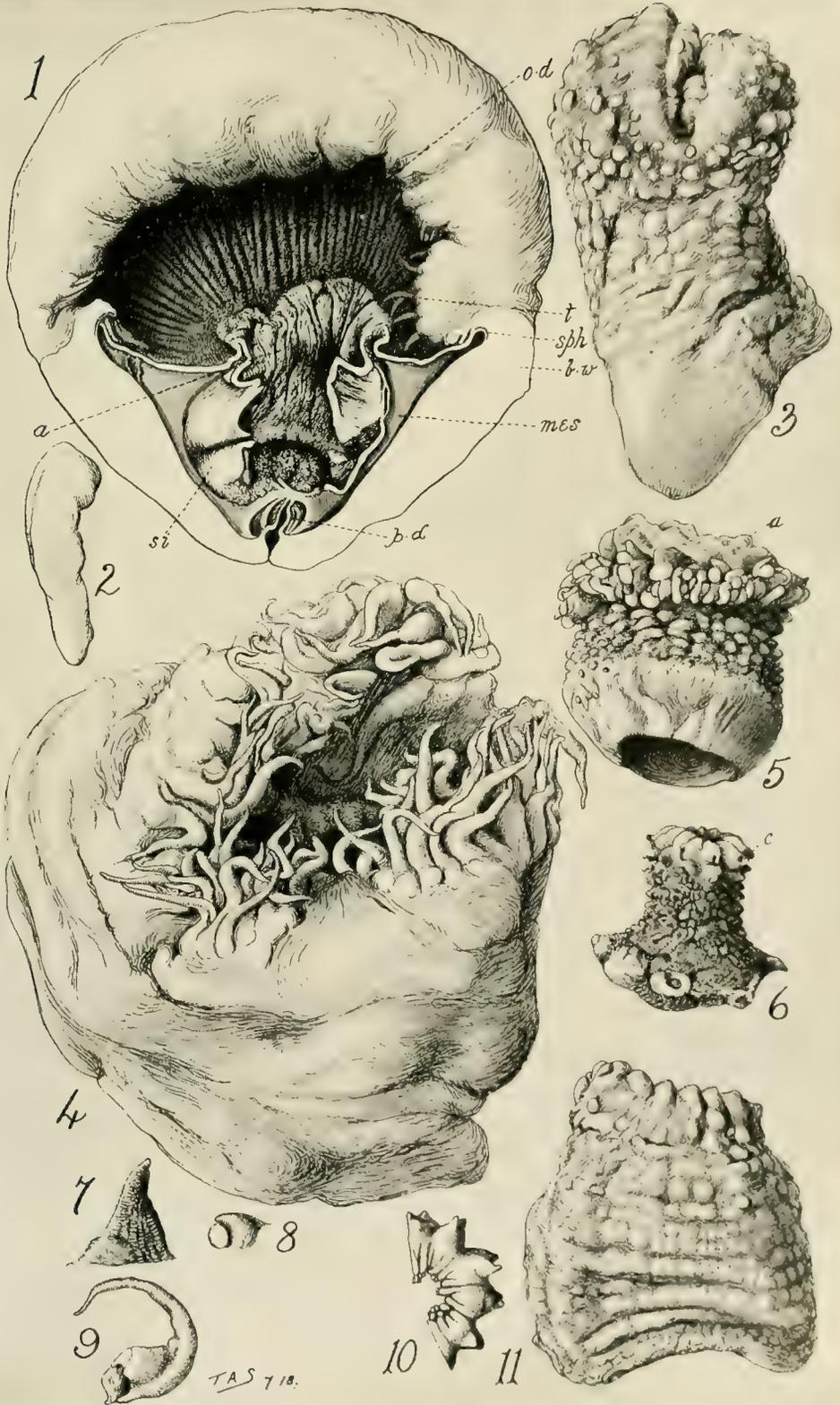
Fig.

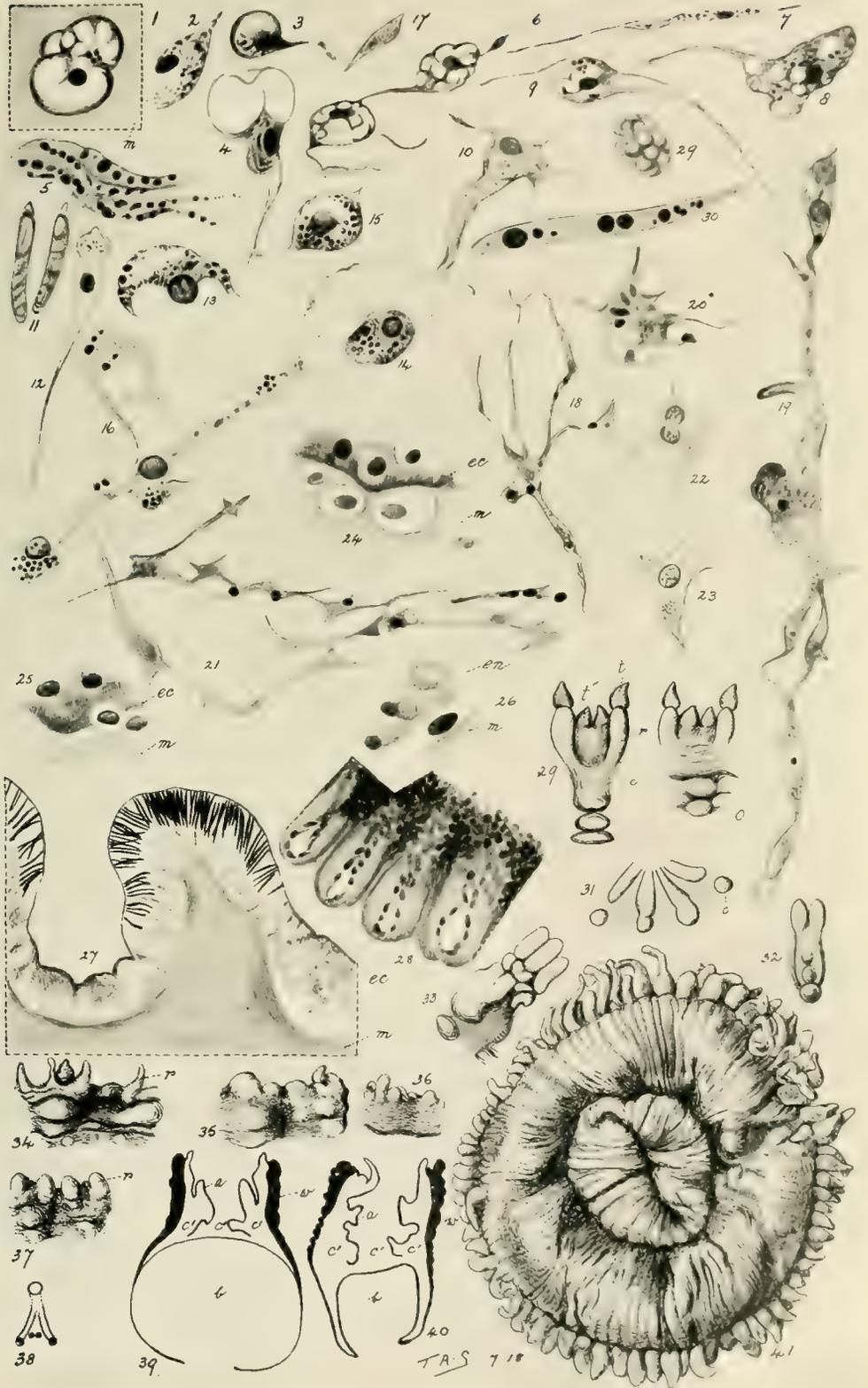
2. *Chondrodactis duplicata*. T. S. of a tentacle. Obj. $1\frac{1}{2}$.
3. " " Sketch of sphincter, as seen with a lens.
4. " " Part of T. S. of Oral disc. Obj. $1\frac{1}{2}$.
5. " " Part of a primary mesentery, showing the pennon. Obj. $1\frac{1}{2}$.
6. " " Parietal muscle of a fourth-cycle mesentery. Oc. 3. obj. $\frac{2}{3}$.
7. " " Whole primary mesentery, as seen with lens.
8. " " A finger of mesogloea from a T. S. of a tentacle, showing longitudinal muscle-fringe and nerve-layer, &c. Oc. 3. Obj. $\frac{2}{3}$.
9. " " Process from pennon of third-cycle mesentery. Oc. 3. Obj. $\frac{1}{2}$.

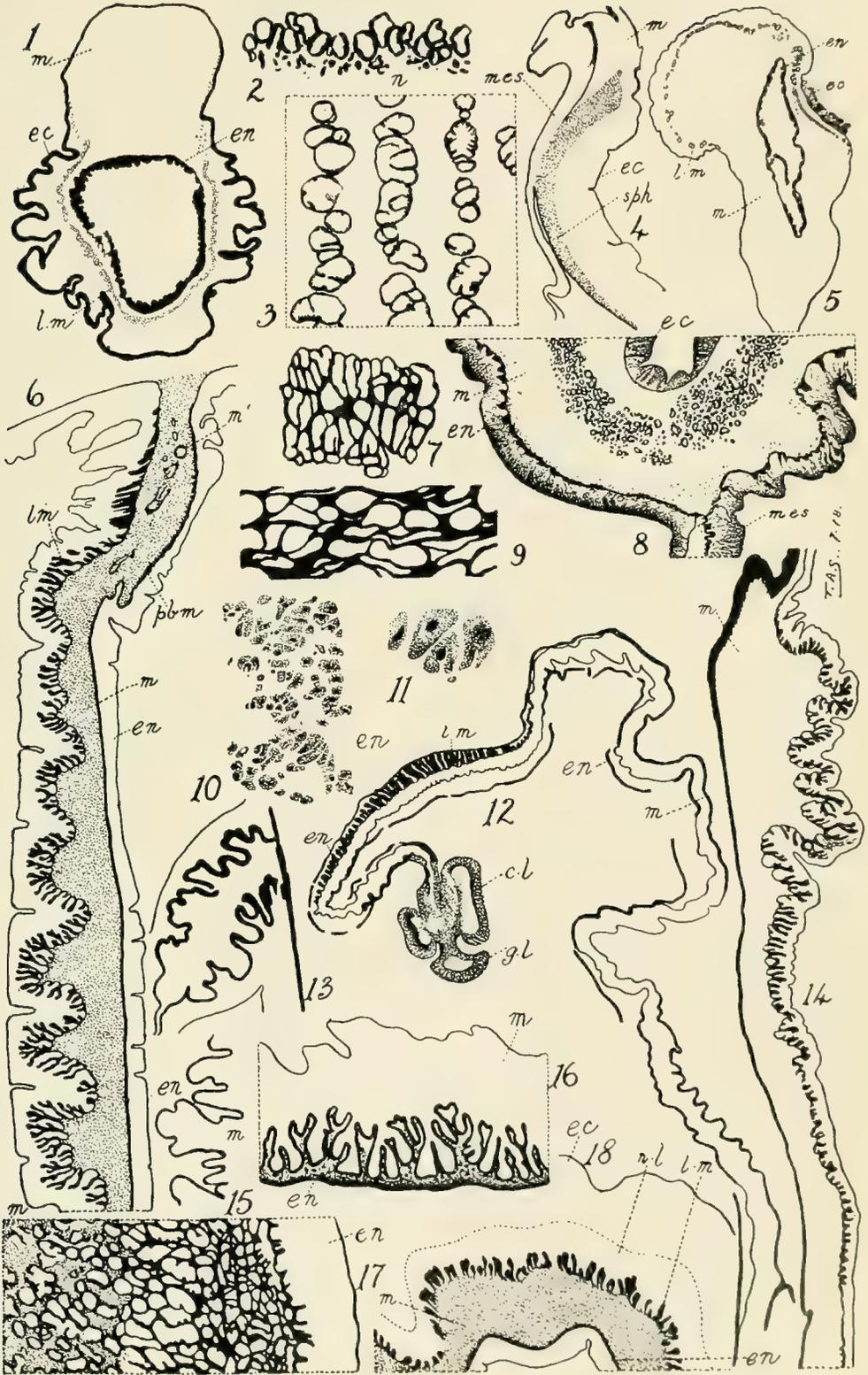
PLATE XX.

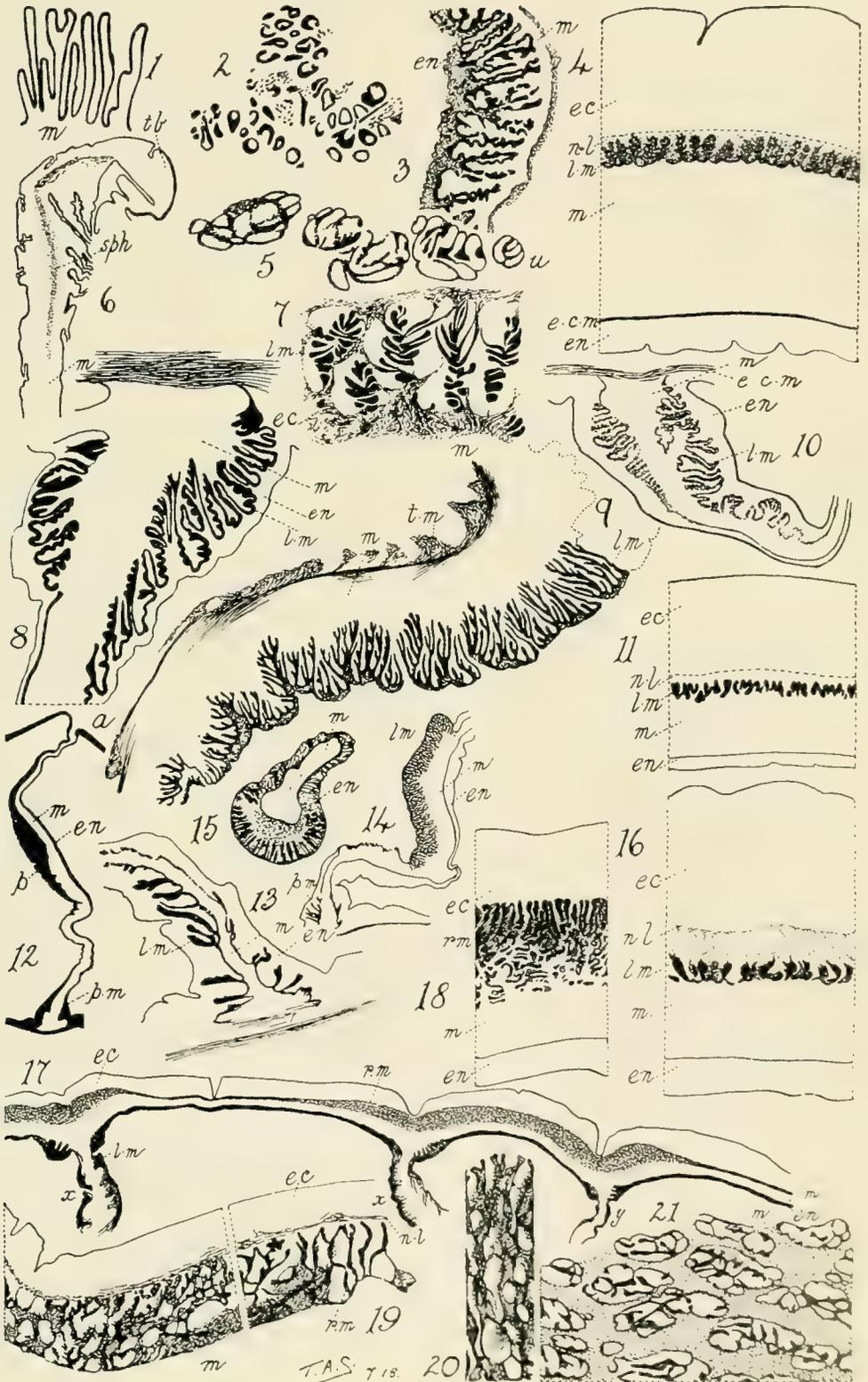
1. Section (longitudinal) passing through the margin of the body and the base of a tentacle of the specimen of *Bolocera tuediae* figured in Pl. XIV, fig. 2. It shows the body sphincter, and both sides of the tentacle sphincter. Obj. $1\frac{1}{2}$.
2. *Carligenia desiderata*. Part of T. S. of tentacle. Oc. 3. Obj. $\frac{2}{3}$.
8. " " Part of T. S. of oral disc. Oc. 3. Obj. $\frac{2}{3}$.
9. " " Diagram showing the arrangement of the macro-mesenteries and the primary micromesenteries in one-half of the animal.
3. *Bolocera tuediae*. Part of a T. S. of a tentacle of the specimen figured in Pl. XIV, fig. 2. Obj. $1\frac{1}{2}$.
4. " " Muscular portion of a mesentery of the last cycle but one, of the specimen figured in Pl. XIV, fig. 2. Obj. $1\frac{1}{2}$.
5. " " Sphincter of a different specimen from that figured in Pl. XIV, fig. 2. Obj. $1\frac{1}{2}$.
6. " " Sphincter of a specimen from the North Sea (not in the present collection). Obj. $1\frac{1}{2}$.
7. *Bolocera longicornis*, Carlgen. Sphincter. Obj. $1\frac{1}{2}$.

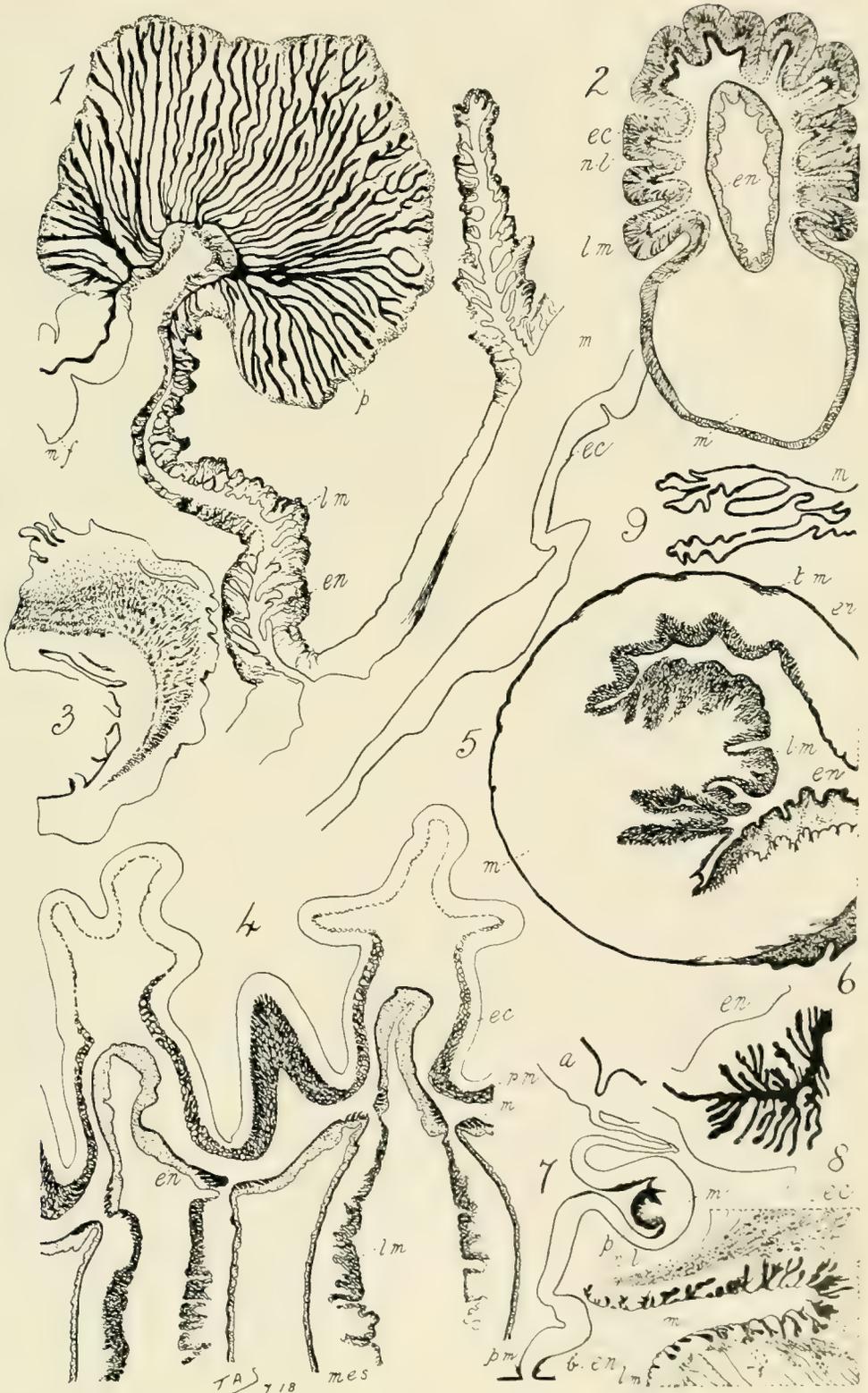












STEPHENSON—IRISH ACTINIARIA.



VIII.

THE NITRO DERIVATIVES OF PHENYL-2-NAPHTHYLAMINE.

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AMONGST the substances proposed for use as stabilisers for nitrocellulose powders is phenyl-aceto-2-naphthalide. The nature, however, of its beneficial action in such powders has not hitherto been investigated.

As far as is known at present, stabilisers may act in various ways. The substance may discharge its "rôle" as stabiliser by combining with the acidic decomposition products of the explosive; it may act catalytically as a negative accelerative agent for the reactions involved in the disintegration of the powder, or its stabilising action may simply be due to any gelatinising effect it may produce when incorporated in the powder—the result of gelatinisation being to render the powder less porous and, therefore, to some extent protecting it from the injurious effects of atmospheric agents. The nitrous and nitric acids formed during the decomposition of nitrocellulose, owing to their oxidising and hydrolysing powers, exert a deteriorating effect on the latter. Since it seemed likely that the stabilising action of phenyl-aceto-2-naphthalide is due to its power of combining with nitrous and nitric acids, the action on it of these substances was examined.

Nitrogen peroxide, the nitrating constituent of dry nitrous fumes, has apparently no action on phenyl-aceto-2-naphthalide, when the latter is free from traces of moisture. In the presence of moisture a mononitro derivative of phenyl-2-naphthylamine is produced; but, as well as nitration, hydrolysis of the naphthalide also occurs. This mononitro compound, which melts at 119° C., was also got by dissolving phenyl-aceto-2-naphthalide in cold concentrated nitric acid. The orientation of the nitro group in the compound was not determined, but the following facts and considerations afford indications as to the position of the nitro-group:—

The mononitro compound melting at 119° C. cannot be 4'- or 1-nitro-phenyl-2-naphthylamine, since these compounds, which were prepared synthetically, melt at 283° C. and 105° C. respectively. It is unlikely that the

nitro radical is in the position 2' - since, if this were so, it is probable that the 4' - nitro compound melting at 283° C. would be formed at the same time. It is probable therefore that the compound is 3-nitro-phenyl-2-naphthylamine, unless the nitro group is contained in the second ring of the naphthalene nucleus, which has not been considered here.

The behaviour of nitrogen peroxide towards an alcoholic solution of the stabiliser was next studied. From the facts mentioned below, it will be seen that hydrolysis or alcoholysis of the aceto-naphthalide first takes place; the nitration then proceeds in two different ways. Before attempting to trace the dual course of the nitration, it may be well to give the facts on which the conclusions are based:—

1. In alcoholic solution, the stabiliser, when treated with nitrogen peroxide, slowly forms two trinitro compounds, one melting at 242° C., and the other at 179° C.

2. When an alcoholic solution of the stabiliser is treated with colourless, concentrated nitric acid (1-10 mols) and allowed to remain at the room temperature for ten days, neither of the above compounds is formed.

3. In acetic acid solution, nitric acid (1-6 mols) has no action on the naphthalide even after standing for some months, but when amyl nitrite is also added, the yellow trinitro compound melting at 242° C. and the orange one melting at 179° C. are slowly formed.

4. At the ordinary temperature, in acetic acid solution, phenyl-2-naphthyl-nitrosamine is completely transformed by nitric acid (1-6 mols), into the yellow trinitro compound melting at 242° C., mentioned above.

5. In acetic acid solution in the presence of nitric acid (3-10 mols), phenyl-2-naphthylamine gives the orange trinitro compound melting at 179° C.

From a study of these results we can trace the sequence of the changes which the stabiliser undergoes in alcoholic solution, when the solution has been previously treated with nitrogen peroxide. The phenyl-aceto-naphthalide is first decomposed into the corresponding amine, which is partly nitrated directly to the orange, trinitro-derivative melting at 179° C.; another part, about three-fourths, of the amine is converted into phenyl-2-naphthyl-nitrosamine, which in turn is transformed by the nitric acid into the yellow, trinitro compound melting at 242° C. For the formation of the latter compound the presence of nitrous acid at some stage of the reaction seems to be essential.

The yellow trinitro compound melting at 242° C. was found to be 2'-4'-trinitro-phenyl-2-naphthylamine, having been prepared synthetically by the combination of 1-chloro-2,4-dinitro-benzene with 1-nitro-2-naphthylamine.

By the action of nitric acid on a solution of phenyl-2-naphthylamine Streiff (Liebig's *Annalen der Chemie*, CCIX, 1881, p. 157) obtained a mononitro-phenyl-2-naphthylamine melting at 85° C. and a dinitro-phenyl-2-naphthyl-amine melting at 192-195° C. In the course of the present work the action of nitric acid on phenyl-2-naphthylamine in acetic acid solution was examined; a red compound, probably the dinitro compound of Streiff, was isolated, but the yellow mononitro body of Streiff was apparently not formed under the conditions obtaining in our experiment, but instead of it an orange trinitro derivative melting at 179° C. was found in relatively large amount. As already stated, this trinitro compound was of special interest, since it was one of the two substances formed by the action of nitrogen peroxide on an alcoholic solution of the stabiliser.

Heim (Ber. d. Dtsch. Chem. Ges., XXI, 1888, p. 589), from 1-bromo-2,4-dinitro-benzene and 2-naphthylamine, and Ernst (Ber. d. Dtsch. Chem. Ges. XXIII, 1890, p. 3429) (from 2,4-dinitro-1-chloro-benzene), obtained 2',4'-dinitrophenyl-2-naphthylamine, melting at 169.5° C. (Heim), 179° C. (Ernst). We obtained it incidentally by the latter method; it consisted of orange-red prisms melting at 171° C.

By heating β -naphthylamine with picryl chloride or with methypicrylnitrosamine, E. Bamberger and J. Mueller (Ber. d. Dtsch. Chem. Ges. XXXIII, 1900, p. 107) obtained 2',4',6'-trinitrophenyl-2-naphthylamine in the form of brick-red diamonds, or as orange-yellow prisms, melting at 233° C. This picryl compound was prepared during the course of the present work. It crystallised as brick-red prisms from glacial acetic acid, and in the form of the yellow variety from aqueous acetic acid. The melting-point of either variety was 230° C. (uncorr.).

Although picryl chloride reacted readily with 2-naphthylamine, we did not succeed in getting it to combine with 1-mononitro-2-naphthylamine, even when the substances were heated together in boiling nitrobenzene.

In many cases organic halogen compounds, such as bromobenzene, do not react easily with primary amines, such as naphthylamine. In such cases, however, the desired reaction between the amine and the halogen compound can often be effected by a method due to I. Goldberg (Ber. d. Dtsch. Chem. Ges., XL, 1907, p. 4541), in which the reaction between the amine and the halogen compound proceeds in nitrobenzene solution in the presence of copper dust, potassium iodide, and potassium carbonate. The following compounds, which could not be got by direct heating of a mixture of their components, were prepared successfully by this method:—

1-nitro-2-naphthylaniline, 4'-nitro-2-naphthylaniline, and 2',4',1-trinitro-2-naphthylaniline.

Ortho-nitro-bromo-benzene, however, could not be made to interact with 2-naphthylamine, nor ortho-nitraniline with 2-chloro-naphthalene, even under the conditions of the Goldberg reaction.

EXPERIMENTAL.

A. Action of Nitrogen Peroxide on Phenyl-Aceto-2-Naphthalide.

1. In Anhydrous Ether Solution.

Nitrogen peroxide, prepared by heating dry lead nitrate, was passed for about an hour through a solution of dry, recrystallised phenyl-aceto-2-naphthalide in anhydrous ether. The mixture was kept in a stoppered flask for a few days, and the ether was then evaporated at a low temperature. The phenyl-aceto-2-naphthalide was recovered unchanged.

2. In Moist Ether Solution.

A current of nitrogen peroxide was passed through a solution of phenyl-aceto-2-naphthalide in moist ether for half an hour. On evaporation of a portion of the ethereal solution and on recrystallisation of the residue from benzene, phenyl-2-naphthylamine was obtained in the form of white prisms melting at 107° C. One action, therefore, of the mixed oxyacids of nitrogen, formed from the nitrogen peroxide and the water present in the moist ether, consisted of the conversion of part at least of the aceto-naphthalide into the free amine.

The main portion of the ethereal solution was allowed to remain overnight, and was then allowed to evaporate at the room temperature. The deep yellow, oily mass which remained, after several recrystallisations from boiling xylene afforded colourless, octahedral crystals, melting at 119-120° C., which gave on analysis the following results:—

0.1940 grams of the substance gave 17.6 cc. of moist nitrogen at 16° C.
and 771 m.m.p.
corresponding to N 10.7
$C_{16}H_{11}N_2O_2$ requires N 10.6
$C_{15}H_{11}N_2O$ requires N 9.15

The compound analysed was therefore a mononitro derivative of phenyl-2-naphthylamine.

3. In Alcoholic Solution.

About six grams of phenyl-aceto-2-naphthalide were dissolved in 200 c.c. of absolute alcohol and a current of nitrogen peroxide was led through the

solution for two hours. The mixture was allowed to remain in a stoppered flask for eight to ten days. At the end of this time, about three grams of a white, crusty solid had separated from the alcoholic solution, the latter having in the interval acquired a red tint. The solid was filtered and recrystallised from glacial acetic acid. It consisted of yellow prisms, which melted at 242–243° C., and gave on analysis the following results:—

0.1470 grams of the substance gave 20.2 c.c. of moist nitrogen at
15.5° C. and 757 m.m.p.

corresponding to N 16.0

$C_{16}H_{10}N_4O_6$ requires N 15.8

The compound was therefore a trinitro derivative of phenyl-2-naphthylamine, and was subsequently found to be identical with 2',4',1-trinitrophenyl-2-naphthylamine.

The parent liquid from which the latter substance had crystallised was found to contain another trinitro derivative of phenyl-2-naphthylamine. It was precipitated from the solution by addition of water, and recrystallised from a little acetic acid. It consisted of orange prisms, which melted at 179–180° C., and gave on analysis the following results:—

0.1428 grams of the substance gave 19.8 c.c. of moist nitrogen at
18° C. and 748 m.m.p.

corresponding to N 15.76

$C_{16}H_{10}N_4O_6$ requires N 15.8

B. *Action of Nitric Acid on Phenyl-Aceto-2-Naphthalide.*

1. *Cold Concentrated Nitric Acid.*

When pure crystallised phenyl-aceto-2-naphthalide was triturated with about three parts of nitric acid (sp. gr. 1.43), it gradually dissolved in the acid, forming a red syrup. On pouring the syrup into ten volumes of water a yellow mass was precipitated. The semi-solid substance was filtered, washed well with water, dried, and recrystallised from xylene, from which it separated in the form of slightly yellow cubical crystals melting at 119–120° C. The yield of the compound was almost quantitative. The substance proved to be identical with the compound of the same melting-point formed by the action of nitrogen peroxide on the stabiliser in moist ether solution.

2. *In Acetic Acid Solution.*

Quantities of nitric acid corresponding to 1.6 molecular amounts of the acid to one molecular amount of the stabiliser were added to a five per cent. solution of the latter in glacial acetic acid. The solutions were allowed to

remain in stoppered flasks at the room temperature for several weeks. In each case the contents of the flask were poured into water, and the solid which separated was filtered, washed, and dried. It proved in each instance to be unchanged phenyl-aceto-2-naphthalide.

C. Action of Nitric Acid on Phenyl-2-Naphthylamine.

1. Concentrated Nitric Acid.

On addition of colourless, concentrated nitric acid (sp. gr. 1.43) to phenyl-2-naphthylamine, a violent reaction set in with separation of a dark-coloured resinous mass. The mixture was poured into water, filtered, and the separated solid was washed well with water. When dried, it was extracted with benzene in a Soxhlet apparatus. The benzene was distilled, and the solid residue was recrystallised from glacial acetic acid. After a number of crystallisations from acetic acid, red prisms were obtained which softened at 178° C. and decomposed at about 210° C. In this method, even when the nitration was conducted in an ice bath, much resin was found. When the nitration was conducted in ethereal solution, a much better yield of the compound was obtained.

Nitric acid (4 mols) was added to an ethereal solution of phenyl-2-naphthylamine so slowly that the temperature did not rise appreciably. The ether was allowed to evaporate at a low temperature, and the residue was crystallised from glacial acetic acid. The substance, which separated almost quantitatively, consisted of red prismatic crystals, melting about 210° C. with decomposition, and gave on analysis the following results:—

0.1522 grams of the substance gave 20 c.c. of moist nitrogen
at 16° C. and 756 m.m.p.
corresponding to N 15.3.
 $C_{16}H_{10}N_4O_6$ requires N 15.8.

The substance was therefore a trinitro-phenyl-2-naphthylamine.

2. In Acetic Acid Solution.

About 5 grams of phenyl-2-naphthylamine were dissolved in 40-50 grams of glacial acetic acid and 15 grams of nitric acid (sp. gr. 1.43) were added. On standing overnight brown crystals separated. The crystals were filtered, and washed with cold water. The solid was next boiled with 10 c.c. of glacial acetic acid for ten minutes, and the acetic acid solution was separated from the yellow undissolved solid by filtration. The red substance which separated from the acetic acid on cooling was probably identical with the dinitro compound obtained by Streiff (*loc. cit.*).

The more sparingly soluble solid crystallized from glacial acetic acid in orange prisms melting at 179–180° C., and proved to be identical with the trinitro compound of the same melting-point formed by the action of nitrogen peroxide on an alcoholic solution of the stabiliser.

D. *Action of Nitric Acid on Phenyl-2-Naphthylnitrosamine.*

1. *In Alcoholic Solution.*

To a solution of 4 grams of the nitrosamine in 100 c.c. of absolute alcohol 10–12 grams of nitric acid (sp. gr. 1.43) were added. In the course of a few hours a reddish, amorphous solid separated. The parent liquid was filtered, and the solid was purified by crystallisation from glacial acetic acid. It was finally obtained in the form of brownish prisms, melting about 170–180° C., with much decomposition, and it gave on analysis the following results:—

0.1679 grams of the substance gave 19.3 c.c. of moist nitrogen
 at 17° C. and 750 m.m.p.
 corresponding to N 13.16.
 $C_{16}H_{11}N_3O_4$ requires N 13.59.

The compound analysed was therefore a dinitro derivative of phenyl-2-naphthylamine.

2. *In Acetic Acid Solution.*

Three solutions, each containing 2 grams of phenyl-2-naphthylnitrosamine in 20 c.c. of glacial acetic acid, were prepared.

One molecular quantity of nitric acid was added to the first solution, two to the second, and six to the third. The solutions, contained in stoppered flasks, were allowed to remain at the room temperature for two days, by the end of which time a yellow powder had separated in each case. The parent liquids were filtered, and the solids were purified by recrystallisation from glacial acetic acid. In each case yellow prisms, melting at 242–243° C., were obtained. This compound was identical with the yellow trinitro compound of the same melting-point got by the action of nitrogen peroxide on an alcoholic solution of the stabiliser.

When 4–6 molecular quantities of nitric acid were employed in the nitration the yield of the trinitro compound was almost quantitative.

E. *Orientation.*

1. *Phenyl-2-naphthylnitrosamine.*

Twelve grams of pure phenyl-2-naphthylamine were heated with a mixture of 50 c.c. of absolute alcohol and 20 c.c. of iso-amyl nitrite, under a reflux

condenser, for two hours. The solution was poured into an evaporating dish. On standing, pale grey prisms separated. An alcoholic solution of the crude product was boiled for half an hour with animal charcoal and filtered. As the melting-point, 98°C ., of the colourless prismatic solid, which separated from the liquid on standing, was somewhat higher than that, 93°C ., given by Streiff (*loc. cit.*) for the same substance, an analysis of it was thought advisable:—

0.1736 grams of the substance gave 16.8 c.c. of moist nitrogen
at 15°C . and 763 m.m.p.
corresponding to N 11.38.
 $\text{C}_{16}\text{H}_{12}\text{N}_2\text{O}$ requires N 11.3.

When boiled with glacial acetic acid the nitroso compound was slowly decomposed. Dilute acids also decomposed it slowly in solution, whilst concentrated sulphuric acid decomposed it in the cold with effervescence.

2. *4'-Nitro-Phenyl-2-Naphthylamine.*

This compound, which had not been previously obtained, was prepared by the interaction of 4-nitro-1-bromo-benzene with 2-naphthylamine.

Two grams of dry potassium carbonate, 0.5 grams of a mixture of copper dust and potassium iodide, 5 grams of dry 4-nitro-1-bromo-benzene, and 3.5 grams of 2-naphthylamine were heated with 10–15 c.c. of nitrobenzene in an oil-bath at a temperature of $180\text{--}190^{\circ}\text{C}$. for 10–12 hours. The nitrobenzene was removed by distillation in a current of steam. It was found important in this, and similar experiments, to neutralize any alkaline carbonate present which in the presence of steam readily attacks many of the nitro compounds dealt with here.

After removal of the nitrobenzene the residue was cooled, filtered, dried, and extracted with 30 c.c. of boiling benzene. When the benzene solution was allowed to stand, yellow, matted, acicular crystals, melting at $283\text{--}284^{\circ}\text{C}$., were obtained. These gave on analysis the following results:—

0.1278 grams of the substance gave 11.9 c.c. of moist nitrogen
at 19°C . and 761 m.m.p.
corresponding to N 10.7
 $\text{C}_{16}\text{H}_{12}\text{N}_2\text{O}_2$ requires N 10.6.

4-Nitro-phenyl-2-naphthylamine is readily soluble in benzene, sparingly soluble in cold alcohol or ether, and gives a violet-blue coloration with concentrated sulphuric acid.

3. *Nitro-2-Naphthylamine.*

The aceto-naphthalide corresponding to 1-nitro-2-naphthylamine had been previously obtained by Kleeman (Ber. d. Dtsch. Chem. Ges. XIX, 1886, p. 338), and was obtained by us by nitration of aceto-2-naphthalide (20 grams) by means of concentrated nitric acid (10 grams) in the presence of acetic acid (24 grams). The mixture was allowed to remain at the room temperature for twelve hours. The yellow, prismatic solid, which separated, when recrystallised from absolute alcohol, melted, as Kleeman (*loc. cit.*) stated, at 123–124° C.

The amine was prepared from the naphthalide by hydrolysing the latter with alcoholic hydrochloric acid.

Fifteen grams of the naphthalide were dissolved in 200 c.c. of alcohol, and the solution was heated with 30–40 c.c. of concentrated hydrochloric acid for about three hours under a reflux condenser. On evaporating the mixture, orange-red prisms separated which, after recrystallisation from alcohol, consisted of dark-brown prisms melting at 123–124° C.

4. *2'.4'.1-Trinitro-Phenyl-2-Naphthylamine.*

Unlike naphthylamine itself, 1-nitro-2-naphthylamine did not couple with 2,4-dinitro-1-chloro-benzene when heated in alcoholic solution. Accordingly, the Goldberg method was tried, and with good results.

Four grams of 2,4-dinitro-1-chloro-benzene were heated with 4 grams of 1-nitro-2-naphthylamine in 10 c.c. of nitrobenzene in the presence of 1.5 grams of dry potassium carbonate, and traces of copper-dust and potassium iodide. The mixture was kept at a temperature of 190–200° C. for eight hours. The crude compound, which remained after the distillation of the nitrobenzene in a current of steam, was purified by repeated crystallisation from glacial acetic acid. It consisted of yellow, prismatic, nodular crystals, which melted at 242–243° C. It was identical with the trinitro bodies formed by the action of nitric acid on phenyl-2-naphthylnitrosamine in acetic acid solution, and of nitric and nitrous acids on phenyl-aceto-2-naphthalide.

5. *1-Nitro-Phenyl-2-Naphthylamine.*

1-Nitro-phenyl-2-naphthylamine was prepared by Goldberg's method from a mixture of 10 grams of 1-nitro-2-naphthylamine, 6 c.c. of bromobenzene and 6 c.c. of nitrobenzene with potassium carbonate, copper-dust, and potassium iodide by heating to 150–160° C. for ten hours. After removal of the nitrobenzene by distillation in steam, the residue was crystallised from hot alcohol,

from which it separated in the form of deep red prisms melting at 105–106° C. It gave on analysis the following results:—

0.1219 grams of the substance gave 11.45 c.c. of moist nitrogen
at 18° C. and 767 m.m.p.

corresponding to N 10.95

$C_{16}H_{12}N_2O_2$ requires N 10.6.

1-Nitro-phenyl-2-naphthylamine is insoluble in dilute alcoholic hydrochloric acid, and readily soluble in ether, glacial acetic acid, or benzene. It is sparingly soluble in cold, and easily in hot, alcohol. Its solution in cold, concentrated sulphuric acid had a deep red colour.

6. *2',4'-Dinitro-Phenyl-2-Naphthylamine.*

The dinitro-phenyl-naphthylamine, which was got by heating on the water-bath for three hours an alcoholic solution of 2-naphthylamine and 2,4-dinitro-1-chlorobenzene, crystallised from glacial acetic acid in the form of red prisms melting at 170–171° C.

In conclusion, we wish to express our thanks to Nobel's Explosives Company for a grant in aid of the investigation; and to Mr. Rintoul, the Manager of the Research Section of that Company, at whose suggestion the investigation was undertaken.

IX.

ON α -, β -, AND γ -TRINITROTOLUENES.

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CRUDE α -trinitrotoluene is liable to contain small quantities of its β - and γ -isomers. The three substances are very similar in physical properties and are equally powerful as explosives. They differ in melting-points and in the colour reactions which they give with certain substances such as ammonia. Although α -trinitrotoluene is by no means a sensitive explosive, some accidents have occurred with it which have not been satisfactorily explained, and which indicated that the substance may sometimes contain a much more sensitive body. It has generally been supposed that the sensitive body is derived from α -trinitrotoluene, but it may equally well be assumed that it is derived from the β - or γ -isomer, and this assumption would be all the more likely if the β - or the γ -isomer were chemically more reactive than the α - compound.

With a view to gaining some insight into this rather obscure field, we have examined under conditions as nearly comparable as possible the behaviour of the three isomers towards alkalis, amines, hydrocarbons, and aldehydes, and also for comparative purposes the behaviour of alkalis towards *s*-trinitrobenzene.

A.—HISTORICAL INTRODUCTION.

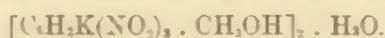
1. *Action of Alkalies.*

J. Wilbrand (Liebig's Annalen d. Chem. cxxviii (1863), pp. 178-9), who was the first to prepare σ -trinitrotoluene, mentions that it is attacked by hot alkali giving a deep red solution from which acids precipitate dark flakes. Tiemann (Ber. d. Dtsch. Chem. Ges. iii (1870), pp. 217-19, 223-25) states that α -trinitrotoluene is coloured red by alcoholic ammonium sulphide, and also that *s*-trinitrobenzoic acid is coloured red by excess of alkali or by

ammonia on heating, and then decomposes: this latter observation was repeated by Victor Meyer (*Ber. d. Dtsch. Chem. Ges.* xxvii (1894), pp. 3153-59). Lohy de Bruyn (*Rec. trav. Chim. Pays-Bas* xiii (1894), pp. 148-54) states that *s*-trinitrobenzene on boiling with caustic soda or sodium carbonate yields tetranitro-oxo-benzene and dinitrophenol; he also (*Rec. trav. Chim. Pays-Bas* xiv (1895), pp. 89-94, 150-155) isolated the red compound formed from potassium methoxide and *s*-trinitrobenzene, and found its composition to correspond with the formula

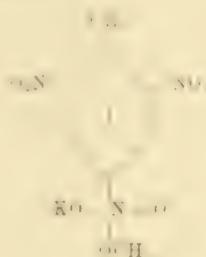


Victor Meyer (*loc. cit.*; *cf.* *Ber. d. Dtsch. Chem. Ges.* xxix (1896), pp. 848-850) regarded this compound as containing one hydrogen atom of the benzene ring replaced by an atom of potassium, and proposed as its formula



Lohy de Bruyn, however, pointed out (*loc. cit.*) that metallic sodium does not react with trinitrobenzene in benzene or toluene solution, even on boiling, so that Victor Meyer's formula was improbable. Jackson and Boes (*Amer. Chem. Journ.* ix (1898), pp. 444-458) give further reasons for believing Victor Meyer's formula to be incorrect.

Hantzsch and Kissel (*Ber. d. Dtsch. Chem. Ges.* xxxii (1899), pp. 3137-48) isolated the compound formed from *a*-trinitrotoluene and potassium methoxide, and to it they gave the formula I.



They state that on treatment with the calculated amount of acid this compound yields the corresponding "nitro-ester acid"

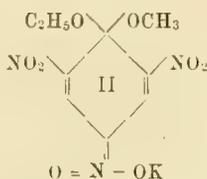


The latter substance they describe as a feeble acid, stable in aqueous solution, but evolving nitrous acid when heated with dilute acids, and forming *a*-trinitrotoluene and methyl alcohol when dissolved in concentrated sulphuric acid.

They also prepared the potassium methoxide derivatives of trinitrobenzene and trinitrophenol, but the corresponding ester acids could not be

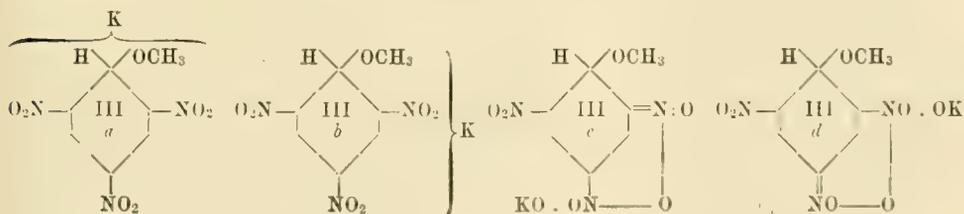
obtained, the compounds yielding trinitrobenzene and trinitroxylene respectively.

According to Meisenheimer (Liebig's Annalen der Chemie cccxxiii (1902), pp. 205-246) the formula of Hantzsch and Kissel is not correct. He found that the compound of potassium methylate with the ethyl ether of picric acid is identical with that formed from potassium ethylate and the methyl ether of picric acid, whereas according to the formula of Hantzsch and Kissel two different substances should be obtained. Meisenheimer proposed the formula II for this compound,



this formula being supported by work on the nitro-derivatives of anthracene, and also by the fact that on decomposition by acids it yields a mixture of the methyl and ethyl ethers of picric acid. The deep colours of this and similar compounds are due, according to Meisenheimer, to their quinonoid structure.

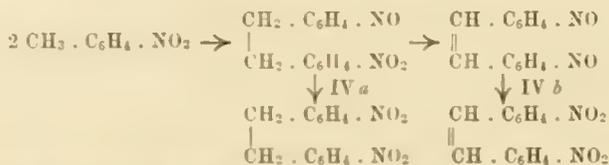
Hantzsch and Picton (Ber. d. Dtsch. Chem. Ges. xlii (1909), pp. 2119-2128) were not in agreement with either the formula of Meisenheimer or that of Hantzsch and Kissel; they argued that the deep colours of these compounds show that more than one nitro group must be affected by the added alcoholates, since the salts of mononitro compounds are colourless. According to Hantzsch and Picton trinitrobenzene-potassium methylate is represented by formula III (*a*, *b*, *c*, or *d*):—



Busch and Koegel (Ber. d. Dtsch. Chem. Ges. xliii (1910), pp. 1549-64) state that picryl aniline unites with one, two, or three molecules of an alcoholate, and that all polynitro-benzene derivatives behave similarly; the higher alcohols, especially, have a marked tendency to form di- and tri-alcoholates.

According to Green and his co-workers (Jour. Chem. Soc., 1904, pp. 1424-31, 1432-38; 1907, pp. 2076-83; 1908, pp. 1721-26), *p*-nitrotoluene

and its derivatives all react with alcoholic potash to give coloured compounds, none of which, however, they succeeded in isolating. By the simultaneous action of oxidizing agents, however, they obtained in all cases derivatives of either dinitro-dibenzyl or dinitro-stilbene, and in many cases obtained derivatives of both of these substances. The reactions were represented as follows:—

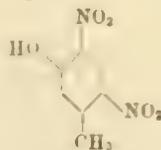


The coloured compounds which, as stated, were not isolated were supposed to be alkaline salts of derivatives of the substances IV *a* or IV *b*, the colour being due to a quinonoid structure.

Will (Ber. d. Dtsch. Chem. Ges. lvii (1914), pp. 704-717) states that *o*-trinitrotoluene reacts with alkali in alcoholic solution to give a deeply coloured solution which on simultaneous oxidation yields hexanitrodibenzyl. The identity of the product was demonstrated by the fact that it was also obtained by nitrating *p,p'*-dinitrodibenzyl, but not by nitrating tetranitrostilbene. Will also states that *β*- and *γ*-trinitrotoluene react with alkalis, forming in each case a dinitro-metacresol, that from the *β*-isomer being



and that from the *γ*-isomer being



II. Action of Aromatic Amines and of Ammonia.

Hepp (Zeits. Chem., cxxv, pp. 344-375) found that *s*-trinitrobenzene and *o*-trinitrotoluene with aromatic amines formed additive compounds possessing deep colours. He stated that *β*- and *γ*-trinitrotoluene did not form additive compounds with amines that aniline reacted with a hot (dilute) solution of *γ*-trinitrotoluene forming a monitrotriphenylamine melting at 142° C., and that *β*-trinitrotoluene yielded an isomeric

compound. He also stated that γ -trinitrotoluene reacted with alcoholic ammonia, on standing, forming a dinitro-metatoluidine melting at 192° C., and that the β -isomer when heated to 100° C. in a sealed tube with alcoholic ammonia yielded an isomeric substance melting at 94° C. The first action of the ammonia with the γ -isomer was to produce a deep blue-green colour, which gradually changed to brown, while with the β -isomer a yellow colour first developed slowly, and this changed finally to brown. Hepp did not publish any analyses of either of the two dinitrotolylphenylamines obtained by him.

The observations of Hepp on the formation of additive compounds of aromatic amines with *s*-trinitrobenzene and α -trinitrotoluene were further extended by van Romburgh (*Rec. trav. chim. des Pays-Bas* xiv (1895), p. 67), Noelting and Sommerhoff (*Ber. d. Dtsch. Chem. Ges.* xxxix (1906), p. 76), Sudborough and co-workers (*Journ. Chem. Soc.* 1901, p. 522; 1903, p. 1334; 1906, p. 583; 1910, p. 773; 1911, p. 209; 1916, p. 1339). These workers confined their attention mainly to *s*-trinitrobenzene, α -trinitrotoluene, and some similar symmetrically constituted bodies, such as picric acid.

The main result of all these investigations has been to demonstrate that these additive compounds are all of the type 1 molecule of trinitrobenzene or trinitrotoluene + 1 molecule of amine, provided the amine contains only one independent aromatic nucleus.

Korczynski (*Anz. Akad. Wiss. Krakau*, 1908, pp. 633-644) prepared additive compounds of *s*-trinitrobenzene and of α -trinitrotoluene with ammonia by interaction of these bodies at -10 to -15° C. The composition of these derivatives was represented by 1 molecule of the nitro-compound + 2 molecules of ammonia.

Will (*loc. cit.*) stated that in acetone solution ammonia gives a greenish yellow colour with β -trinitrotoluene and a blue colour with the γ -isomer. Giua (*Atti R. Accad. dei Lincei* (5) xxiii (1914), ii, pp. 484-489) stated that these colorations gradually change to a more or less intense red colour, and that in the reaction one of the nitro groups is replaced by an amino group, this replacement being assumed to be preceded by the addition of a molecule of ammonia to the nitro compound, as in the case of α -trinitrotoluene (*cf. Korczynski, loc. cit.*).

III. Action of Aldehydes.

Thiele and Escales (*Ber. d. Dtsch. Chem. Ges.* xxxiv (1901), pp. 2842-2848) have shown that 2,4-dinitrotoluene reacts with aldehydes, such as benzaldehyde, in the presence of piperidine diethylamine, triethylamine, or ammonia to form nitrated stilbene derivatives,

Pfeiffer and Monath (Ber. d. Dtsch. Chem. Ges. xxxix (1906), pp. 1304-1306) have shown that *a*-trinitrotoluene reacts readily with benzaldehyde in the presence of piperidine, yielding 2.4.6-trinitrostilbene.

Pfeiffer (Ber. d. Dtsch. Chem. Ges. xlvi (1915), p. 1777) has prepared further stilbene derivatives by the same reaction.

IV. *Action of Hydrocarbons.*

Hepp (Liebig's Annalen der Chemie, ccv, pp. 375-380) showed that *s*-trinitrobenzene and *a*-, β -, and γ -trinitrotoluene combine with aromatic hydrocarbons such as benzene, naphthalene, and anthracene. Sudborough (Journ. Chem. Soc. 1916, pp. 1339-1348) has further examined the behaviour of *s*-trinitrobenzene in this respect, and has announced his intention of studying these additive compounds spectroscopically.

B.—EXPERIMENTAL PART.

I. *Action of Aqueous Alkalies on s-Trinitrobenzene.*

Five grams of *s*-trinitrobenzene were heated on the water-bath with 50 c.c. of 5 p. c. caustic soda. On heating the liquid an orange-red colour developed, which then became brown, and finally dark brown, ammonia being evolved during the reaction. After half an hour the dark-coloured solid was separated, washed well and dried. It was then extracted with benzene, in which the main portion dissolved leaving a dark, almost black, insoluble residue which exploded when heated. The benzene solution on concentration yielded a yellowish solid, melting at 175-180° C., and which on recrystallisation from alcohol-acetone melted at 185° C., and gave on analysis the following results:—

0.1212 grams substance gave 24.2 c.c. moist nitrogen at 16° C.,
and 75.4 m.m.p.

Corresponding to N 22.35.

$C_{12}H_6N_6O_6$ requires N 22.22.

Hence the substance is probably *tetranitroazobenzene*. It is soluble in benzene and acetone, and slightly soluble in alcohol. In acetone solution it gives with caustic soda a violet colour, which is decolourised by hydrochloric acid. The tetranitroazobenzene of Anschutz and Zimmermann gives a similar coloration with caustic soda.

The benzene mother-liquors gave a solid melting at 200-220° C., but the amount of it was too small for further examination.

More dilute caustic soda reacts similarly with trinitrobenzene. Thus 5 grams of trinitrobenzene when heated for a quarter of an hour with one per cent. caustic soda gave a dark-brown solution and a solid residue consisting of somewhat impure tetranitro-azoxybenzene.

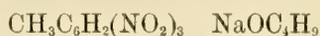
Five per cent. sodium carbonate reacted similarly, but more slowly, with the trinitrobenzene.

In all cases more tarry products tended to be formed when the time of heating was prolonged.

II. Action of Sodium *n*-Butylate on α -Trinitrotoluene.

One gram of α -trinitrotoluene was dissolved in a mixture of approximately equal parts of benzene and *n*-butyl alcohol. The solution was cooled in a freezing mixture, and to it was added a solution of 0.1 gram of sodium in butyl alcohol. On addition of the sodium butylate a red solid separated. The mixture was allowed to stand for half an hour, the solid was then filtered, washed with benzene and butyl alcohol, and allowed to remain in a desiccator over calcium chloride until dry. Excess of trinitrotoluene was removed from it by washing with benzene, and the substance was freed from benzene.

On analysis the body was found to contain 8.3 per cent. of sodium, the percentage of sodium required by the formula



being 7.1. Two other analyses from different preparations gave 8.2 and 8.3 per cent. of sodium.

Probably the body contained a small amount of a *di*-alcoholate, since Busch (*loc. cit.*) has shown that the higher alcoholates have a tendency to form such compounds.

This compound explodes when heated over a Bunsen flame. It does not explode on heating slowly to 220° C., nor on being dropped into a tube heated to 160° C.; but, on the other hand, explodes when dropped into a tube heated to 170° C.

III. Action of Caustic Potash on α -Trinitrotoluene in the presence of Iodine.

One gram of trinitrotoluene was dissolved in benzene and a solution of 1.6 grams of iodine in methyl alcohol was added to it. The mixture was cooled in a freezing mixture, and to it a solution of 1.6 grams of caustic potash in methyl alcohol was added in small quantities, and with constant shaking. During the addition of the potash the temperature did not rise above -5° C.

After standing about half an hour the mixture was filtered, and the residue on the filter was washed first with warm alcohol and then with water. This residue was recrystallised twice from benzene. It formed colourless, prismatic needles, melting at 210–213° C. Only a very small quantity of the substance was obtained in this way.

IV. *Action of Aqueous Alkalies on α -Trinitrotoluene.*

(a) The formation of a colourless crystalline substance, melting at 212° C., and probably identical with hexanitrodibenzyl, by the action of sodium carbonate on α -trinitrotoluene was observed by Dr. T. J. Nolan of Nobel's Explosives Company, Ardeer, and the fact was communicated to us by the Research Department of that Company. We succeeded in confirming this observation by the following method, which is substantially the same as that employed by Dr. Nolan.

A mixture of 5 grams of α -trinitrotoluene, 5 grams of dry sodium carbonate, and 150 c.c. of water was heated on the water-bath for about five hours. The solution assumed a pale violet tint, which gradually deepened, and ultimately became deep red-brown.

The mixture was then cooled and filtered, and the residue was washed with water until the washings were almost colourless. The residue was dried, boiled with an equal weight of benzene, and filtered from a dark, amorphous solid. On standing about twenty minutes, the solution deposited colourless prismatic crystals, which were separated and purified by re-crystallisation a few times from benzene. The crystals melted with slight decomposition at 216–217° C. The substance is moderately soluble in boiling benzene or boiling xylene. When treated with sodium amalgam and alcohol, a red coloration is developed. Its alcoholic solution gives a brownish-red coloration with caustic soda. Since a mixture of this substance with that obtained by the action of potash and iodine on trinitrotoluene melted about 215° C., the two substances are identical.

(b) The action of aqueous caustic soda on α -trinitrotoluene yields products similar to those obtained by the action of sodium carbonate.

The black substance, which separated from the alkaline solution and was not dissolved by the benzene, exploded when heated on a platinum foil. The dark-coloured alkaline filtrate from the undissolved matter gave on acidification, a copious evolution of nitrous fumes, a dark-coloured, slimy solid being precipitated. This solid when washed and dried, formed a black, tarry mass from which no crystalline derivative was obtained.

(c) *Preparation of Tetranitro-Azoxytoluene.*

In the preparation of tetranitro-azoxytoluene, we followed the method of

Anschütz and Zimmermann (Ber. d. Dtsch. Chem. Ges. xviii (1915), pp. 152-155).

Ten grams of α -trinitrotoluene were dissolved in 50 c.c. of absolute alcohol on the water-bath, and the solution was cooled with shaking. In this way a fine suspension of trinitrotoluene was obtained. One c.c. of concentrated ammonia was then added, and the mixture was cooled in ice. A current of gaseous sulphuretted hydrogen was passed through, the colour of the mixture changing from deep violet to reddish-orange in about half an hour. The mixture was boiled and filtered, the residue (sulphur) being washed with alcohol. The filtrate was poured into water, and the precipitated solid was filtered and dried.

The dry solid was extracted with benzene in a Soxhlet apparatus. The first three or four extracts were neglected; the later ones which, according to Anschütz and Zimmermann, contain mainly 2·6-dinitro-4-hydroxylaminotoluene, deposited a yellow substance melting at 127-130° C. (the melting-point of the hydroxylamino compound is 135-136° C.).

One and a half grams of this substance were heated on the water-bath for three quarters of an hour with 15 c.c. of concentrated hydrochloric acid. The mixture was cooled and filtered, and the residue was washed with warm hydrochloric acid. When dried and re-crystallised from benzene, it formed colourless, prismatic needles, melting at 210° C. On treatment with sodium amalgam and alcohol, a violet-blue coloration was developed. Its alcoholic solution gives a violet-blue colour, with caustic soda. Since a mixture of this substance with that obtained by the action of sodium carbonate on α -trinitrotoluene melted at 183-186° C., the two substances cannot be identical.

(d) *Attempt to prepare Hexanitrodibenzyl.*

Dibenzyl was prepared in the usual manner by the action of metallic sodium on benzyl chloride, and was then treated as follows:—

Six grams of dibenzyl were added in small quantities to a mixture of 50 c.c. of nitric acid (sp. gr. 1·44) and 150 c.c. of concentrated sulphuric acid, with constant shaking. The dibenzyl all dissolved and, on standing, a solid began to separate. It was allowed to remain overnight, and was then heated on the water-bath for about 2½ hours, and the mixture was then poured into water. The solid was separated and, when dried, melted at 130° C.

This solid was further nitrated by heating with 60 c.c. of concentrated sulphuric acid and 32 grams of potassium nitrate on the water-bath for eight hours. This yielded a product which, when washed with alcohol and re-crystallised from benzene, formed colourless prisms melting at 165° C. This substance was probably the 2,4,2',4'-tetranitro-dibenzyl, obtained by Braun and Rawicz (Ber. d. Dtsch. Chem. Ges., xlix (1916), p. 799).

Attempts to further nitrate this substance, by using (*a*) concentrated nitric acid and glacial acetic acid; (*b*) a mixture of one part of fuming nitric acid, and two parts of fuming (20 p. c. SO_3) sulphuric acid, were unsuccessful.

When treated in alcohol with sodium amalgam, this substance gave a red coloration similar to that got with the substance obtained in IV (*a*), above.

V. *Action of Aqueous Alkalies on β -Trinitrotoluene.*

(*a*.) Five grams of β -trinitrotoluene were heated on the water-bath for an hour with 200 c.c. of 1 p. c. caustic soda. The solution quickly developed a yellow colour, which gradually changed to a deep brown. The trinitrotoluene dissolved almost completely. On acidifying the solution, nitrous fumes were evolved and a brown solid was precipitated. This solid was filtered, washed, and repeatedly extracted with boiling water. The extracts on cooling gave a yellow solid, which was re-crystallised from dilute alcohol, melted at 100–101 C., and was therefore dinitro-*m*-cresol (*cf.* W. Will, *Ber. d. Dtsch. Chem. Ges.*, xlvii (1914), p. 712).

(*b*.) Five grams of β -trinitrotoluene were heated on the water-bath with 5 grams of sodium carbonate and 100 c.c. of water for three hours. The solution treated as in the last experiment gave the same dinitro-*m*-cresol.

The undissolved residue was filtered and dried. On boiling with benzene the main portion dissolved, leaving a black amorphous residue, which exploded on heating. The benzene solution yielded only unchanged β -trinitrotoluene.

VI. *Action of Aqueous Alkalies on γ -Trinitrotoluene.*

Two grams of γ -trinitrotoluene were heated for three-quarters of an hour with 50 c.c. of 1 per cent. caustic soda. The colour of the solution rapidly became dark brown, and ammonia was at the same time evolved. The brown liquid was filtered from a slight residue and acidified. The brown solid which separated was filtered and extracted with boiling water. The aqueous solution was extracted with ether, the ether was evaporated, and the residual solid was recrystallised from ligroin. It consisted of pale-yellow crystals which melted at 72–73 C. The dark, tarry body from which this substance had been separated deflagrated on heating. The crystalline solid itself was evidently a dinitro-*m*-cresol (*cf.* W. Will, *loc. cit.*).

The residue which remained undissolved in alkali was boiled with benzene and filtered from a slight residue which exploded feebly when heated on a platinum foil. The benzene solution on cooling gave acicular crystals melting with decomposition about 190 C. In alcoholic solution it gave a greenish-

yellow coloration with ammonia, while γ -trinitrotoluene gives a blue, and hexanitrodibenzyl a pink, coloration under the same conditions.

The amount of the substance obtained was insufficient for further examination.

In another experiment 2 grams of γ -trinitrotoluene¹ were heated on the water-bath for two hours with a solution of 2 grams of sodium carbonate in 50 c.c. of water. The products obtained in this case were the same as those got when caustic soda was employed.

VII. Action of Aqueous Ammonia on γ -Trinitrotoluene.

Five grams of α -trinitrotoluene and 100 c.c. of ammonia (formed by diluting 50 c.c. of concentrated ammonia to 100 c.c.) were shaken in a stoppered bottle for a month. At the end of that time the brown liquid was filtered, and the residual solid was washed with water and dried. On extraction with boiling benzene a slight amount of unchanged trinitrotoluene passed into solution, leaving a dark-brown amorphous residue, which exploded feebly on heating. The ammoniacal solution on acidification gave a brown amorphous precipitate.

VIII. Action of Ammonia on β -Trinitrotoluene.

1. Alcoholic Ammonia.

Two grams of β -trinitrotoluene, 5 c.c. of strong ammonia, and 35 c.c. of alcohol were shaken in a stoppered bottle for four hours. On adding the ammonia a greenish coloration was produced, and this gradually changed to a brownish-yellow. The trinitrotoluene went into solution, and after some time a yellow solid separated. After a few hours' shaking the mixture was allowed to stand overnight. The yellow solid was separated, filtered, dried, and recrystallised from alcohol. It melted at 95–96° C., and was therefore identical with the β -dinitrotoluidine of Hepp.

Its alcoholic solution gave a bright-red coloration with caustic soda, which turned crimson when the solution was warmed.

2. Aqueous Ammonia.

Two grams of β -trinitrotoluene were shaken with 40 c.c. of ammonia (formed by diluting 20 c.c. of concentrated ammonia with water to 40 c.c.). The liquid gradually acquired a brownish-yellow colour, and the solid changed

¹ On purifying some crude γ -trinitrotoluene by crystallisation from benzene a black amorphous solid remained undissolved. This substance resembled the dark-coloured insoluble solids isolated from the products of reaction of the trinitrotoluenes with alkalis, and exploded when heated on a platinum foil.

in colour through yellow to light-brown. After a month the solid was filtered, washed, boiled with alcohol, and again filtered from a small amount of brown residue. From the alcoholic solution on cooling the same dinitrotoluidine as that previously obtained separated.

The aqueous ammoniacal solution on acidification evolved nitrous fumes, and gave a slight brown precipitate.

IX. Action of Ammonia on γ -Trinitrotoluene.

1. Trinitrotoluene was treated with aqueous ammonia in a manner similar to that described for the β -compound. The solid which remained after standing for a month, had a brown colour, and when crystallised from alcohol consisted of yellow crystals which melted at 190-192° C., and it was therefore the γ -dinitrotoluidine of Hepp (*loc. cit.*).

The aqueous ammoniacal solution on acidification gave a slight brown precipitate with evolution of nitrous fumes.

X. Action of *p*-Toluidine on α -Trinitrotoluene.

Equivalent proportions of α -trinitrotoluene and *p*-toluidine (5 grams of the former and 2.4 grams of the latter) were dissolved in benzene and the warm solutions were mixed. A red-coloured solution was obtained which, on cooling, gave a copious deposit of red needles, which were separated and dried. The compound melted at 68-70° C.

Using 4 molecular proportions of trinitrotoluene to 3 molecular proportions of *p*-toluidine, the same red substance, mixed with excess of *p*-toluidine, was obtained.

The red compound on exposure to air becomes paler in colour, and finally almost colourless. Alcohol and acetic acid dissolve it with decomposition into its constituents. When alcohol is added to it it first turns lighter in colour giving a brownish solution. On heating it gradually dissolves completely the colour of the solution becoming red. If this solution be cooled rapidly, colourless molecular crystals, melting about 81° C., are deposited. The mother liquor from these crystals gives, on concentration, first a crop of red crystals melting about 70° C., and then almost colourless plates softening at 32° C. and melting at 42-44° C. Hence it is evident that the substance is dissociated into its components in alcohol solution.

Dilute hydrochloric acid converts the body into trinitrotoluene and *p*-toluidine hydrochloride.

Jackson and Clarke previously obtained this compound by a somewhat different method (*Proc. Chem. Soc.*, 1906, p. 83).

XI. Action of Aniline on β -Trinitrotoluene.

β -Trinitrotoluene (2 grams) was shaken with a solution of 2 c.c. of aniline in 50 c.c. of alcohol. From the solution, which had at first a dark colour, red crystals slowly separated. After two days the crystals were separated, washed, and recrystallised from alcohol. The substance thus got consisted of prismatic crystals which melted at 114–115° C., and gave on analysis the following results:—

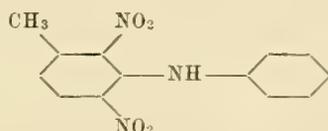
0.1506 grams substance gave 20.2 c.c. nitrogen at 20° C. and
752 m.m.p.

Corresponding to N 15.22.

$C_{13}H_{11}N_3O_4$ requires N 15.3.

$C_{13}H_{12}N_4O_6$ requires N 17.5.

The substance is therefore a dinitrotolylphenylamine, and probably has the formula:—



This substance was previously prepared by Hepp, but he did not publish an analysis of it. *

XII. Action of *p*-Toluidine on β -Trinitrotoluene.

A solution of 2 grams of *p*-toluidine in 10 c.c. of alcohol was added to 2 grams of β -trinitrotoluene in 40 c.c. of alcohol. A yellow colour was developed, and on shaking the trinitrotoluene apparently dissolved with simultaneous separation of a red solid. After shaking for a quarter of an hour the red solid was filtered, washed, and recrystallised from alcohol. It consisted of red prismatic crystals which melted at 131° C., and gave on analysis the following results:—

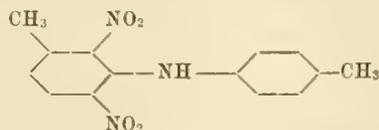
0.1082 grams substance gave 13.7 c.c. nitrogen at 17° C. and
771 m.m.p.

corresponding to N 14.9.

$C_{14}H_{13}N_3O_4$ requires N 14.63.

$C_{14}H_{14}N_4O_6$ requires N 16.76.

Hence this substance is a dinitro-ditolylamine, and probably has the formula:—



The constitutional formulae assigned to this and the preceding compound

are based on the conversion of β -trinitrotoluene into 2,6-dinitro-3-methylphenol by the action of alkalis, and into the corresponding amine by the action of ammonia.

XIII. Action of *p*-Toluidine on γ -Trinitrotoluene.

Equimolecular proportions of γ -trinitrotoluene and *p*-toluidine were dissolved in benzene, and the cold solutions were mixed. The mixture was allowed to evaporate in the cold, and the separated solid was washed with benzene and alcohol and dried in a vacuum desiccator over calcium chloride. A substance was obtained in this way which consisted of yellow needles soluble in alcohol readily soluble in benzene and pyridine. On heating it turned a reddish-orange colour at 147° C., and melted to a red liquid at 154° C. It gave on analysis the following results:—

0.1128 grams substance gave 16.2 c.c. moist nitrogen at 12° C.
and 766 m.m.p.

corresponding to N 17.17.

$C_{10}H_{11}N_4O_6$ requires N 16.76.

The substance was therefore an additive compound in equimolecular proportions of γ -trinitrotoluene and *p*-toluidine.

If hot alcoholic solutions of γ -trinitrotoluene and *p*-toluidine be mixed, the mixture on cooling quickly deposits a solid which consists mainly of yellow needles through which are mixed some monoclinic platy crystals having an orange colour. The yellow needle-shaped crystals dissolve more readily in alcohol than the orange substance which is, however, readily soluble in benzene or pyridine. When heated the orange substance melts to a red liquid at 154° C. It gave on analysis the following results:—

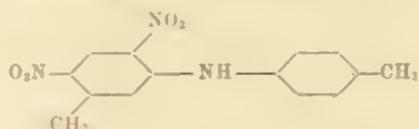
0.1140 grams substance gave 14.0 c.c. moist nitrogen at 12° C.
and 774 m.m.p.

corresponding to N 14.84

$C_{11}H_{13}N_3O_6$ requires N 14.63

$C_{10}H_{11}N_4O_6$ requires N 16.76.

The substance is therefore a dinitroditolylamine. According to Will (Ber. d. Deutsch. Chem. Ges. xlvii (1914), p. 712), γ -trinitrotoluene is converted by caustic soda into 2,4-dinitro-5-methylphenol. It is probable therefore that the ditolylamine has the following formula:—



XIV. *Action of Aldehydes on α -Trinitrotoluene.*

Following the method of Pfeiffer and Monath (Ber. d. Dtsch. Chem. Ges. xxxix (1906), pp. 1304–1306), the following compounds were prepared by condensing α -trinitrotoluene with benzaldehyde, anisaldehyde, and piperonal, respectively, in the presence of piperidine:—2.4.6-trinitrostilbene, 2.4.6-trinitro-4'-methoxystilbene, and 2.4.6-trinitro-3'.4'-methylenedioxy-stilbene. The first two substances have been previously obtained by Pfeiffer (Ber. d. Dtsch. Chem. Ges. xxxix (1906), pp. 1304–1306; xlvi (1915), p. 1777).

The last-named substance, which has not previously been obtained, was prepared in the usual manner by adding 5 or 6 drops of piperidine to a mixture of 3 grams of α -trinitrotoluene and 2 grams of piperonal, and heating the mixture on the water-bath for about half an hour.

The product was re-crystallised several times, first from benzene and alcohol, afterwards from benzene. It separates from the latter solvent in the form of dull yellow prisms which on standing or on being heated become scarlet, owing to loss of benzene of crystallisation. The scarlet substance melts at 156–157° C. It was heated to a temperature of 90–100° C. before analysis.

0.1139 grams substance gave 11.8 c.c. moist nitrogen at 16° C.
and 758.6 m.m.p.

corresponding to N 12.05
C₁₅H₉N₃O₈ requires N 11.7.

XV. *Action of Aldehydes on β - and on γ -Trinitrotoluene.*

All attempts to prepare stilbene derivatives from the β - and γ -trinitrotoluenes by methods similar to that described for the α -isomer were unsuccessful, even when the reaction was tried at temperatures of 125–130° C., and the time of heating was prolonged to several hours. The trinitrotoluenes were generally recovered unchanged from the mixtures.

When the γ -isomer was heated with piperonal, first on the water-bath for an hour, and then to a temperature of 130° C. for five hours, a brown amorphous substance, almost insoluble in all solvents, except acetone, was obtained.

XVI. *Action of Phenanthrene on α -Trinitrotoluene.*

Equimolecular proportions of α -trinitrotoluene and phenanthrene were dissolved in benzene, and the warm solutions were mixed. On cooling, the mixture deposited bright yellow needles, which were recrystallised from glacial acetic acid. The same substance, mixed with excess of phenanthrene,

was obtained by taking one molecular proportion of trinitrotoluene and three of phenanthrene.

This compound forms bright yellow needles which melt at 98-99° C., are very readily soluble in benzene, soluble in acetone, ether, or glacial acetic acid. It dissolves in pyridine, giving a violet-coloured solution, the colour of which is probably due to the dissociation of the substance into its components, since the trinitrotoluene itself gives a violet coloration with pyridine.

The substance is much more stable than the additive compound formed from *p*-toluidine and α -trinitrotoluene: it is not decomposed by alcohol, nor is it decomposed by acetic or hydrochloric acid. It is decomposed by 10 p.c. caustic soda solution, giving a violet coloration. It gave on analysis the following results:—

0.1352 grams substance gave 14.0 c.c. moist nitrogen at 18° C.
and 742 m.m.p.

corresponding to N 10.66.

$C_{21}H_{13}N_3O_6$ requires N 10.32.

Hence the substance is an additive compound having a composition represented by the formula



XVII. *Action of Phenanthrene on β -Trinitrotoluene.*

Equimolecular quantities of β -trinitrotoluene and phenanthrene were dissolved in alcohol and the solutions were mixed and concentrated. The solid which separated on cooling was recrystallised from alcohol and dried in a vacuum desiccator over calcium chloride. It formed pale yellow prismatic plates, which melted at 105° C., were readily soluble in benzene, and soluble in alcohol, glacial acetic acid, or ether. When heated with 10 p.c. caustic soda solution, it decomposed, giving a violet-brown coloration. On analysis it gave the following results:—

0.1165 grams substance gave 10.2 c.c. moist nitrogen at 11.5° C.
and 771.5 m.m.p.

corresponding to N 10.55.

$C_{21}H_{13}N_3O_6$ requires N 10.32.

XVIII. *Action of Phenanthrene on γ -Trinitrotoluene.*

Equimolecular proportions of γ -trinitrotoluene and phenanthrene were dissolved in alcohol, and the solutions were mixed and concentrated. The solid which separated on cooling was purified as in the case of the last compound,

It consisted of dull yellow acicular prisms, which melted at 83° C., and otherwise resembled the corresponding derivative of the β -isomer. It gave on analysis the following results:—

0.1075 grams substance gave 10.0 c.c. moist nitrogen at 16° C.
and 757 m m.p.

corresponding to N 10.8.

$C_{12}H_{16}N_3O_6$ requires N 10.32.

SUMMARY OF RESULTS.

The following is a summary of the results obtained in the course of the work:—

1. The action of the aqueous alkalis on *s*-trinitrobenzene yields, in accordance with Lobry de Bruyn's statement, tetranitroazoxybenzene. A small amount of a substance melting about 200–220° C. was also obtained, and this may possibly be hexanitrodiphenyl, which melts at 234° C.

Tetranitroazoxybenzene resembles in its reactions the tetranitroazoxytoluene of Anschütz and Zimmermann.

α -trinitrotoluene yields a fairly stable compound with sodium *n*-butylate. The analyses obtained for this compound indicate, possibly, the formation, in addition to the mono-alcoholate, of a di- or tri-alcoholate in small quantities, this being in agreement with the statement of Busch and Koegel, already mentioned.

With alkalis in the presence of an oxidising agent, α -trinitrotoluene yields hexanitrodibenzyl. The same substance is obtained by the action of hot caustic soda or sodium carbonate on α -trinitrotoluene. Hexanitrodibenzyl possesses properties different from those of the tetranitroazoxytoluene of Anschütz and Zimmermann.

β -trinitrotoluene with alkalis yields a dinitrometacresol, melting at 101° C., with a large quantity of more complex products.

γ -trinitrotoluene with alkalis gives a small quantity of a dinitrocresol and also a small quantity of a crystalline substance which is insoluble in alkalis, and which may possibly be a dibenzyl or stilbene derivative.

From the products of the reaction of each of the substances mentioned with alkalis dark amorphous explosive substances were isolated.

2. α -trinitrotoluene yields brown complex products by the prolonged action of aqueous ammonia.

β -trinitrotoluene reacts very readily with alcoholic ammonia in the cold, yielding dinitrotoluidine. This is apparently at variance with Hepp's results,

which imply that while γ -trinitrotoluene reacts with alcoholic ammonia on the cold, the β -isomer reacts only when treated with alcoholic ammonia in a sealed tube.

β -trinitrotoluene reacts with aqueous ammonia, yielding a small quantity of dinitrotoluidine, and a similar reaction takes place in the case of the γ -isomer.

a-trinitrotoluene forms an additive compound with *p*-toluidine. This compound has been previously described by other workers. (Jackson and Clarke, Proc. Chem. Soc., 1906, p. 83.)

β -trinitrotoluene reacts very readily with both aniline and *p*-toluidine in alcoholic solution, yielding substituted diphenylamine derivatives.

γ -trinitrotoluene with *p*-toluidine forms an additive compound, which is readily transformed into a substituted diphenylamine derivative. Thus Hepp's statement that γ -trinitrotoluene does not form simple additive compounds with amines is incorrect.

3. *a*-trinitrotoluene reacts readily with piperonal, anisaldehyde, and benzaldehyde on the water-bath, in the presence of piperidine forming stilbene derivatives. Neither the β - nor the γ -isomer underwent such a reaction even at 130° C.

4. All three isomeric trinitrotoluenes form additive compounds with phenanthrene.

The results obtained show that the four substances examined all react differently with alkalis. There are, however, some points of agreement. In each case a process of reduction takes place as shown by the evolution of ammonia; but it is not possible to say exactly how this reduction takes place. The reduction probably in all cases proceeds to the formation of an amine, the NH_2 group being then replaced by OH with evolution of ammonia. In all four cases the reaction is by no means so simple as this might imply. Phenolic substances of a complex nature are apparently formed in considerable quantities, their formation probably following a reaction such as is indicated here.

Simultaneously with this reduction there is in the case of *a*-trinitrotoluene a process of oxidation with formation of hexanitrodibenzyl. This is the only case in which we have definite proof of a process of oxidation; but it may be pointed out that non-phenolic substances were obtained from *s*-trinitrobenzene and γ -trinitrotoluene which may possibly be derived from these substances by such a process. Symmetrical trinitrobenzene is unique in that it yields considerable quantities of a tetranitro-azoxy compound.

In most cases dark-coloured substances insoluble in alkali were formed, and these exploded on being heated.

The action of amines on the three trinitrotoluenes also proceeds somewhat differently in the three cases. One interesting fact is, that an additive compound of the γ -isomer with *p*-toluidine has been isolated. Hepp. (*loc. cit.*) stated that neither β - nor γ -trinitrotoluene formed simple additive compounds with primary amines. It is probable that additive compounds are also formed by β -trinitrotoluene; but, if so, they are very unstable. The action of ammonia and amines on the substances seems to show that the β -isomer yields a toluidine or diphenylamine derivative as readily as the γ -compound, whereas Hepp's statements (*loc. cit.*) would lead one to think that the latter was in this respect much more reactive than the former.

The reactions of the trinitrotoluenes with aldehydes show clearly a difference in the reactivity of the CH_3 group in these substances, the α -isomer being the only one from which stilbene derivatives were obtained.

Attention may be drawn to the fact, mentioned above, that a sample of crude γ -trinitrotoluene was found to contain a dark, amorphous substance, which explodes on heating. In view of the facts mentioned in the introduction to this paper, this may be of considerable interest.

In conclusion, we wish to thank Nobel's Explosives Company for the materials employed in our experiments; and Mr. Rintoul, the Manager of the Research Section of that Company, at whose suggestion the investigation was undertaken.

We also desire to thank the Advisory Council for Scientific and Industrial Research for a grant which enabled us to carry out the work.

X.

ON THE ACTION OF NITRIC ACID AND NITROUS ACID ON
DIPHENYLAMINE.

PART I.

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Read APRIL 27. Published DECEMBER 4, 1918.

MANY investigators have examined the actions which occur between the oxoacids of nitrogen and diphenylamine, or its derivatives, in solutions which are concentrated both with respect to the acid and the amine.

In the changes which occur during the life of a stabilised explosive the reactions may be assumed to take place not only at the ordinary temperature, but also at low concentrations of the amine and the acid.

It was deemed advisable therefore to determine the nature of the compounds formed by the action of various, but always low, concentrations of nitric acid on diphenylamine and diphenylnitrosamine under conditions approximating as closely as possible to those actually existing in a nitro-cellulose explosive.

O. N. Witt (Ber. d. Dtsch. Chem. Ges. viii (1875), p. 855; *cf.* Otto Fischer (Liebigs Ann. cxv (1877), p. 1745), by the action of nitrous acid on a cold alcoholic solution of diphenylamine obtained diphenylnitrosamine, and by the action of nitric and nitrous acids on a warm alcoholic solution of diphenylamine he obtained 4-nitro-diphenylnitrosamine (Ber. d. Dtsch. Chem. Ges. xi (1878), p. 756); *cf.* R. Stoerner and Hofmann (Ber. d. Dtsch. Chem. Ges. xxxi (1898), p. 2535).

E. Joubert (Bull. Soc. Chim. Paris (3) xxviii (1905), p. 1172-1190), by the short action of nitric acid on a solution of diphenylnitrosamine in acetic acid, obtained a mixture of 4- and 2-nitro-diphenylnitrosamines.

Witt also (Ber. d. Dtsch. Chem. Ges. vi (1878), p. 758) obtained a mixture of 4:10- and 2:10-dinitro-diphenylnitrosamine by the action of nitric and nitrous acids on the amine, while R. Stoerner and Hofmann (*loc. cit.*) found that dilute nitric acid converts 4-nitro-diphenylnitrosamine into 4:10-dinitro-diphenylamine.

From 2-nitro-diphenylnitrosamine and nitric acid P. Juillard (*loc. cit.*) obtained a mixture of 2·8- and 2·10-dinitro-diphenylnitrosamines, and the same chemist, by heating 2-nitro-diphenylnitrosamine with acetic acid, prepared 2·8- and 2·10-dinitro-diphenylamines.

By further nitration of 2·10-dinitro-diphenylamine Juillard obtained 2·4·8-trinitro-diphenylamine and 2·4·10-trinitro-diphenylamine, while Norton and Allen (*Ber. d. Dtsch. Chem. Ges.* xviii 1885, p. 1997), by boiling acetyl-diphenylamine with diluted nitric acid, prepared a trinitro-diphenylamine melting at 135° C., which is probably a mixture of polynitro-diphenylamines.

No tetranitro-diphenylamine has been hitherto obtained by the direct nitration of diphenylamine. Gnehm and Wys (*Ber. d. Dtsch. Chem. Ges.* x (1877), p. 1319), by the action of nitric acid on a hot acetic acid solution of diphenylnitrosamine, obtained a "tetranitro-diphenylamine" melting at 192°C., which we have found to be somewhat impure, 2·4·8·10-tetranitro-diphenylamine.

Pure 2·4·8·10-tetranitro-diphenylamine was obtained by Amé Pictet and E. Klein (*Arch. d. Sciences phys. et nat.*, Genève (4) xvi (1903), pp. 191-212) by the action of diacetyl-nitric acid on acetyl-diphenylamine, and by P. Juillard (*loc. cit.*) by the nitration of 4·10-dinitro- and 2·4·10-trinitro-diphenylamines in the presence of diphenyl-nitrosamine.

Gnehm (*loc. cit.*; *cf.* Mertens (*Ber. d. Dtsch. Chem. Ges.* xi (1878), p. 845) by warming diphenylamine with nitric acid, prepared 2·4·6·8·10·12-hexanitro-diphenylamine.

In our experiments, which were all carried out at the laboratory temperature and at low concentrations, we have found that prolonged action of equivalent amounts of diphenylamine and nitric acid forms only the nitrate of the base, and that when more than one equivalent of the acid is taken, one portion of the amine is converted into a brown resinous solid, and another portion into nitro-derivatives of diphenylamine, amongst which we have, up to the present, been able to identify 2·10-dinitro-diphenylamine, 4·10-dinitro-diphenylamine, and 2·4·8·10-tetranitro-diphenylamine. In one experiment (4) a trace of 2·10-dinitro-diphenylnitrosamine was obtained.

Under the same conditions the nitration of diphenylnitrosamine proceeded in an entirely different manner. The colour of the solution changed slowly from orange to orange-yellow, or yellow with separation of the sparingly soluble 2·10-dinitro-diphenylnitrosamine, in the case of all solutions containing two or more equivalents of nitric acid to one of diphenylnitrosamine. The dinitro-nitrosamine was not formed when only one equivalent of acid was employed, the products in this case being 4-nitro-diphenylnitrosamine with

probably a small amount of 2-nitro-diphenylnitrosamine. When larger amounts of nitric acid were employed, we found that the acetic acid solution contained 2:4:8:10-tetranitro-diphenylamine and 4:10-dinitro-diphenylamine with other polynitro compounds, which we have not been able to separate in a pure condition.

The dinitro-diphenylnitrosamine was decomposed with evolution of nitric oxide when its solution in xylene was boiled under a reflux condenser, and the chief product obtained by distillation of the xylene was 2:10-dinitro-diphenylamine.

O. N. Witt's dinitro-diphenylnitrosamine was a mixture of 2:10- and 4:10-dinitro-diphenylnitrosamines.

According to Juillard (*loc. cit.*) 2:10-dinitro-diphenylnitrosamine consists of light rose-coloured leaves, melting with decomposition at 160–162, while 4:10-dinitro-diphenylnitrosamine consists of dense, slightly orange-yellow prisms, melting with decomposition at 150° C.

H. Wieland and H. Lecher (*Liebig's Annalen chemii* (1912), p. 167) state that 4:10-dinitro-diphenylnitrosamine is a yellow crystalline solid, melting with decomposition at 159°, and showed that when heated in boiling xylene it splits off nitric oxide, forming 4:10-dinitro- and 2:4:10-trinitro-diphenylamines with some tarry matter. It had already been shown that the decomposition of dinitro-diphenylnitrosamines can be effected by heating with aniline or alcoholic potash (O. N. Witt, *Ber. d. Dtsch. Chem. Ges.* xi (1878), p. 758), with alcohol and hydrochloric acid (Nietzki and Witt., *Ber. d. Dtsch. Chem. Ges.* xii (1879), p. 1400), or with alcohol alone (Juillard, *loc. cit.*).

In this laboratory, three apparently different dinitro-diphenylnitrosamines have been prepared, all of which are light-yellow in colour, melt with decomposition, and mixtures of which, in pairs, melt several degrees lower than either of the constituents. They all lose nitric oxide when heated, a property the investigation of which will prove of great interest in connexion with the heat tests for nitrocellulose powders stabilised by addition of diphenylamine.

Our experiments indicate that in the absence of nitrous acid the diphenylamine is first converted into its nitrite, and that so long as the amount of nitric acid does not exceed that equivalent to the diphenylamine, the colour never becomes more intense than green. With two equivalents of nitric acid the colour changes very slowly from yellowish-green through dark green, and black-brown to red, and with larger amounts of the acid the same colour-changes are obtained more rapidly without the appearance at any time of the orange-yellow intermediate colour which has apparently been observed. In

only one case (Expt. 4) have we, as yet, been able to isolate the trace of nitrosamines formed during the reactions. In addition to the brown resinous body which is not, as has been assumed, a trinitro-diphenylamine, the chief products are 2·10-dinitro-, 4·10-dinitro-, and 2·4·8·10-tetranitro-diphenylamines.

On the other hand, when one equivalent of nitrous acid is present, the first product is the nearly colourless diphenylnitrosamine which can be readily recognized by the deep-blue colouration it gives with sulphuric, even in the absence of nitric acid. The nitric acid acts upon the compound, producing first an orange-yellow solution from which the nearly colourless 4-nitro-diphenylnitrosamine can be, without difficulty, isolated. It is probable that the orange-yellow colour of the solution is due to small amounts of 2-nitro-diphenylamine and 2-nitro-diphenylnitrosamine, which we have not, however, isolated.

In the next stage the main product is the sparingly soluble, yellowish-white, 2·10-dinitro-diphenylnitrosamine, which separates from the system and undergoes no further change.

The dissolved portion, which also contains 4·10-dinitro-diphenylamine or its nitroso derivative, is finally converted into the pale-yellow 2·4·8·10-tetranitro-diphenylamine, the colour of the solution changing slowly from orange-yellow to pale-yellow, and in these cases never becoming green, brown, or red.

It has been generally, but incorrectly, assumed (V. Buisson, *loc. cit.*) that the order of formation of the compound is 4-nitro-nitroso-, 4-nitro-, 2·4-dinitro-, and finally 2·4·6-trinitro-diphenylamine. In no one of our experiments were there any indications of the formation of the easily recognizable 2·4-dinitro- or 2·4·6-trinitro-diphenylamine. The main product is in every case, where nitrous acid is also present, a dinitro-diphenylnitrosamine, and at present we regard the formation of this compound as indicating the completion of the stabilizing action of the diphenylamine.

In the qualitative tests now employed technically for the detection of diphenylamine derivatives the dinitro-nitroso, trinitro-, and tetranitro-diphenylamines, which are very sparingly soluble in hot alcohol, remain in the powder in the first stage of the tests. The examination of these and also of the quantitative tests will be undertaken at a later period.

There is little doubt that the dinitro-diphenylnitrosamine interferes with the heat tests at 110° or 135° C., and may interfere even with the Abel test. Although the presence of this compound in a powder may not affect the rate of deterioration, there is no doubt that a heat test at 135° C. will indicate a lower degree of stability of the powder, owing to the loss of nitric oxide from the nitrosamine group, than magazine storage under normal conditions will show.

EXPERIMENTAL.

A.—*Action of Nitric Acid on Diphenylamine.*

1. To a solution of 2 grams of diphenylamine in 100 c.c.s of glacial acetic acid 0·7 c.c. (1 *mol.*) of nitric acid (sp. g. 1·43) was added, and the solution was allowed to remain in a stoppered flask at the laboratory temperature for six weeks. The mixture developed a greenish-yellow colour during the first ten days, and this, after gradually becoming green during the succeeding ten days, then remained green without separation of any solid until the end of the sixth week.

The green solution was poured into 400 c.c.s of water, and the mixture was shaken in a flask until the liquid above the precipitated solid was clear. The pale-greenish crystals, which were filtered, weighed very nearly 2 grams. When recrystallized from alcohol in which they were very soluble, they melted at 53–54° C., were white in colour, and proved to be *diphenylamine*.

2. A solution of diphenylamine, similar to the last, to which 1½ c.c.s (2 *mols.*) of nitric acid had been added, developed a greenish-yellow colour in the first week, and a green colour during the succeeding fortnight. Its colour then changed very slowly through dark-green to red, the latter colour being retained until the end of the experiment.

The brown resinous solid which separated from the solution from the seventeenth day onwards was filtered after eleven weeks, and reserved; the filtrate was poured into three or four volumes of water. The yellow, oily solid which was precipitated melted at 135–145° C., when purified several times from alcohol and chloroform. We did not, however, succeed in separating it into its components.

3. In our next experiment we added an amount (2·1 c.c.s) of nitric acid, corresponding to three molecular proportions of the acid, to a diphenylamine solution of the same concentration as the last, and observed changes in the colour of the solution similar to those just described during the eleven weeks the experiment continued.

The brown solid, which had separated, was filtered, and the oily solid, which separated from the filtrate, on the addition of water, was filtered and washed first with alcohol, afterwards with chloroform. The undissolved solid was found after crystallization from acetone to be 2·4·8·10-*tetra*-nitro-*diphenylamine*; but the more soluble substance which was contained in the chloroform filtrate was not isolated in a pure condition.

4. To another solution of 2 grams of diphenylamine in 100 c.c.s of glacial acetic acid we added 2·8 c.c.s (4 *mols.*) of nitric acid, and again allowed the mixture to remain in a stoppered flask at the room temperature.

The colour of the solution changed relatively rapidly through greenish-yellow and green to dark brownish-red, acquiring the latter tint about the seventeenth day and retaining it until the end of the fourteenth week, when the solution was filtered from the brown resinous solid, which had begun to separate on the fifth day, and which finally weighed about 1 gram.

The yellow solid, which was precipitated from the acetic acid solution by addition of water, was filtered, washed with alcohol, dried, and boiled a couple of times with carbon tetrachloride. The light brownish-yellow, undissolved solid weighed 2 grams, and when recrystallized from acetone and alcohol melted at 198–200° C., and proved to be 2·4·8·10-tetranitro-diphenylamine.

The solid which separated in small quantity from the carbon tetrachloride on cooling was impure, melting at 180–190° C., while that got from the filtrate on evaporation was also very small in quantity, and when washed with alcohol and ether melted with decomposition at 156–159° C., apparently being dinitro-diphenylnitrosamine.

5. In this experiment the amount of nitric acid employed was 4·2 c.cs (6 *mols.*). The solution became dark green on the second day and rapidly changed to a dark brownish-red colour, which it retained until the end of the seventh week, when the solution was filtered from the brown resinous solid which had begun to separate on the second day. The solid, which separated from the acetic acid solution on the addition of excess of water, was filtered, washed with alcohol and chloroform, and recrystallized from xylene. It melted about 192° C., and proved to be slightly impure 2·4·8·10-tetranitro-diphenylamine. From the alcohol-chloroform washings further fractions were obtained, melting at lower temperatures, and which we were unable to resolve into their pure components.

6. In another experiment 12·5 grams of diphenylamine were dissolved in a mixture of 26·3 c.cs (6 *mols.*) of nitric acid, and 250 c.cs of glacial acetic acid.

The solution rapidly acquired a dark-green colour, and later became dark reddish-brown—a copious separation of a brown solid simultaneously taking place.

After seven days the mixture was filtered, and the filtrate was diluted with a litre of water. The yellow solid, which separated, was filtered, dried, and washed with chloroform. The portion which remained undissolved was recrystallized from boiling xylene, and proved to be 2·4·8·10-tetranitro-diphenylamine.

On evaporating the chloroform extract, a somewhat oily orange solid was obtained. It was purified a few times by solution in boiling alcohol and washing with ether. The semi-crystalline residue melted at 130–140° C., and

was freed from a small amount of higher nitro compounds by boiling with dilute alkali, and filtering. It melted, but not sharply, at about 135° C.; and although on analysis it had a composition corresponding to that of a trinitro-diphenylamine, its further examination showed that it was a mixture of poly-nitro-diphenylamines. Thus, on exhausting it with hot carbon tetrachloride, a small proportion of the substance dissolved, and after evaporation of the solution and recrystallization from acetone-alcohol, a mixture of orange and yellow crystals was got. The yellow crystals, when mechanically separated from the orange, melted at 210° C. (uncorr.), and consisted of 4·10-dinitro-diphenylamine. The orange crystals which melted, but not sharply, about 195° C. were not identified.

The *dark-brown resinous solid*, which separated during the prolonged standing of the diphenylamine and nitric acid in the acetic acid solutions, was nearly insoluble in all the ordinary solvents. It was not distinctly crystalline, and did not melt below 280° C. It is not identical with any of the known nitro derivatives of diphenylamine, and it is probable that the red colour finally acquired by the acetic acid solution in the above experiments is due to traces of this compound remaining in the solution.

A determination of nitrogen in this substance gave the following results:—

0·1825 gram substance gave 19 c.c.s nitrogen at 16° C. and
767·4 mms., corresponding to N 12·25.

The low percentage of nitrogen in this substance indicates that in its formation from diphenylamine reactions other than nitration must have occurred.

B.—*Action of Nitric Acid on Diphenylnitrosamine.*

7. To a solution of 2 grams of diphenylnitrosamine in 100 c.c.s of glacial acetic acid 0·6 c.c.s of nitric acid (sp. gr. 1·45) was added, and the mixture was allowed to remain in a stoppered flask at the temperature of the laboratory for three weeks. The solution, which had an orange colour at the end of the first day, became deep orange on the second, and retained this colour without separation of any solid until the twenty-first day, when it was poured into excess of water. The orange precipitate thus got was filtered, washed and dried on a plate. The crude solid, which melted on the water-bath and gave a deep violet colouration with concentrated sulphuric acid, was obviously a mixture of 4-nitro-diphenylnitrosamine and 2-nitro-diphenylnitrosamine. By recrystallizing it from chloroform and alcohol we obtained the 4-nitro-diphenylnitrosamine in a pure state. It consisted of nearly

colourless, leafy crystals, which melted at 132–133° C., gave an intense violet coloration with concentrated sulphuric acid, and, when boiled with alcohol containing a small amount of aqueous potash, formed 4-nitro-diphenylamine with a small quantity of higher melting constituents. The former when recrystallized from diluted alcohol, separated in sulphur-yellow, platy crystals, which melted at 131–132° C., and gave a nearly colourless solution with concentrated sulphuric acid.

8. To another solution of 2 grams of diphenylnitrosamine in 100 c.c.s of glacial acetic acid we added 1.2 c.c.s (2 mols.) of nitric acid, and, as before, allowed the solution to remain in a stoppered flask at the ordinary temperature for three weeks. On the first day the solution had an orange colour, on the second day deep orange, and from it yellowish-white crystals had separated. From the third to the twenty-first day the solution was orange in colour.

The solution was filtered from the yellowish-white crystals, which weighed 1.7 grams, and the filtrate was mixed with several volumes of water. The deep-yellow solid, which separated, weighed 1.1 gram, and partially melted on the water-bath. This solid, which had separated from the acetic acid solution on dilution with water, dissolved easily in chloroform; and on evaporation of the chloroform a deep-yellow, somewhat oily, residue remained. This was extracted with boiling alcohol, leaving a dark-coloured, tarry substance. The alcoholic solution on evaporation gave an orange solid, which, after several recrystallizations from chloroform and alcohol, separated as yellow prisms, melting at 213–214° C., and consisted of 4.10-dinitro-diphenylamine. A dilute solution of it in alcohol (cold) gave a violet colouration with a trace of alkali. The crystals were coloured orange-red by contact with concentrated sulphuric acid, in which they dissolved, forming a faintly yellow solution, the colour of which was scarcely affected by addition of a crystal of potassium nitrite. The orange solid contained in the mother liquids was mixed with a tarry substance from which we were unable to separate it in a pure condition.

9. In another experiment we added 1.8 c.c.s (3 mols.) of nitric acid to the diphenylnitrosamine solution which developed an orange-yellow colour on the first day, and from which yellowish-white crystals separated. The separation of the crystals continued for several days, the colour of the solution becoming gradually lighter until the seventeenth day, when it was orange-yellow. At the end of the third week the solid, which was filtered off and reserved, weighed about 1.4 grams. The filtrate, on dilution with water, gave an orange-yellow precipitate which weighed 1.3 grams.

This precipitate was dried, washed with chloroform, and recrystallized from acetic acid. It melted at 192–195° C., and consisted of slightly impure

2·4·8·10-*tetranitro-diphenylamine*. From the chloroform filtrate a small quantity of 4·10-dinitro-diphenylamine was isolated in addition to other, lower melting, impure substances.

10. The behaviour of another diphenylnitrosamine solution to which 2·4 c.cs (4 *mols.*) of nitric acid had been added was quite similar to that of the last. The yellowish-white solid which separated from the acetic acid on standing weighed 1·3 grams, and the orange-yellow solid which was precipitated by addition of water to the acetic acid filtrate weighed 1·5 grams. From the latter solid were isolated in a pure condition 2·4·8·10-*tetranitro-diphenylamine* and 4·10-dinitro-diphenylamine.

11. In this experiment the amount of nitric acid used was 3·6 c.cs 6 *mols.*. The behaviour of the solution differed from that described under Experiment 9 only by its colour at the end of the second week being yellow, instead of orange-yellow. The solid which separated from the acetic acid solution on standing weighed 1·5 grams and that got from the filtrate by dilution with water weighed 1·3 grams. The latter solid was washed with alcohol and chloroform. The residue when recrystallized from xylene melted, not quite sharply about 133° C., and proved to be slightly impure 2·4·8·10-*tetranitro-diphenylamine*. The alcohol-chloroform filtrate on evaporation gave an orange solid, which melted over a wide range of temperature.

12. In another experiment 4 grams of diphenylnitrosamine were dissolved in 200 c.cs of glacial acetic acid and 7·2 c.cs (6 *mols.*) of nitric acid (sp. gr. 1·43) were added. After a fortnight at the temperature of the laboratory the light-yellow-colored solution was filtered from 3·4 grams of 2·10-dinitro-diphenylamine, and the filtrate on dilution with water gave 2·5 grams of a yellow, oily solid from which chloroform and alcohol removed the lower melting compounds leaving a substance which, after recrystallization from xylene, weighed 9·6 gram and consisted of nearly pure 2·4·8·10-*tetranitro-diphenylamine*. From the chloroform-alcohol parent liquid a somewhat oily solid was obtained, and this, after heating with alcoholic potash and recrystallization from alcohol, melted at 125-145° C.

2·4·8·10-*tetranitrodiphenylamine*, which was obtained in several of the foregoing experiments consisted of pale-yellow prisms, melting at 198-200° C. It was very slightly soluble in cold alcohol, ether, or chloroform, dissolved in hot acetic acid, xylene, or acetone, and gave on analysis the following results:—

0·1900 gram substance gave 32·9 c.cs of nitrogen
at 15° C. and 753 m.m.p.

corresponding to N 20·08.

$C_{12}H_8N_4O_8$, requires N 20·06.

The yellowish-white solids which had separated from the acetic acid solutions of diphenylnitrosamine containing two, three, four, and six equivalents of nitric acid were all identical. The solids were washed with cold chloroform, which removed some of the colouring matter (melting at 125–145° C.), the residual solid then melting with decomposition at 156–159° C. This substance turned orange-yellow when heated on the water-bath, and in trying to purify it by crystallization from hot solvents the colour became much more intense, and the melting-point, which rose considerably, became much less sharp. After several attempts to purify a portion of it by crystallization from alcohol, chloroform, and glacial acetic acid we finally obtained the cinnabar red 2:10-*dinitro-diphenylamine*, melting at 219° C. of O. N. Witt (Ber. d. dtsh. chem. Ges. xi (1878), p. 758), with a smaller amount of a lighter-coloured, lower-melting (175–205° C.), impure substance.

It was evident, therefore, that we were dealing with a very unstable nitro-nitroso derivative, and we found in fact that when 0.9 gram of the substance was dissolved in 30 c.cs. of boiling xylene, and heated under a reflux condenser for two hours, it split off oxides of nitrogen, which appeared as brown fumes in the reflux condenser, and turned iodized starch paper blue. The dark-red xylene solution was distilled, and the residue, which consisted almost entirely of 2:10-*dinitro-diphenylamine*, after recrystallization from glacial acetic acid melted at 219° C.

The nearly white parent substance was, therefore, 2:10 *dinitrodiphenylnitrosamine*.

It gave on analysis the following results:—

0.1896 gram substance gave 32 c.cs. of nitrogen
at 19° C. and 766 m.m.p.
corresponding to N 19.56.
C₁₂H₈N₄O₅ requires N 19.4.

2:10 *dinitrodiphenylnitrosamine* consists of nearly colourless crystals which are sparingly soluble in cold organic solvents, and are coloured dark orange in contact with concentrated sulphuric acid.

C.—*Action of Nitric Acid on 4-Nitro-Diphenylnitrosamine.*

Four grams of 4-nitro-diphenylnitrosamine were dissolved in a cold mixture of 6 c.cs. (6 *mols.*) of nitric acid (sp. gr. 1.43) and 200 c.cs. of glacial acetic acid. The solution was let remain in a stoppered flask at the temperature of the laboratory for two weeks. After twenty-four hours a yellowish-white solid began to separate, and the colour of the solution, which was at first orange-yellow, gradually changed to yellow.

The solid which separated was filtered, washed with acetic acid, water, and alcohol, and dried in the air. It melted with decomposition, at 155-159° C. and a mixture of it with 2:10-dinitro-diphenylnitrosamine melted about 148° C. It gave on analysis the following results:—

0.212 gram substance gave 35 c.cs. nitrogen
at 17° C. and 762 m.m.p.
corresponding to N 19.2.
C₁₂H₈N₄O₅ requires N 19.4.

The substance was, therefore, a dinitro-diphenylnitrosamine, and the melting-point of a mixture of it with 2:4-dinitro-diphenylnitrosamine (melting-point 148-151° C.) melted about 149° C. Since it is not identical with 2:10- or 2:4-dinitro-diphenylnitrosamine, it is probably 4:10-*dinitro-diphenylnitrosamine*.

When it was boiled with xylene under a reflux condenser for two hours brown fumes were evolved, and from the solution a very small quantity of 2:4:8:10-tetranitro-*diphenylamine*, melting at 199-200° C., separated, and a portion somewhat soluble in carbon tetrachloride, which melted from 205-210° C., and was probably 4:10-*dinitro-diphenylamine*. The 2:4:8:10-tetranitro-diphenylamine is probably present as an impurity in the original substance, since in a later experiment at a higher mean temperature the chief compound which separated from the solution was 2:4:8:10-*tetranitro-diphenylamine*.

The yellow solid which was precipitated from the above-mentioned acetic acid solution was filtered, dried, and washed with chloroform and alcohol. The residue, after recrystallization from xylene, washing with hot carbon tetrachloride and cold acetone, was found to be 2:4:8:10-tetranitro-diphenylamine. The chloroform-soluble portion liquid on evaporation gave a light-yellow, oily solid, from which no pure substance was isolated.

In conclusion, we wish to express our thanks to Nobel's Explosives Company for a grant in aid of this investigation, and to Mr. Rintoul, the manager of the Research Section of that company, at whose suggestion the investigation was undertaken.

XI.

ON THE ATTACHMENT ORGANS OF SOME COMMON
PARMELIAE.

BY LILIAN PORTER, M.Sc.

PLATES XXI-XXIII.

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I.—INTRODUCTION.

AMONG foliaceous lichens the genus *Parmelia* is characterized by a simple type of anatomical structure which persists in species differing widely in general habit, colour, segmentation, and habitat. The upper cortex consists of a distinct layer of branched, septate hyphae, running at right angles to the surface; below this is a gonidial layer with *Protococcus* gonidia and a medullary layer of loosely woven hyphae, running more or less parallel to the surface.

The under cortex as a rule resembles the upper. Reinke¹ states that the upper, as the under, side is covered by a thickly woven horny cortex; but it will be seen later that exceptions to this generalization occur. Zahlbrückner's² statement that the under cortex is usually dark-coloured, applies without restriction to all species which are dorsiventral in habit.

The variations in colour and in distribution of rhizines and papillae exhibited by the under-surface are valuable aids to identification of species, and have been well described by Lindau.³

The following studies deal with these variations microscopically and in greater detail than was necessary for the pioneer work of the same author⁴ on the subject of attachment organs of lichens. The methods used are those described previously for a similar study of the Ramalinae,⁵ and the materials

¹ Reinke, J. Abhandlungen über Flechten IV. Pringsheim's Jahrbücher f. w. Botanik 28, 1895, p. 385.

² Zahlbrückner, A. "Flechten" in Engler und Prantl's Natürlichen Pflanzenfamilien Teil I*. B Specieller Teil, 1907, p. 211.

³ Lindau, G. Die Flechten. Berlin, 1913, p. 184 et seq.

⁴ Lindau, G. Lichenologische Untersuchungen I, Über Wachstum und Anheftungsweise der Rindenflechten. Dresden, 1895.

⁵ Porter, L. On the attachment organs of the common corticolous Ramalinae. Proc. Roy. Irish Acad., xxxiv, B, 2, 1917.

have been gathered chiefly in Ireland, and especially in the neighbourhood of Cork, where the moist, smoke-free atmosphere favours the luxuriant growth of these and other corticolous lichens.

The author is indebted to Miss M. C. Knowles of the National Museum, Dublin, for identification and confirmation of the specimens used.

II.—SELECTION OF SPECIES.

The numerous species of *Parmelia* are grouped by Zahlbrückner into the sub-genera *Hypogymnia*, *Mesoparmelia*, and *Eoparmelia*. Of these the two former possess no distinct rhizines, their under-surfaces being described as naked. It is evident, however, that attachment must be brought about by some means, and that, considering the presence of some of these forms on the uppermost branches of trees in windy places, this attachment must be very close. The method will be illustrated by the species *P. Physodes*.

Of the sub-genus *Eoparmelia*, those sections which bear numerous true rhizines may be divided according as the rhizines reach the edge either in their normal form or in a rudimentary, papillose condition, or are confined to the middle being absent at the edge or represented by cilia.

To the first class belong the sections *Xanthoparmelia* and *Hypotrachynia*. The former comprises the species having a yellowish colour in the upper surface, and will be represented by *P. conspersa*; the latter includes the white grey or brown members, and is illustrated by *P. sacatilis*, *P. Borreri*, *P. omphalodes*, and *P. olivacea*.

To the second class belongs the section *Asphigmonia*, including *P. caperata* (yellowish), and *P. perlata* (grey).

III.—DESCRIPTION OF ATTACHMENT ORGANS.

1. *Parmelia physodes* (L.).

This species, as stated above, has no true rhizines. The further diagnostic character assigned by Linker—that of the separation of the lower cortex from the medulla leaving an empty space—is restricted to older specimens and to the portions of these which are not in contact with substrata to which adherence is possible. Younger thalli or thalline lobes, especially if in contact with a suitable surface such as wood bark or moss, show a lower cortex either less definitely developed than the upper or even entirely absent.

The hyaline or the medulla turn from their normal horizontal direction and grow downwards into the substratum in the manner described for the

lower layers of epiphloeodic, crustaceous lichens Lindau.¹ The development of a definite cortex is probably dependent on external conditions. Thus, if the thallus is growing on a surface to which immediate and intimate adherence is possible, there is no definite cortex, but the hyphae of the medullary, or even the gonidial, layer turn downward, effecting an attachment which is exceedingly difficult to destroy. On the other hand, if the thallus cannot effect such adherence, a definite cortex is developed from which numerous single hyphae grow later.

Where a thalline lobe bends upwards or outwards from the substratum, the lowest layers of medullary hyphae resume their normal direction, and form a tissue of interwoven threads running parallel to the lower surface. These horizontal hyphae appear to the naked eye to be of a lighter colour than the more nearly vertical ones, owing to the more limited accumulation of detritus for which their youth and arrangement are responsible.

Fig. 1 shows the general structure of the thallus after carefully removing the moss on which it grew.

Fig. 2 shows the same more highly magnified, and is taken from a portion in which the gonidial and medullary tissues are not clearly delimited. An interesting feature of this is the pyramidal arrangement of gonidia which occurs more or less clearly in many lichens, recalling the shape of palisade cells in some higher plants and the distribution of chlorophyll corpuscles in those cells.

Fig. 3 represents the details of a rhizoidal layer developed from a definite cortical layer, showing that occasionally branching takes place and suggesting a comparison with the branched, anastomosing hyphae of *Anzia colpodes* as described and figured by Reinke.²

2. *Parmelia conspersa* (Ehrh.).

This species has a brown under-surface, the rhizines being dotted all over and reaching almost to the edge. The thallus is pressed very closely to the substratum, and in consequence the rhizines are less well developed than in the next species *P. saxatilis*, under which heading they will be more fully described. In *P. conspersa* they appear as short, peg-like outgrowths of the dark-coloured lower cortex.

The cortex is comparatively thin, but has the power of forming bridges or connecting masses of tissue of a dark colour and dotted appearance. This

¹ Lindau, G. Lichenologische Untersuchungen I. Über Wachstum und Anheftungsweise der Rindenflechten. Dresden, 1895.

² Reinke, *loc. cit.*, p. 402.

phenomenon occurs in other species where one thallus lobe is closely pressed to the surface of another or has not become completely separated from the parent lobe.

In fig. 4, a section of *P. conspersa isidata*, the gonidial layer is still evident below the covering lobe, showing that the upper lobe was in process of growing out along the surface of the lower one, rather than that the lower one represents the younger growth.

It is these connecting masses of tissue which unite the thallus into the compact growth which is one of its characteristics. The under-surface is not only papillose but also corrugated, even when moist, the ridges being outgrowths of the lower cortex with a core of medullary tissue.

3. *Farmelia saxatilis* (L.).

The black under-surface has rhizines reaching to the edge. To the naked eye the lower cortex presents an almost smooth surface, but on examination it is found to be rugged or even papillose. If stripped from the thallus, it has a dotted appearance and a brown colour. In transverse section it is seen to consist of a matted felt of short hyphal endings at right angles to the surface, the transition from the medullary tissue with its horizontally directed hyphae being very sharp.

The rhizines are very numerous and well developed, and are clearly composed of more or less branched strands of hyphae which run together from the lower cortical and medullary tissues, forming in the young state a papilla which grows in length and thickness till it reaches the substratum. Here it expands, the apical hyphae spreading more or less radially to form an outgrowth which, when torn from its support appears as a cup or disc (fig. 5). These outgrowths continue until a complete layer is formed covering the substratum. This layer would presumably be included among the hypothalline structures of Zukal (Zahlbrückner)¹ and is welded together by lichen detritus and excreta, dead gonidia, disorganized cork-cells, and all the usual components of such layers.

In fig. 6 the effect of rhizines on the bark of alder is shown. The apical hyphae of several rhizines have united to form not only a hypothalline layer, but also an eroding, lateral mass from which mycelial strands run in all directions.

In fig. 7 a single rhizine is shown having covered and filled up an interspace in the bark of larch.

Fig. 8 shows the normal action of the rhizines in forming a hypothalline

¹ Zahlbrückner, *loc. cit.*, p. 8.

layer from which slender mycelial strands branch among the bark cells, breaking up the tissue by their wedge-like action, and hastening the decomposition of the individual cells.

The lower cortex and rhizines are exemplified in fig. 9, representing a strip removed from the under-surface and flattened beneath a cover glass.

In figs. 10 and 11 the detailed structure of the rhizines is shown, the former illustrating also the structure of the lower cortex, the latter one mode of branching of the rhizines. In fig. 9, the more usual antler-like method is seen.

4. *Parmelia Borreri* Turn.

The brown under-surface becomes paler towards the edge, which is reached by papillae, but not by fully developed rhizines (fig. 12). Corrugations occur as in the last species, and the rhizines are similar in structure, but of a paler colour. They consist of fewer hyphae which run together from a broader base, as a rule. The core of medullary hyphae is more loosely woven than in *P. saxatilis*; it is well seen in the younger stages of the rhizines, or as a light-coloured mass more or less filling the dark-edged hypothalline cup.

5. *Parmelia omphalodes* (L.).

This species has a bronze or dark-brown upper-surface, and was formerly regarded as a sub-species of *P. saxatilis*. Its under-surface resembles that of this species, but the marginal rhizines are, as a rule, more prominent, even giving a ciliated appearance to the thallus lobes (fig. 13).

The general structure of the thallus (fig. 14) is seen to differ from that figured for *P. saxatilis*; but as Reinke¹ has remarked concerning the constant anatomical structure of the genus, this variation is a question merely of the relative and absolute depth of the individual layers. Thus, *P. omphalodes* has a comparatively greater development of the cortical layers which is associated with its darker colour and its more exposed habitat. Bitter² has commented on the darkening of exposed thalli and the variations in colour in the same species exposed to different intensities of illumination. This species occurs chiefly on exposed rocks in mountainous districts, whereas *P. saxatilis* prefers more shaded rocks or trees and reaches its best development at lower levels.

¹ Reinke, *loc. cit.*, p. 385.

² Bitter, G. Über die Variabilität einiger Laubflechten und über den Einfluss äusserer Bedingungen auf ihr Wachstum. Pringsheim's Jahrbücher f. w. Bot. 36, 1901, p. 464.

6. *Parmelia olivacea* (L.).

The olive-green of the upper-surface is due to the absence of a definite cortical layer. The gonidial layer is an irregular one, but contains large numbers of gonidia reaching to the upper-surface: here and there they also extend almost to the lower. The lower-surface is blackish and thickly covered with rhizines towards the centre: it is paler, shining, and without rhizines towards the edge. The corrugations of the lower surface frequently appear in section as angular out-growths, the whole being covered by a thin but definite and very darkly coloured cortex. The rhizines are stout and well developed, with a central core of medullary tissue.

The species represented in fig. 15 is *P. evasperata*, regarded formerly as a papillate variety of *P. olivacea*, now accorded specific rank, but agreeing essentially in structure with the typical specimens of the parent species.

7. *Parmelia caperata* (L.).

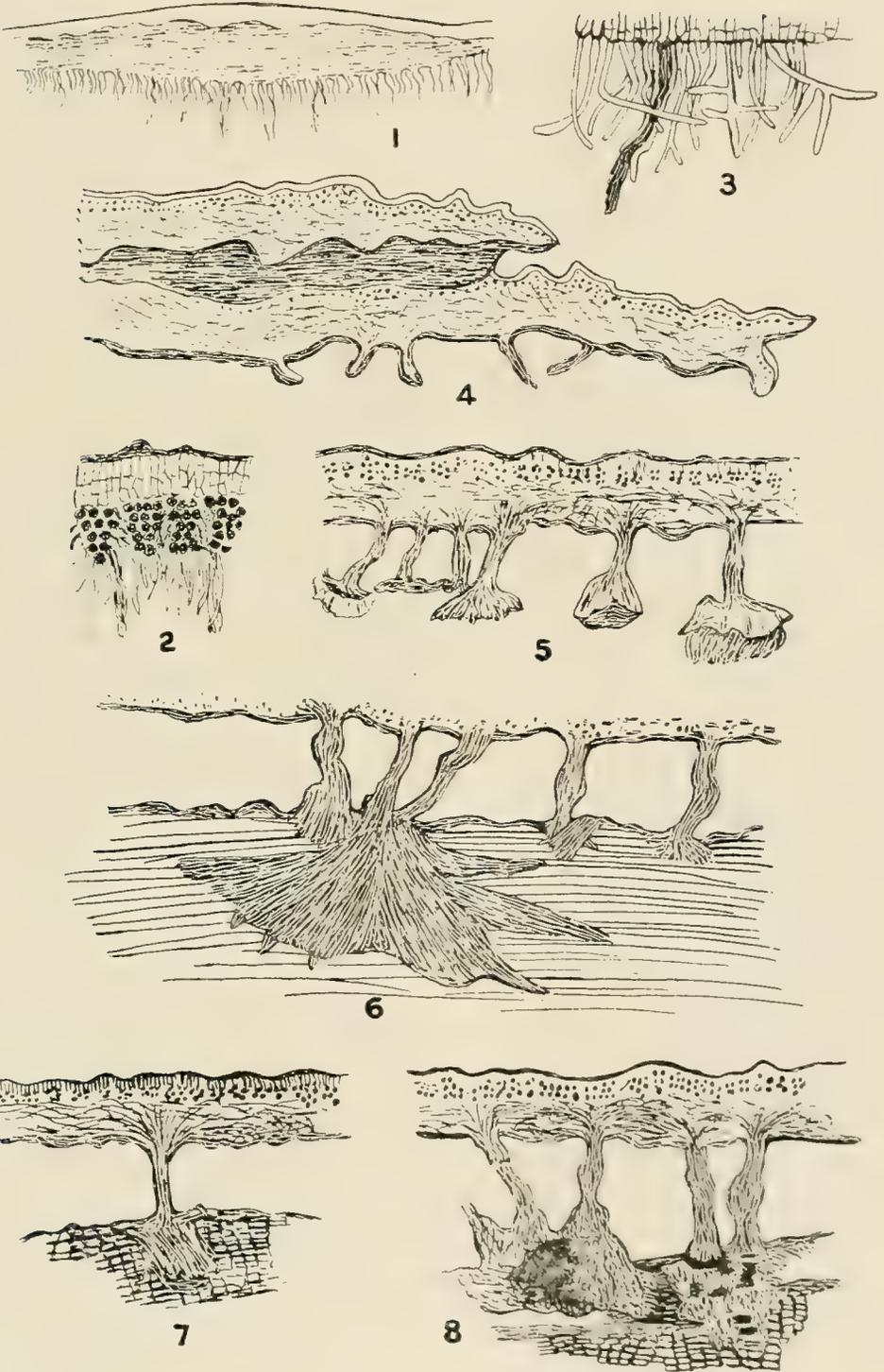
The pale-greenish upper-surface with its broad lobes is easily distinguished. The under-surface is black, becoming a shining light brown towards the edge. Rhizines do not reach the edge, but are large and numerous in the centre (fig. 16).

Fig. 17 shows an extreme case of fusion of the thalline lobes. At (a) the edge of a lobe is overshadowed by a neighbouring lobe and has on its morphologically upper surface a black cortex continuous with its lower cortex. At (b) a lobe is completely surrounded by a black cortical layer. The broad masses of black tissue are lower cortices of connecting lobes, and not connecting masses such as occur between (b) and (c).

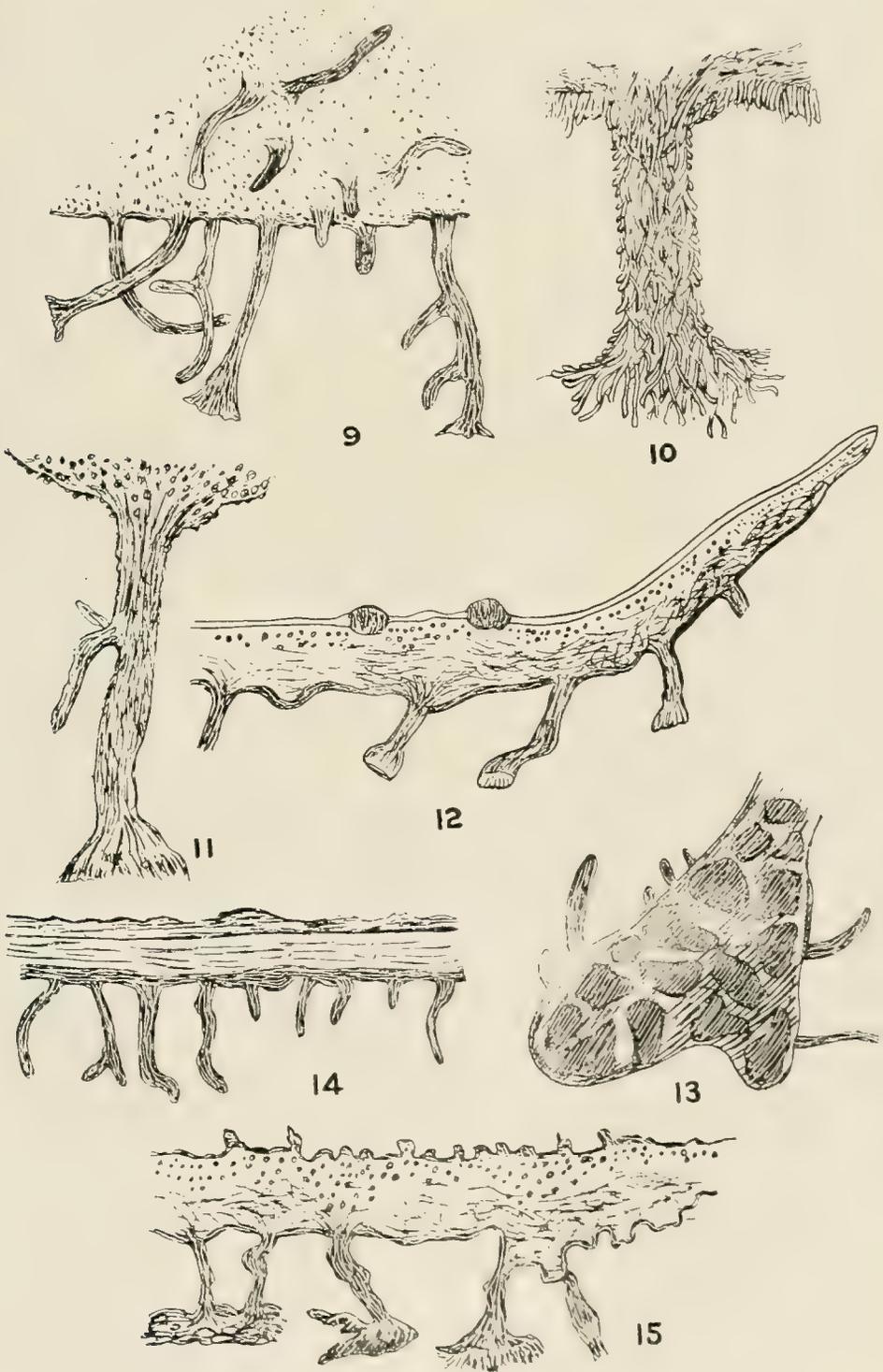
8. *Parmelia perlata* (L.).

The upper-surface is light grey or bluish white, and, both cortices being very strongly developed, affords a striking contrast to the black under-surface (fig. 18). The latter becomes pale brown towards the edge. The rhizines are comparatively few, not reaching the edge, but well developed and black. In central portions of the thallus which are not adherent to the substratum, papillae are present in large numbers and present an irregular surface, becoming smooth in the young rhizine state (fig. 19). Further, they arise from a broad-spreading base, whereas the rhizines are frequently without a definite basal expansion or thalline cup. The hypothalline cup or disc is, on the other hand, well developed, as in fig. 20.

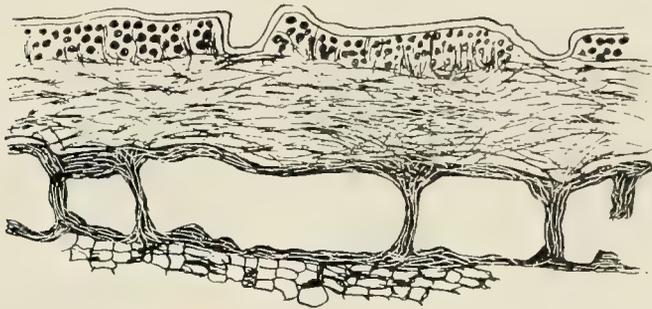
These considerations suggest that the papillae are abortive rhizines which,



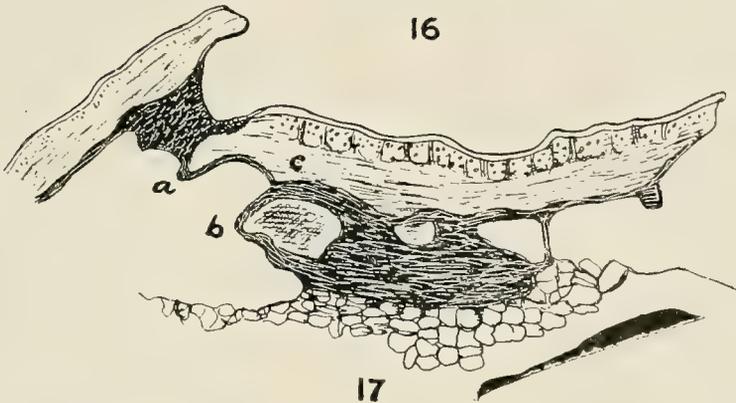
PORTER.—ATTACHMENT ORGANS OF PARMELIAE.



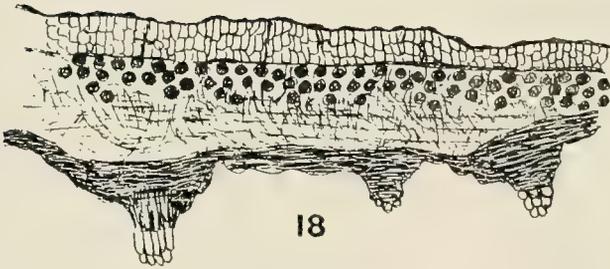
PORTER.—ATTACHMENT ORGANS OF PARMELIAE.



16



17



18



19



20

lacking the stimulus of the presence of a suitable substratum, have become basally thickened and rugose, but have not developed apically. Whether this stimulus is tactical, chemical, or physical, would be hard to decide.

CONCLUSION.

The attachment organs of the *Parmeliæ* are, as a rule, rhizines, *i.e.*, strands of hyphæ, usually of a dark colour, holding the thallus more or less closely appressed to the substratum. The hyphæ are derived from the tissues of the medulla and lower cortex; they penetrate and disintegrate bark or even the wood of posts, and by the radial expansion of their apices they may form a continuous layer on the surface of the substratum. Species which have no rhizines are attached by the action of individual hyphæ.

XII.

ON THE ACTION OF NITRIC ACID AND NITROUS ACID ON
DIPHENYLAMINE II.BY PROFESSOR HUGH RYAN, D.SC., AND MISS PHYLLIS RYAN, M.SC.,
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Read NOVEMBER 30, 1918. Published FEBRUARY 13, 1919.

IN our first communication [Proc. Royal Irish Acad., XXXIV, B, p. 194] the results of experiments on the action of nitric acid on diphenylamine and diphenylnitrosamine in acetic acid solution were described. With a view to maintaining as fully as possible the conditions which obtain when the decomposition products of a nitrocellulose powder interact with diphenylamine during the storage of a powder stabilised with this base, we allowed the reactions to progress for long periods at low temperatures and low concentrations of the interacting bodies.

It was found that when a 2 per cent. solution of diphenylamine in glacial acetic acid was mixed with an equivalent amount of nitric acid the solution gradually became green in colour without separation of any solid. The diphenylamine was recovered almost quantitatively from this solution even when the solution had been allowed to remain for six weeks at the room temperature. When the quantity of nitric acid added corresponded to two, three, four, or six equivalent amounts of the acid a brownish-red, resinous oxidation product of diphenylamine slowly separated, and in the case of the solutions in which the larger amounts of nitric acid had been added the acetic acid usually contained 2,4,8,10-tetra-nitro-diphenylamine. In some cases 4,10-dinitro-*o*-phenylnitro, and in one case a small amount of a dinitro-diphenylnitrosamine, consisting mainly of 2,10-dinitro-diphenylnitrosamine, were isolated. Other products were obtained in small quantity which we were unable to isolate in a pure state.

In the experiments with diphenylnitrosamine, which were conducted under similar conditions, we obtained in relatively large amount a mixture of 2,10- and 4,10-dinitro-diphenylnitrosamines, consisting mainly of the former nitrosamine. We also isolated 4-nitro-diphenylnitrosamine, 4,10-dinitro-diphenylamine, and 2,4,8,10-tetra-nitro-diphenylamine. There were indications

of the presence of other nitro-diphenylamines in some of the fractions which we were unable to resolve into their components.

The colour changes during the nitrations were from colourless to green or to brownish-red in the case of amine, and to orange-yellow or light yellow in the case of the nitrosamine.

Owing to the ease with which the nitroso group may be split off from nitro-diphenylnitrosamines, we deemed it advisable to examine the behaviour of nitric acid towards diphenylamine and diphenylnitrosamine in an inert solvent such as carbon tetrachloride.

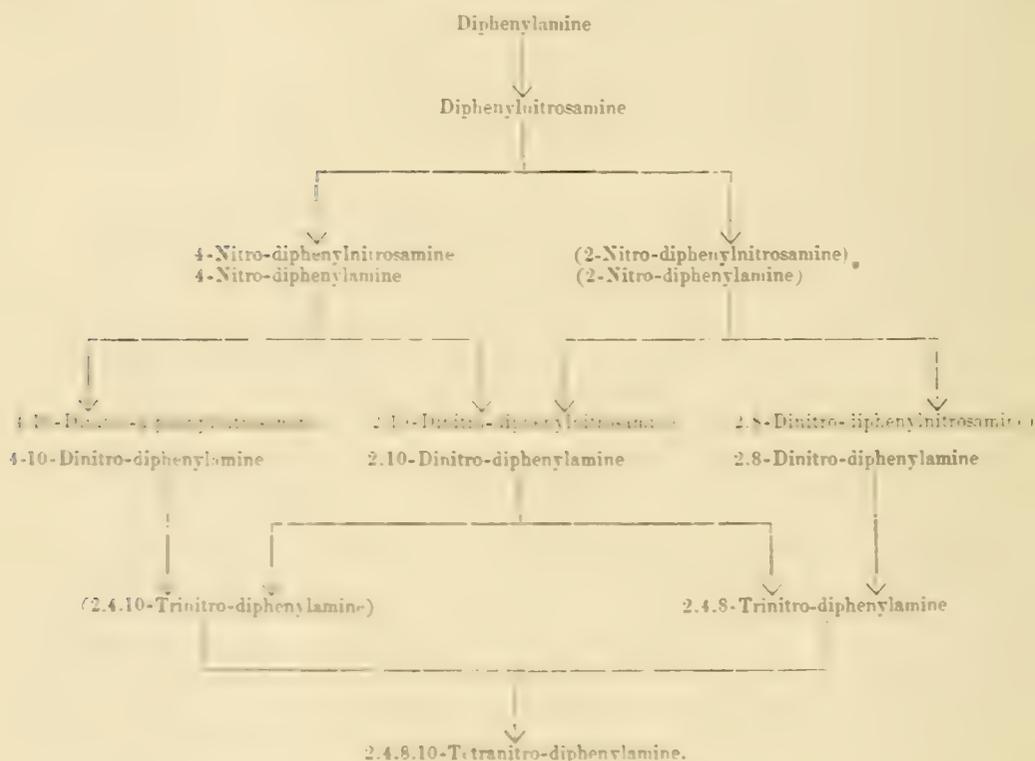
The latter solvent is, however, in some respects not so suitable a medium for nitrations as glacial acetic acid. When the nitric acid (sp. g. 1.5) was added to the carbon tetrachloride solution of the amine or its nitrosamine two layers formed, and the relative concentrations of the interacting substances were, of course, different in the two layers, and in neither layer did it correspond to the relative concentration of the interacting substance for the system as a whole.

Hence, although in acetic acid solution equi-molecular quantities of nitric acid and diphenylnitrosamine formed only mononitro-diphenylnitrosamines, in addition to these substances, both dinitro-diphenylamine and mononitro-diphenylamine were obtained in carbon tetrachloride solution.

Differences in the solubilities of the lower nitro and nitro-nitroso derivatives in the two solvents, together with the decomposing action exercised by the acetic acid on the dissolved nitro-nitroso compounds, affected the results, but, generally speaking, the nitrations followed similar courses in the two solvents.

In the experiments, described below, on the action of nitric acid on diphenylamine in carbon tetrachloride solution we obtained, in addition to the resinous oxidation product referred to in our previous communication, diphenylnitrosamine, 2.8- and 2.10-dinitro-diphenylamine, and somewhat impure 2.10-dinitro-diphenylnitrosamine. From the corresponding experiments with diphenylnitrosamine we got 4-nitro-diphenylnitrosamine, 4-nitro-diphenylamine, 2.8-, 2.10-, and 4.10-dinitro-diphenylamine, somewhat impure 2.10-dinitro-diphenylnitrosamine, 2.4.8-trinitro-diphenylamine, and 2.4.8.10-tetranitro-diphenylamine.

Combining the results of the nitrations in the two different solvents, the course of the reaction between nitric acid, nitrous acid, and diphenylamine at the ordinary temperature and at low concentrations of the interacting substances may be represented by the following scheme:—



The compounds the names of which are enclosed in brackets, although probably present in some of the fractions, were not isolated by us.

EXPERIMENTAL.

Action of Nitric Acid on Solutions of Diphenylamine in Carbon Tetrachloride.

Two per cent. solutions of diphenylamine in carbon tetrachloride were placed in five flasks, and to these were added quantities of concentrated nitric acid (sp. g. 1.5) corresponding to 1, 2, 3, 4 and 6 molecular amounts of the acid respectively. The solutions were allowed to remain in the stoppered flasks at the room temperature for periods varying in length from two to six months, and were then examined separately in a manner similar to that described in our first communication.

1. The colour of the solution to which 1 *molecular amount* of nitric acid had been added, was at first light-green, and gradually changed to dark-brown, with separation from the solution of a dark-coloured tarry solid.

On evaporation of the solvent from the dark-brown carbon tetrachloride

solution a mixture of 2.10-*dinitro-diphenylamine* with some oily matter was obtained. When this mixture was treated with a small quantity of ether the oily matter dissolved, and its solution was then filtered from the dinitro-diphenylamine. By means of diluted alcohol *diphenylnitrosamine*, melting at 65–66°C., was separated with some difficulty from the oil which was recovered by evaporation of the ether.

2. The behaviour of the solution to which 2 *molecular amounts* of nitric acid had been added was similar to that of the last. From the brown carbon tetrachloride layer some 2.10-*dinitro-diphenylamine* was again obtained. Small amounts of impurities in it were not isolated.

3. The final colour of the carbon tetrachloride solution to which 3 *molecular amounts* of nitric acid had been added was light-yellow.

The dark-coloured, oily solid, which was filtered off, was insoluble in the ordinary solvents, and did not melt completely below 260°C.

When the carbon tetrachloride filtrate was concentrated a yellowish solid separated. On boiling this solid with ligroin a portion dissolved, leaving red crystalline 2.10-*dinitro-diphenylamine* melting at 217–219°C.

The solid, which separated when the ligroin filtrate was cooled, was filtered and recrystallized from carbon tetrachloride. It consisted of golden-yellow leaves, which melted at 162–165°C., and was probably slightly impure 2.8-*dinitro-diphenylamine*.

4. The behaviour of the solution to which 4 *molecular amounts* of nitric acid had been added was similar to that of the last.

The solid which separated was, however, a mixture of a brownish and a light-yellow coloured solid. By washing it with chloroform and ether and evaporating the mixed washings, some 2.10-*dinitro-diphenylamine* (probably formed by the decomposition of the corresponding nitrosamine) was obtained.

The carbon tetrachloride contained a small amount of *dinitro-diphenylnitrosamines* melting at 150–154°C.

5. When the quantity of nitric acid was increased to 6 *molecular amounts* the separated solid consisted mainly of a relatively low-melting unstable compound (probably a mixture of dinitro-diphenylnitrosamines with the insoluble high-melting body), and from the carbon tetrachloride a small quantity of *dinitro-diphenylnitrosamines* melting at 150–155°C. was obtained.

Action of Nitric Acid on Solutions of Diphenylnitrosamine in Carbon Tetrachloride.

The action of nitric acid on solutions of diphenylnitrosamine in carbon tetrachloride was examined under conditions similar to those described above

(A₁ to A), the reactions being, however, allowed to progress for shorter periods (ten days to five weeks).

1. The flask to which 1 *molecular amount* of nitric acid had been added contained at the end of ten days a mixture of an orange and yellow solid: the carbon tetrachloride solution had an orange-yellow colour.

From the solid, 2,10-*dinitro diphenylamine* (possibly formed by decomposition of its unstable nitroso derivative) was separated by recrystallisation from chloroform and alcohol.

When the carbon tetrachloride filtrate was distilled a mixture of a yellow and a reddish solid remained in the flask. The red solid was separated from the yellow one by boiling with ligroin in which it was nearly insoluble. It consisted of 2,10-*diaceto-diphenylamine*. The yellow solid was recovered from the ligroin and dissolved in hot alcohol, from which it separated in the form of pale-yellow crystals which melted at 131.5–132.5 C. It gave a deep violet colouration with concentrated sulphuric acid, and consisted of 4-*nitro-diphenylnitrosamine*.

By concentrating the alcoholic filtrate from the latter substance a small amount of somewhat impure 4-*nitro diphenylamine* was obtained, the occurrence of which was probably due to decomposition of its nitroso derivative during the operations by which the nitroso compound was purified.

2. In the flask to which 2-*molecular amounts* of nitric acid had been added a solid separated which, when washed with alcohol and chloroform, was light-yellow in colour, melted between 150 and 155 C., and was a mixture of *dinitro-diphenylnitrosamines* consisting mainly of 2,10-*dinitro-diphenylnitrosamine*. The orange-red solid which separated from the alcohol-chloroform washings was filtered and recrystallised from glacial acetic acid. In this way 2,10-*dinitro diphenylamine* was obtained.

On further concentrating the parent liquids, light yellow-coloured crystals, melting at 214 C., separated. These crystals gave a violet colouration with alcoholic potash, and consisted of 4,10-*dinitro-diphenylamine*.

The carbon tetrachloride filtrate was evaporated, and the golden-yellow crystals, which remained, were recrystallised from ligroin. They melted at 162–165 C., were identical with those described in A 3, and consisted of slightly impure 2,8-*dinitro-diphenylamine*. The solid which had remained undissolved by the ligroin was found to be 4-*nitro-diphenylnitrosamine*.

3. From the solution to which 3-*molecular amounts* of nitric acid had been added we obtained, as in the last experiment, a solid consisting of a mixture of *diaceto-diphenylnitrosamines*, and from the carbon tetrachloride filtrate we isolated 2,10- and 4,10-*dinitro-diphenylamines*.

4. In addition to the dinitro-diphenylnitrosamines which had separated during the reaction, the flask to which 4-molecular amounts of nitric acid had been added contained 2,4,8-trinitro-diphenylamine dissolved in the carbon tetrachloride.

5. The solid which separated in the flask to which 6-molecular amounts of nitric acid had been added, again consisted of a mixture of dinitro-diphenylnitrosamines, and the carbon tetrachloride solution contained 2,4,8-trinitro-diphenylamine (M. P. 183–184°C.), and 2,4,8,10-tetranitro-diphenylamine.

In conclusion, we beg to thank Nobel's Explosives Company for the materials employed in this investigation, and Mr. Rintoul, the Manager of the Research Section of that Company, at whose suggestion the investigation was undertaken.

We are also indebted to the Advisory Council for Scientific and Industrial Research for a grant which enabled us to carry out the work.

XIII.

ON THE ACTION OF BROMINE ON SOME DERIVATIVES OF
DIPHENYLAMINE.

By HUGH RYAN, D.Sc., AND WILLIAM O'RIORDAN, M.Sc.,
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Read NOVEMBER 11, 1918. Published FEBRUARY, 13, 1919.

WHEN diphenylamine is employed as a stabiliser it is gradually changed, by the action of the decomposition products of the powder, into nitro derivatives which cease to desorb nitrous gases and, hence, do not act as stabilising agents. It is important, therefore, to have a reliable method for estimating the amount of diphenylamine remaining unaltered at any time during the life of the powder. Further, diphenyl nitrosamine, which is probably the first product formed by the action of the nitrous gases on diphenylamine, is itself almost as efficient a stabiliser as diphenylamine, so that a means of ascertaining the amount of this product would also be of much importance.

M. Buisson in "Le Problème de Poudres" describes a volumetric method, due to M. Berger of the Commission des Poudres de Versailles, for the estimation of the total amount of diphenylamine, no matter whether it be present in a powder in the free state or as its nitroso derivative. The method depends on the fact that diphenylamine, when acted upon by bromine, is converted into tetralinone-diphenylamine. A weighed quantity of the powder (containing diphenylamine, diphenylnitrosamine and nitro derivatives of diphenylamine) is boiled with a dilute solution of sodium hydroxide in a flask fitted with a condenser. Under the action of the alkali and the decomposition products of the powder the diphenylnitrosamine is converted, according to M. Berger into diphenylamine and, as the latter is volatile with steam, the distillate contains all the diphenylamine contained in the powder as free diphenylamine and diphenylnitrosamine. The nitro derivatives of diphenylamine, it is stated, are not converted during this process into diphenylamine. The diphenylamine in the distillate is then estimated by converting it into its tetralinone derivative by adding excess of a standard solution of bromine and estimating the excess of bromine volumetrically.

Experiments carried out at the Aulsebrook factory of Nobel's Explosives Company failed to confirm the statement that the diphenylnitrosamine in the process described is converted into diphenylamine, and in this connexion

experiments were carried out there on the bromination of diphenylnitrosamine. These experiments went to show that the product of bromination of diphenylnitrosamine is tetrabromo-diphenylamine with a small quantity of some yellow-coloured product.

Preliminary experiments of ours on the action of bromine on diphenylnitrosamine showed that in addition to tetrabromo-diphenylamine and this yellow substance another white product melting about 220° C. was obtained under certain conditions. We then undertook the qualitative examination of the action of bromine on diphenylnitrosamine with the following results:—

(a) It was found that the prolonged action of bromine on diphenylnitrosamine in chloroform solution, and in the presence of sunlight, yielded as main product hexabromo-diphenylamine.

(b) The same product was obtained by the prolonged action of bromine in sunlight on tetrabromo-diphenylamine.

(c) The first product isolated in the action of bromine on diphenylnitrosamine was found to be tetrabromo-diphenylamine, together with a small quantity of some yellow substance.

The remainder of this investigation is concerned with the action of bromine on some of the nitro derivatives of diphenylamine and diphenylnitrosamine. It was thought that it would be of interest to ascertain what substances would be formed by the action of bromine on these nitro compounds, in view, especially, of the fact that preliminary experiments of ours showed that some of those nitro compounds were, to an appreciable extent, volatile with steam, and would consequently be present in the diphenylamine distillate obtained by the method of Berger already described.

The nitro derivatives examined by us were:—4-nitro-diphenylnitrosamine, 2, 4-dinitro-diphenylamine, 2, 10-dinitro-diphenylamine, 4, 10-dinitro-diphenylamine, 2, 10- and 4, 10-dinitro-diphenylnitrosamines, and 2, 4, 8, 10-tetranitro-diphenylamine. Of these, the three nitrosamines and the tetranitro-diphenylamine have been observed amongst the products of the interaction of diphenylamine with the oxyacids of nitrogen. All these substances, with the exception of the tetranitro compound, react with bromine in chloroform solution, and in each case the only product obtained was a dibromo derivative. The derivatives of diphenylnitrosamine on bromination split off the nitroso group and yield the same bromo compound as the corresponding nitro-diphenylamines, thus 2, 10-dinitro-diphenylnitrosamine, and 2, 10-dinitro-diphenylamine on bromination give the same bromo compound.

Although diphenylamine and diphenylnitrosamine in chloroform solution are readily converted by bromine at the ordinary temperature

into tetrabromo-, and even into hexabromo-diphenylamine, the mononitro- and dinitro-diphenylamines, examined by us, formed only dibromo derivatives; and the tetranitro-diphenylamine did not brominate at all, under the same conditions.

In connexion with a volumetric process such as that of Berger, or a gravimetric process like that of Dreger (*Ztschr. f. d. ges. Schiess. u. Sprengstoffwesen*, iv, 1909, p. 123), for the estimation of diphenylamine in a powder, which depends on the action of bromine on diphenylamine, we may point out that diphenylnitrosamine and 4-nitro-diphenylnitrosamine are volatile with steam; and that any of these which may have escaped interaction with the alkali will volatilise during the experiment, and will be present with diphenylamine in the distillate. The higher nitro derivatives are not appreciably volatile with steam. Also the temperature at which the bromination occurs, and the time allowed for the completion of the change will affect the estimation. A rise of temperature, due, for instance, to rapid addition of the bromine, or contact of the bromine solution with the product for a few hours, produces a mixture of tetrabromo- and hexabromo-diphenylamines. In cases such as these the estimation of the diphenylamine on the assumption that the only product formed is tetrabromo-diphenylamine must necessarily give inaccurate results.

EXPERIMENTAL.

I. *Action of Bromine on Diphenylnitrosamine.*

To a solution of 2 grams of diphenylnitrosamine in 5 c.c. of chloroform, a solution of 8 grams of bromine in 50 c.c. of chloroform was added in quantities of 5 c.c. at a time. At first nitrous fumes were evolved; and when about 70 per cent of the bromine solution had been added, a copious separation of a yellow solid was noticed. Towards the end of the reaction fumes of hydrobromic acid were evolved. The mixture was allowed to remain overnight, and in the morning it was placed in the sunlight for an hour. The chloroform and the excess of bromine were then removed by evaporation on the water-bath, and the residue, which consisted of a brownish solid with some oily matter, was crystallised from chloroform. The chloroform solution on cooling gave a white solid which, when purified by further crystallisation from chloroform, formed white, monoclinic plates (or flat prisms) melting at 22° C. The parent liquids from this substance yielded a yellow solid which crystallised in fine needles melting at 175° C.

By stopping off the bromination in the following manner a much larger amount of the white substance melting at 22° C. was obtained:—1 gram of diphenylnitrosamine dissolved in 15 c.c. of chloroform, was added rapidly,

in small quantities, to a solution of 4 grams of bromine in 25 c.c. of chloroform, with constant shaking. Fumes of hydrobromic acid were copiously evolved. The flask containing the mixture was then placed on a white surface in bright sunlight for about six hours. At first felted needles (probably tetrabromo-diphenylamine) separated; but these dissolved on standing, forming a clear solution. After allowing the solution to remain in the sunlight it was let stand overnight. In the morning white crystals had separated, and the solution on evaporation yielded a further quantity of this substance in a slightly impure condition; altogether 2.1 grams—a yield of approximately 70 per cent.—was obtained. It is soluble in benzene and chloroform, and slightly soluble in alcohol.

A determination of bromine in the compound by Stepanow's method gave the following result:—

0.2036 gram of the substance on treatment with sodium and alcohol gave an amount of sodium bromide which required 18.91 c.c. of N/10 silver nitrate for complete precipitation,

corresponding to Br 74.3
C₁₂H₄Br₆NH requires Br 74.6

The compound is, therefore, a hexabromo-diphenylamine; and it is probably identical with the hexabromo-diphenylamine (m. p. 218° C.) obtained by Gnehm (Ber. d. Dtsch. Chem. Ges. VIII, 1875, p. 926) by the bromination of diphenylamine in acetic acid solution.

The yellow substance melting about 175° C. was found, on recrystallisation a few times from chloroform, to melt at 186–187° C. The melting-point of tetrabromo-diphenylamine (188° C.) was not appreciably lowered by mixing some of this substance with the tetrabromo compound. The two substances are, therefore, identical; the yellow colour of the compound here mentioned being probably due to the presence of a small amount of some other substance which we did not, however, isolate.

This substance, which is slightly impure tetrabromo-diphenylamine, was almost the only product obtained when the bromination was carried out by adding the bromine solution as before, allowing the mixture to stand for half an hour in sunlight, and isolating the product by the method described above. In this way discoloured, flaky, acicular crystals were obtained which, after recrystallisation, were pale-yellow in colour, and melted at 187.5° C.

II. *Action of Bromine on Tetrabromo-Diphenylamine.*

Tetrabromo-diphenylamine was first prepared by addition of the theoretical quantity of bromine in chloroform solution to a chloroform solution of

diphenylamine in a manner similar to that described for the bromination of diphenylnitrosamine.

Two grams of bromine dissolved in 12.5 c.c. of chloroform were added slowly to a solution of 3 grams of tetrabromo-diphenylamine in 15 c.c. of chloroform. The mixture was then placed in bright sunlight for about six hours, hydrobromic acid being evolved, but not very copiously. After remaining overnight the solvent was evaporated, and the residue was washed with chloroform. The product consisted of white prismatic crystals, mixed with a small amount of an oily substance which was difficult to remove. The substance, which melted at 221.2° C., was evidently identical with the hexabromo diphenylamine obtained from diphenylnitrosamine.

III. *Action of Bromine on 4-Nitro-Diphenylnitrosamine.*

A solution of 5 grams of bromine in 25 c.c. of chloroform was added in small quantities to a solution of 1 gram of 4-nitro-diphenylnitrosamine in 10 c.c. of chloroform. When about half the bromine had been added, the evolution of nitrous fumes was noticed, and a thick yellow precipitate formed. The evolution of hydrobromic acid was not observed. The mixture was allowed to remain in sunlight for a quarter of an hour, after which, by evaporation of the chloroform and the excess of bromine, a yellow solid was got, which was purified by recrystallisation from chloroform. When heated it softened at 212° C., and melted at 216° C. It consists of fine bright yellow needles which are soluble in chloroform, alcohol, and benzene. A determination of bromine in the compound gave the following result:—

0.1549 gram of the substance on treatment with sodium and alcohol gave an amount of sodium bromide which on precipitation with silver nitrate yielded 0.1528 gram of silver bromide,

corresponding to Br 42.3
 $(C_{12}H_8Br_2NO_2)NH$ requires Br 27.2
 $C_{11}H_7Br_2NO_2$ NH requires Br 42.9
 $(C_{12}H_8Br_2NO_2)NH$ requires Br 53.1

The substance is, therefore, a dibromo-4-nitro-diphenylamine, which so far as we are aware has not been previously obtained.

In carrying out the analysis of this substance, as also in the analysis of the compound obtained in the following experiment, the ordinary method of estimating the bromide by adding excess of $N/10 AgNO_3$ and titrating the excess by means of a thiocyanate, could not be employed owing to the deep colour of the solution. The silver bromide precipitated from the acid solution was, therefore, weighed.

IV. *Action of Bromine on 2,4-Dinitro-Diphenylamine.*

Five grams of bromine in 20 c.c. of chloroform were added to a solution of 1 gram of 2,4-dinitro-diphenylamine in 20 c.c. of chloroform. Hydrobromic acid was freely evolved during the addition of the bromine. The mixture was placed in bright sunlight, and allowed to stand for six hours. Fumes of hydrobromic acid were evolved, and an orange solid separated. The mixture was allowed to remain overnight, the solid was then filtered, washed with alcohol and ether, and dried. It melted at 195.5° C. A further quantity of this substance was obtained from the parent liquid. The total weight of substance obtained was 1.6 grams, which corresponds to the formation of a dibromo-dinitro-diphenylamine. The body is orange in colour, and crystallises in rhombic prisms which are slightly soluble in alcohol and soluble in benzene and ether. A determination of bromine in the compound gave the following result:—

0.1916 gram of the substance on treatment with sodium and alcohol gave an amount of sodium bromide which, on precipitation with silver nitrate, yielded 0.1722 gram of silver bromide,

corresponding to Br 38.4

$C_{12}H_7Br(NO_2)_2NH$ requires Br 23.6

$C_{12}H_6Br_2(NO_2)_2NH$ requires Br 38.3

$C_{12}H_5Br_3(NO_2)_2NH$ requires Br 48.4

The substance is, therefore, a dibromo-2,4-dinitro-diphenylamine. Leymann (Ber. d. Dtsch. Chem. Ges. XV, 1882, p. 1236) obtained a substance melting at 196° C, by the bromination of dinitro-diphenylamine. It is not explicitly stated that the 2,4-dinitro compound was that used, but from the context it appears to have been so. In this case it is probably identical with our substance.

V. *Action of Bromine on 2,10-Dinitro-Diphenylamine.*

10 c.c. of a solution of bromine in chloroform (containing 40 grams of bromine in 100 c.c.) was added to 1 gram of 2,10-dinitro-diphenylamine in 20 c.c. of chloroform. The substance, which is only slightly soluble in chloroform, dissolved on adding the bromine solution. The mixture was allowed to remain in a bright place for two days, during which time hydrobromic acid was evolved, and a yellow solid separated. The solid was recrystallised a couple of times from chloroform. It consisted of yellow,

felted needles, which melted at $185-186^{\circ}\text{C}$., and were soluble in chloroform and alcohol. It gave on analysis the following results:—

0.1150 gram of the substance gave 0.1023 gram of silver bromide,

corresponding to Br 37.85.

$\text{C}_{12}\text{H}_7\text{Br}(\text{NO}_2)_2\text{NH}$ requires Br 23.6

$\text{C}_{12}\text{H}_6\text{Br}_2(\text{NO}_2)_2\text{NH}$ requires Br 38.3

$\text{C}_{12}\text{H}_5\text{Br}_3(\text{NO}_2)_2\text{NH}$ requires Br 48.4

Hence the substance is dibromo-2.10-dinitro-diphenylamine.

VI. *Action of Bromine on 4.10-Dinitro-Diphenylamine.*

0.1 gram of 4.10-dinitro-diphenylamine was brominated in a manner similar to that described for the 2.10-dinitro compound. On adding the bromine solution hydrobromic acid was evolved: and on standing a pale-yellow solid separated, which was purified by recrystallisation from chloroform. It consisted of minute, very pale yellow needles melting at 247°C .; and it was identical with the yellow substance obtained by the action of bromine on the corresponding nitrosamine (see VIII, below).

VII. *Action of Bromine on 2.10-Dinitro-Diphenylnitrosamine.*

In a previous communication by one of us and Miss P. Ryan two somewhat impure dinitro-diphenylnitrosamines were obtained from diphenylnitrosamine and 4-nitro-diphenylnitrosamine respectively. These preparations were employed in this and the following experiments.

One gram of crude 2.10-dinitro-diphenylnitrosamine was brominated in the manner already described. The bromination mixture was allowed to remain in a bright place for about ten days, during which time no evolution of hydrobromic acid was noticed. The chloroform solution was evaporated to dryness: and the yellow solid residue was recrystallised from chloroform and alcohol. It was found to consist of two substances, one a bright yellow compound melting at 185°C ., and identical with that described in V, above. The other had a pale yellow colour, melted about 240°C ., and was less soluble in chloroform and alcohol than the first; it proved to be identical with the substance melting at 247°C ., described in VI, above. An analysis of this substance gave the following result:—

0.1048 gram of the substance gave 0.0741 gram of silver bromide,

corresponding to Br 38.2

$\text{C}_{12}\text{H}_6\text{Br}_2(\text{NO}_2)_2\text{NH}$, requires Br 38.3

The substance was therefore dibromo-4.10-dinitro-diphenylamine.

Since the amount of the bromo derivative derived from the 4.10-dinitro compound was much smaller than the amount of that derived from the 2.10-dinitro compound, the original body, which melted at 155–159° C., consisted mainly of 2.10-dinitro-diphenylnitrosamine.

VIII. *Action of Bromine on 4.10-Dinitro-Diphenylnitrosamine.*

0.5 gram of the crude dinitro-diphenylnitrosamine was brominated in the manner described in experiment VII; and from the product of the bromination the same two substances were got as were obtained in the last experiment. As was to be expected, the dibromo derivative of 2.10-dinitro-diphenylamine was now formed in smaller quantity than before. It was not possible to form an accurate idea of the relative amounts of the two dibromo derivatives, but they were roughly about equal.

IX. *Action of Bromine on 2,4,8,10-Tetranitro-Diphenylamine.*

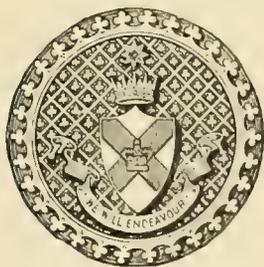
Attempts to brominate tetranitro-diphenylamine by the method used in previous experiments were all unsuccessful, the compound being in all cases recovered unchanged.

In conclusion, we wish to thank Nobel's Explosives Company for the materials employed in our experiments, and Mr. Rintoul, the Manager of the Research Section of that Company, at whose suggestion the investigation was undertaken.

PROCEEDINGS
OF THE
ROYAL IRISH ACADEMY

VOLUME XXXIV

SECTION C.—ARCHÆOLOGY, LINGUISTIC, AND
LITERATURE.



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ERRATA.

SECTION C.

- p. 59, l. 1. *For Doonakemna read Doonakenna.*
- p. 149, l. 24. *For Retaliation read Retaliator.*
- p. 164, l. 24. *For Donn read Dana.*
- p. 165, l. 11. . *For bride of Macconmara read bride daughter of Macconmara.*
- p. 165, l. 25. *For Nuada read Nuadat.*
- p. 168, l. 3. Delete (*d*).
- p. 179, note 4. *For N.W. read N.E.*
- p. 236, l. 10. *For Máirisend read Máirisen, and so throughout the paper.*
- p. 256, last line. *For ater tone read later atone.*
- p. 331, l. 1. *For Dionysoa, Zagreus read Dionysos Zagreus.*
- p. 350, l. 4 from bottom. *For "bull-roarer" an oar, read bull-roarer "an oar".*
- p. 360, l. 4 from bottom. *For so read as.*

PROCEEDINGS
OF
THE ROYAL IRISH ACADEMY
PAPERS READ BEFORE THE ACADEMY

I.

PLACE-NAMES AND ANTIQUITIES OF S. E. CORK.

By THE REV. PATRICK POWER.

Read DECEMBER 11, 1916; Published MAY 11, 1917.

PURPOSE and scope of the survey hereby initiated will bear, and may require, a few words of introductory explanation. This work is the outcome, in part, of a proposal made, and practically advocated, some time since, by the President of University College, Cork, for a full and systematic study of the archaeology of Cork county. In connexion with the study in question the present writer undertook—as his portion of the task—to collect the local names, and to note the antiquities of the south-eastern portion of the county. The region scheduled embraces the three baronies of Barrymore, Imokilly, and Kinnataloon, and was apparently, some of it at least, at one period, portion of the Decies.¹ At the Synod of Rathbreasail the western boundary of the Diocese of Lismore was fixed at Cork, whence we may infer that in the early twelfth century the Deisi had extended their territory in that direction.

The task involved in the proposed survey is by no means easy or light; it is heavier far than the casual reader dreams, and, in the ordinary course of things, it will take some years to accomplish it. It postulates a personal visit, not only to every townland of the wide area described, but, in nearly every case, to several parts of each townland; it requires the interviewing and cross-examination of hundreds of Irish speakers and other residents;

¹ Martyr. Gorman, p. 228; Martyr. Donegal, pp. xxxvii and 321; MacErlan, "Synod of Raith Breasail," p. 25, in *Archiv. Hibernicum*, vol. iii, &c.

it demands, finally measurements and critical examination of historic and pre-historic monuments, as well as much collation of ancient documents and authorities.

For convenience sake and facility of subsequent reference, the writer proposes to follow the system of treatment by parish and townland, first adopted by him nine or ten years since, in his "Place-Names of Decies." Baronies, parishes, and townlands will be taken alphabetically—parishes under their respective baronies, and townlands under their respective parishes. Under townlands will come townland sub-denominations, when there are any. In enumeration or record of sub-denominations some discrimination is necessary. There are thousands of sub-denominations not worthy of record, these are such frequently occurring names as "Big-Field," "Lass (or Forty Field)" &c. which may be regarded as merely generic or descriptive, and really common nouns or adjectives.

Our place-names naturally arrange themselves in strata, according to age, somewhat after the manner of geological deposits. Some of them are of the remotest antiquity; others are of the last generation; between the two extreme layers some three or four others are more or less clearly defined. The majority of territorial names are of great age, while most of the sub-denominations are comparatively recent. River, mountain, and territorial names seem the oldest of all. Nearest the surface, i.e. most recent, are, as a rule, names of fields, walls, and roads. A fair proportion of sub-denominations are however, undeniably old. Of the townland names probably nearly fifty per cent. go back to the thirteenth century. Some of them indeed are older than history, and date from pagan times. Of all these various strata, and of some intermediate classes not enumerated, our south-east of Co. Cork affords copious illustrations. Generally speaking, mountain and maritime districts yield most (though not necessarily the most interesting) names, and demesnes and urban areas the fewest.

The present unit of Irish land division is the townland—a denomination now of very varied extent and duration. Strictly speaking, the area of a townland is, or should be, 450 acres. The ancient Irish survey was by rough computation, and not by *chain*; moreover bog or mountain was not counted. At the time of the Ordnance Survey, however, many smaller divisions or denominations were raised to townland rank, and some amalgamation of townlands was effected; hence, we have to-day townlands varying in area from an acre to thousands of acres. The chief ancient Irish land subdivisions were, in ascending order, the *grantee* (*Grainbh*), *sessageh*, *tate* or *ballybe*, *seisneach* or *ploughland* (also called *carrow*, *carriate*, or *quarter*), the *ballybetagh* or *townland*, and the *tracha-geat* or *barony*. All these terms,

or most of them, we shall find incorporated in the place-names of the region with which we deal. A gneeve (Gníomh measures, roughly, ten acres; a sesseagh is equivalent to two gneeves; a ballybo (Bailebó) is thrice as extensive again, while a seisreach or carrow (Ceathramha) equals 120 acres, and a ballybetagh (Baile-biadhtaigh) contains four seisreachs. The Tricha-Cét (Triocho-cead), which became the modern barony, contained thirty ballybetaghs.¹ According to Keating the Baile contained twelve Seisreacha. The truth seems to be that the Baile (and, proportionately, the Seisreach) varied somewhat in area, according to the period and the population, as indeed also did the acre, according to the stock it could carry.

Up to the forties of the last century some of the lesser sub-denominations were recognized as official sub-divisions, but, since the Ordnance Survey, all divisions below townlands have been discarded, and the term "townland" is now applied to every official sub-denomination, whatever its area. The parish is, in its origin, a purely ecclesiastical division. In course of time, however, it came to be recognized for various civil purposes. Generally speaking, the parish name is taken from the townland in which stood the ancient parish church. Sometimes, however, the church (e.g. Kilshanahan, Killaspugmullane, Templeusque) gives name to the parish. Needless to add, the parishes of the present paper are not the modern, but the ancient, ecclesiastical divisions, now often styled civil parishes. These are, from the point of view of the local historian and the antiquary, the most important divisions of all. Unfortunately the new Ordnance maps omit them entirely.

In collection and interpretation of the place-names here recorded, my primary care has been to get the name from the lips of a local speaker of Irish. Observance of this precaution is a matter of vital importance, for nothing, except the authority of an ancient document, can replace the native, traditional pronunciation. To neglect of it most of the "howlers" in popular place-name etymology are traceable. A fact which it behoves the student of this subject to keep well before his mind is that the place-name is nearly always a very simple thing. When first applied the name was intended as descriptive merely. Hence, in its invention, there was no conscious striving at effect, and there is much less poetry latent in our local names than irresponsible local histories and fatuous guide-books would have us believe. There are, of course, occasional flashes of fancy, but they are based, as a rule, on resemblances, more or less apparent, to some object or animal.

¹ Harding, "On MS. Mapped Townland Surveys of Ireland," *Proceedings R.I.A.*, vol. viii, pt. I; Windele MSS., R.I.A.; MacNeill, "Early Irish Population Groups," *Proceedings R.I.A.*, vol. xxix, pp. 102, &c.

ABBREVIATIONS USED.

A.F.M.	Annals of the Four Masters.
A.S.E.	Acts of Settlement and Explanation (seventeenth century).
B.S.D.	Books of Survey and Distribution (seventeenth century).
D.S.	Down Survey (maps and references).
Inq.	Inquisition.
O.M.	Six-Inch Ordnance Map.
S.D.D.	Sub-denominations of Townland.
Sub-div.	Sub-division.
Tax.	Papal Taxation (twelfth century).
Visit.	Ecclesiastical Visitation Book (end of sixteenth or beginning of seventeenth century).

BARONY OF BARRYMORE.

The barony derives its name primarily from the Anglo-Norman De Barrys, whose territory it became. More particularly, however, the name came from the Lords Barrymore, whose barony the region bearing it was constituted at an early period. The ancient designation was *Ui Uíbh Leathain*, i.e. the tribal land of O'Lehane—a name perpetuated in Castle Lyons. *Ui Lehane* probably embraced *Ui Mac an t-úir*. Barrymore is a barony of large extent, embracing twenty-nine parishes and parts of parishes, and covering roughly some 153,000 acres. Inland, besides the great and little islands, are the islands of Spike, Hawlbowlane, Foaty, and Harper's, &c., in Cork Harbour. Fermoy and Cansinos bound it on the north, Barretts', Cork, and Kerrycurryh on the west, Cork Harbour and Imokilly on the south, and Kinnatallon and Imokilly on the east. Physically, Barrymore is undulating, or, rather, heavily hilly in character, but there is little actual mountain. The soil is of at least average fertility, and the condition of the people is comfortable in the main. Through the barony run the main Cork-Fermoy and Cork-Youngtal roads, and this fact, coupled with the situation of towns like Cork, Millerton and Fermoy, practically on its borders, explains to some extent the considerable Anglification that has taken place. Irish is hardly spoken at all at the present time, and in some parishes I found great difficulty in discovering an Irish speaker who could remember the traditional pronunciation of the names. Fortunately, however, desuetude of the native tongue is so recent that much of the folk-lore is still recoverable.

The picturesque and mainly thatched homesteads of the nineteenth and

¹ *Book of Leinster*, p. 360; *Martyr, Donegal*, p. 129.

eighteenth centuries are fast disappearing or have disappeared in Barrymore, and ugly two-story slated dwellings are, thanks presumably to Board of Works plans, taking their place. Perhaps it is not quite fair to associate the ugly, modern houses with destruction of ancient monuments, but it seems a fact that where the new houses are most common, vandalism has been most rampant. Within the whole barony I scarcely remember to have seen a quern-stone, and I can recall but one dresser of pewter. In the neighbouring territory of Decies both the quern-stone and the set of pewter-plates are quite common, though neither quern nor pewter has been in use for half a century; the objects are preserved for old family associations. Similarly, in Barrymore, I have found scarcely any trace of the *Bógha Bride* (or custom of plaiting a cross of straw on St. Brigid's Eve) or of other folk-customs prevalent in the Decies. The tally-stick, for account of labourers' wages, is not in use, though the older people remember it, and it still survives in other parts of Co. Cork. Lioses, many of them fine specimens, and in excellent preservation, abound, though hundreds have been levelled in recent years. Pillar-stones are also very numerous; so are holy wells, and devotion to the latter is practised throughout the whole barony. An inexplicable phenomenon is the almost total disappearance of ancient church remains. Of the twenty-nine parish churches, and the many connected chapels of post-invasion times, not more, perhaps, than a dozen in all have left any remains; the others have been literally razed to their foundations. This wholesale clearance, as well as some of the other phenomena, or absence thereof, referred to already, I feel inclined *prima facie* to attribute largely to the Desmond war and its consequences. Strange that the Cromwellian plantation of the neighbouring counties should have produced results so very much less marked.

PARISH OF ARDNAGEEHY.

Ardnageehy parish, which, on its north side, runs well into the Nagles Mountains, includes a considerable area of wild and rugged country. Consequently its local names are of somewhat more than ordinary interest and number. Many of the older people—though few of them speak Irish freely—retain sufficient knowledge of the vernacular to be able to quote the correct forms of the names. The parish is called, in the usual way, from the townland in which the ancient church and graveyard are situated. An older name was Garthenegaythe,¹ which may be rendered—"Breezy Garden." Of the pre-Reformation church, which was a plain oblong in plan—twenty

¹ Tax., 1291.

yards in length, by seven yards wide—only the west gable and the foundations of the north side-wall survive. In the gable is a single, small, oblong ope, which splays inwardly, and was intended evidently to light a chamber or gallery, partly supported upon a projecting ledge at the west end of the interior.¹ Above the ledge referred to, the thickness of the gable is about three feet, as against a thickness of four feet from the ledge downwards. There is a small, nearly square holy-water stoup, or font, measuring roughly some eighteen inches at the sides. The surrounding graveyard—some half-an-acre in extent—possesses hardly any feature or monument of interest. The earliest inscription I found was dated 1770. I was unable, unfortunately, to ascertain date of the “pattern.”

TOWNLANDS.

ARDAROW. ‘Aid a Rogha—“Chosen (or Choice) Height.” Area, 369A. This name, at least as a townland designation, seems to be of comparatively recent origin. Formerly the place, which is mostly mountain, was regarded as a sub-division of Lickendarragh. Mr. R. A. Foley suggests ‘Ard Idir dá Abba—“The ‘tween Rivers’ Height,” instead of Aid a Rogha, and very likely his interpretation is correct.

S.DD. An Branar—“The Fallow Field.”

Tobar an Uisce—“(Household) Water Well.”

Tobar na Leacht—“Well of (beside) the Monumental Piles.” The piles or heaps in question, are of stones, and apparently of natural origin—simulating however, the artificial. I am not at all sure of this name. First, I doubt that the term “leacht” would be applied in this way to a natural stone-heap. Secondly, my informant, who was an indifferent Irishian, and not overburdened with intelligence, wavered somewhat between leacht, lag, and leac. He inclined most to the first, and I could not, on the occasion, get his testimony corroborated. I imagine the word is really leacan, a glen slope.

“Tro Carragains” (Na Carragáin) — “The Little Rock-abounding Fields.”

An Fhaitheche—“The Lawn (Green, or Hurling Field).”

An Seagal—“The Rye (Field).”

“The Sweeteen”—A field deriving its name from its succulent pasturage.

Seana Garraidhe—“Old Garden.”

¹ This gallery was quite a common feature in churches of the present class. It may have been intended for the orchestra’s seating. Sometimes, instead of the gallery, we find at the west end a chamber entered from within the church, and occasionally we have traces of both gallery and chamber.

Páirc na dTor—"Field of the Bushes."

Páirc na Móna—"Turf Field."

ARDNAGEEHY, 'Ard na Gaoithe—"Wind-swept Height." Area (in two parts), 1075 A. The name-giving "height" is, presumably, the exposed elevation half-a-mile, or less, to south-west of the ruined church. The church itself is on comparatively low and level ground. Other antiquities of the townland are four lioses (O.M.), and a small pillar-stone. The last-mentioned object is on the farm of John Sheehan. One of the four lioses, situated on west side of the townland, has been levelled, and its souterrains have been partly destroyed.

Ardnageehy (Inq. Car. I).

S.DD. Crosara na Con—"The Dog's Cross-roads." The eponymous canine was an enchanted hound, or a woman who sometimes took the shape of a dog or sheep. This dread creature frequented the present cross-roads at night, injuring and sometimes killing inoffensive wayfarers. A former parish priest of the district met his death at the place, but a successor of his, a Father Falvey (?), is popularly believed to have exorcised and finally banished the malicious and supernatural visitant. Exorcism and banishment notwithstanding, the spot is still dreaded, and daring is the man who would pass there alone after nightfall. A cattle-fair was formerly held at Crosara-na-Con.

'Ard Magàna—Meaning unknown; a sub-division of no great area; also an old name for the whole townland, according to Denis Dunlea, an intelligent resident.

Réidh a Gheilte—"The Lunatic's Mountain-Plain"; a former wild spot of some six or eight acres, now cultivated.

Bun a Bhaile—"The Homestead Hollow."¹

Páirc na Ceárdchan—"Field of (adjoining) the Smithy."

Páirc na Nóiníní—"Daisy Field."

Páirc a Leasa—"Lios Field."

Páirc na bhFear—"The Men's (Meeting) Field," i.e. the place where men assembled on Sundays or on summer evenings.

Páirc na mBréithre—"Field of the Judgment (Verdict)"; evidently its ownership was the object of a lawsuit.

Páirc na mBullana—"Field of the Large Round Stones (Bowls)."

¹ I translate Baile uniformly as *homestead*, though I feel that this word does not always express the exact sense of the Irish term. The ordinary rendering, *town*, is less exact and somewhat misleading. An alternative rendering, *stead*, has been suggested; but I do not think that it has any advantage over *homestead*, and it is not as well understood. In Australia, the word "homestead" is in constant use to signify the same thing exactly as our Irish *Baile*.

Garraidhe Fada—"Long Garden"; locally, by garden is meant a tillage-field.

Faithche—"Paddock (or Hurling Field or Fair Green)."

BALLINLEGANE. Baile an Liagáin—"Homestead of (beside) the Pillar-Stone." Area, 631 A.

Dallilega (Depositions, 1652).

The word *Baile*, by the way, enters into the composition of no fewer than 6,400 Irish townland names.¹ Names incorporating the term we may regard as almost exclusively of post-invasion origin. The eponymous pillar-stone, which stands in Twomey's farm, is a massive, and indeed magnificent, example of this class of monument: it is almost square in horizontal section, and measures nearly twelve feet in height by from thirty-eight to forty-five inches at the sides. Close to the great dallan, and in the same large field, is a well-preserved circular lios of medium area with rampart some six or eight feet high. On the townland are two further lioses, also in fair preservation. Near the south-west angle of the townland, on the farm of Mr. Cashman, is a second, but much smaller, standing stone—also, apparently, a true dallan.

S.D.D. Seann Bhaile—"Old Homestead or Village"; a sub-division, consisting of three or more large fields, on which a fair was formerly held.

"The Faheens" (Faithchínidhe—"The Paddocks (Greens or Hurling Fields)."

Páire na Cloiche—"Field of the Pillar-stone;"² from the great dallan above referred to.

Bán a Bhaile—"Home Field"; it adjoins "The Faheens" above.

Fóla a Tóe—"Tee Well"; now drained by a subterranean aqueduct.

"The Young Fields"; two large fields.

"The Scarped Field," "The Lumpy Field," and "The Lime Field."

BISHOP'S ISLAND, Caisleán an Easpoig—"The Bishop's Castle." Area, 587 A.

The Ordnance Survey field books give Oileán an Easpoig as the Irish form; but I distinctly got Caisleán from the only local speaker of Irish (an intelligent and trustworthy man) who had ever heard an Irish form. Perhaps Caisleán is a mistake for Oileán, or vice versa; the two words could be easily confused. The name Ballinaspingmore occurs in the Depositions of 1652,

¹ Reeves, "Townland Distribution of Ireland."

² In local usage *cloich* is generally a pillar-stone, with which dallan, gallan, liagan and cloch fhada are synonymous.

³ Oileán is one of the words of occasional occurrence in Irish place-names, the true secondary sense of which it is difficult to fix. Often, of course, its force is our English "island"; but there are many cases, like the present, in which the literal sense is impossible. It has been suggested that the toponymical oileán is a small area surrounded

and most likely it designates the present townland. Consequent on agricultural improvements (?), a fairly clean sweep has been made of the former antiquities; the only items surviving are—one large circular lios, almost perfect, and a solitary pillar-stone, five feet high by three feet six inches and one foot nine inches—both on Mr. James Cashman's farm. On surface of the pillar-stone are some natural cup-hollows. Built into a gate-pier, at entrance to the field in which stands the pillar-stone, I found an ogham-inscribed slab which I had removed to University College, Cork.¹ The inscription which, unfortunately, is incomplete, reads: "Olagni Maqi . . ." (Of Olagnos, the Son of . . .). Sub-denominations are very few, and portion of the townland lies within the neighbouring parish of Kilquane.

S.DD. Páire 'Ard—"High Field."

Bogach 'Ard—"Elevated Swamp." The name is applied to a field now quite dry and arable, but sporadically producing bog-plants which testify, as does the name, to its former marshy character.

BRIDESOWN Baile na Bríde. ats, Cnoc an Chatha—"Homestead by the Bird's River," otherwise "Hill of the Battle." Area, 905 A. I got the first name from P. Murphy, Edmondstown, and the second from P. Kennedy, who could not say for certain whether it was a synonym for the first or merely designative of a sub-division of the latter. I failed to find local corroboration of the second name; the first was amply corroborated, although the Ordnance Surveyors do not record any Irish form. Reasoning from failure of the Surveyors to find (or record) an Irish form, it looks as if the present official name is modern; moreover, we do not find it in the usual seventeenth-century documents. From its appearance, however, I am inclined to think it some centuries old.

S.DD. "Bride River" (O.M.)—Bríde; the name of a Celtic goddess, from root Brí, strength, &c. Compare Brigantes, the name of a well-known Celtic tribe. Our present Bride, which joins the Blackwater, is sometimes styled Bríde Barracha to distinguish it from the B. Muscraíde, a tributary of the Lee.

Cúile—"Back Place," the name (locative case)² of a well-known sub-division. Cúl, gen. cúil, and cúil, gen. cúile, are very difficult, and often impossible, to distinguish in place-names. Of course one is masculine and

by a stream or marsh; even this does not explain away the difficulty, for the oileán is not always so surrounded. Perhaps the word had reference to proprietorship or estate; the place may have been a small property surrounded on all sides by another estate.

¹ See "Ivernian Journal," vol. vi, pp. 201, &c.

² Use of the dative (locative) for the nominative is fairly frequent in Irish place-names. The usage doubtless arose from association of the name with the idea of motion thither or thence.

the other feminine; but the gender is of little help, since both words generally appear at the beginning of the name. It is some comfort in the matter that the words do not differ greatly in meaning.

Poll Lughaidh—"Drowning Place (Pool) of Louis"; a deep pool in the Bride, the name of which has been corrupted to Poll-a-Wig, in popular usage.

Poillín na bhFód—"Little River-Hole of the (Turf Sods," in allusion probably to the use of burning turf in poaching.

"The Turning Hole," a third river-hole and small whirlpool well known to anglers and poachers.

Céim—"Pass"; a sub-div. containing some twenty acres.

CNOIPOGE, Chapóg—"Knoll." Area, 330 A. This townland is almost entirely uninhabited, although as long ago as the year before the famine twenty-five acres of it were under cultivation.

S.D. Seefin (O.M.) Suidhe Finn—"The Sitting Place of Fionn (Mac Cumhaill)": a name of frequent application to mountain peaks and cairns. The present *Saidhe* is at the extreme north-east angle of the townland, and at an elevation of 1392 feet.

BUNNAGLIANNA, Bun a Ghleanna—"Glen Bottom (End)." Area, 247 A. The old people use Bun a Bhaile, "Village End," as a synonym. Agricultural occupation is recent, and that the name is comparatively modern is suggested by its absence from ancient documents.

S.D.D. Prist an Úisce—"Water Serpent"; I give the name as I got it, though I cannot explain its application here to a field.

Poll an Rialair—"The Knight's Pool": a hole in the Bride River, perhaps the Knight's drowning place.

Cumalach Liath ("Grey Stubble"), Cumalach ("Swamp"), Barra Leacan ("Summit of the Glen-Slope"), Fiadhán ("Wild Place"), Móin Lomán ("Bare Mountain Bog"), and Cnocán Ruadh ("Little Red Hill")—the names of a number of fields.

CARRIG, Carrig—"Rock." Area, 325 A.; a long and narrow strip of mountain land, thinly populated, and in part uninhabited.

S.D.D.—Two fields, named respectively Seana Ghairdín and Seana Pháirc—"Old Garden" and "Old Field."

CHIMNEYFIELD, Binn a (Sinné—"Field of the Chimney." Area, 141 A. The name is derived from a ruined house with a standing chimney, once almost the only artificial feature on the townland. Reclamation has been recent. Ath a Dúna appears to have been the older name. The Dun is not necessarily a path or lies, or any artificial structure at all; sometimes, especially in glens and mountain regions it is a natural mound, simulating

a rath in its rounded and regular appearance. At the date of the Ordnance Survey one Catherine Heaphy was engaged in teaching Irish here; there was also, at the same period, a private school attended by about forty pupils, who paid 2s. each per quarter for tuition in reading: 2s. 6*d.* for tuition in reading and writing; and 3s. for the whole three R's.¹

S.D. Carraig an Aifrinn—"Mass Rock"; a natural outcrop or cliff by the river, in the shelter of which, presumably, people met feloniously to worship in the Penal Days of saddening memories.

COMMONS, Coimín and Réidh a Choimín.—Idem. Area, 389 A.; all mountain, and practically uninhabited. The Ordnance Surveyors² add a note—"John Hide, Esq., and Pierce Nagle, Esq., each claim the whole as their property. None of it cultivated, but very capable of being so. No rent paid for it."

S.D.D. An Leacht—"The Monumental Pile," on the mountain summit. Leachts deserve to be classed as a special type of rude stone monument; they vary enormously in age—from the Bronze period to the nineteenth century. Even within the past sixty years leachts have been raised to commemorate tragic events like murders and deaths by accident. Leachts—like our present specimen—on mountain summits are of the oldest variety, and date from prehistoric times.

Féith Ghorm. "Bluish-Green (Dark) Vein." "Féith," of rather frequent occurrence in mountain and bog names, is applied to the luxuriant green band or patch which marks the course of a subterranean spring. In the present instance the Féith is a well; originally the name must have been applied to the strip of coloured herbage which indicated the course of the spring issuing from or feeding the well.

CORBALLY, Corra Bhaile—"Round Hill of the Homestead." Area, 431 A.

This is a townland name of fairly frequent occurrence throughout Ireland. O'Donovan generally, if not universally,³ explains it as "Odd Town," i.e. Cor Bhaile, which I venture to designate incorrect. Joyce follows O'Donovan, and I may appear guilty of temerity in differing from such eminent authority, but I have always heard the name pronounced Corr a Bhaile.

Corbally (D. S. Reference).

S.D. Fleisc—"Wet Place"; a sub-div. of some hundred acres. There is also a Flesk River in this barony, as well as one in Kerry and another in Antrim.

GLENNASACK, Gleann na Sac.—"Glenn of the Sacks"; presumably

¹ Ordnance Survey Field Books.

² Field Books, Ordnance Survey, Mountjoy Barracks.

³ Field Books, Ordnance Survey.

because, owing to want of roads, loads had to be carried in sacks slung across horses' backs. Area, 485 A., largely mountain.

S.D.D. An Réidh—"The Mountain Plain"; a field.

"The Downy Field": a large semi-rectangular enclosure of perhaps forty acres, which is said to have been "graffed" many years ago by two or three deaf mutes.

GLENNVILLE. Gleann na hEanáim—"Glen of the Crow"; originally, according to one authority, the name was Gleann na hEanáim ("Valley of the Whortle-berries"). Area, 941 A.

S.D.D. An Búirneadh (The Búirneadh)—"The Waterress-Flowing Spring." This is the same as the Irish name of Watergrasshill: it is applied in the present instance to a well.

"Coaling Wood" (O.M.), being a superior kind of hard turf made there, and said to resemble sea-coal in quality.

Cúntar na Sagar—"The Priests' River Confluence"; perhaps because the priests' residence was near by, or because the confluence marked the meeting-place of numerous parishes, or death, perhaps because some priests were drowned in the river at this spot.

Gleann Bán—"White Glen."

Glacleana—"Little Castle"; the name is now applied to a stream, but originally it designated a rock which overhides an overhang, the river.

"The Stone Field" within Sir E. Keble's domain. Here one stood 4 dollars "as large as the Pallymore specimen." Throughout the Barony the "stone" or "dun" of the numerous "Stone Fields" and Cairns-na-Cháidhe (or Fúar-cháidhe) are really pillar-stones. Alas, that so many of them have disappeared!

Bun a Bhaile and Tiar a Bhaile—"Village End" and "Village Top" respectively.

"The Tinker's Hole" a over-pool in which, presumably, the straggling man of solder met his untimely end.

"The Water Holes"—Inn (Inn) is the positive base of Inn, an island, and the word is commonly applied to a rock basin or a low-lying meadow by a stream.

Glacleana, Rive (O.M.). Glacleana na hEanáim—"Trout Stream," on the east boundary of the townland. The common name now is "Trout-truck," in which, as effort is made to preserve both the sound and the sense of the original.

GRAIGUE, An Ghráig—"The Village." Area, in two parts, 1,161 A.

Graig—Inq. Car. I.

S.D. "The Bow Field." I met nobody who could throw any light on

origin of the name. Perhaps it was a half-rendering of Páine na mBó, "Field of the Cows," or of P. na mBoth—"Field of the Tents."

INCHINANAGH, Inse na nEach.—"The Horses' River Holm." Area, 230 A. S.DD. Barr a Bhóthair—"Top of the Road"; applied here to a cross-roads.

Cluain—"Meadow"; a field.

"The Blacks"; applied to a group of small fields in allusion to the colour of their peaty soil.

"The Long Streak" and "The Short Streak" = two fields. *Streak* here is really the Irish, *Stráic*, a portion of anything involving length.

Poll a Choreáin—"The Pot Hole"; in the river.

KILLEAGH, Coill Liath—"Grey Wood." Area 631 A. "Torna" states that the name is Cill Liath—"Grey Church." I believe the townland is now uninhabited, though it was not so at the date of the Ordnance Survey, when it produced thirty barrels of potatoes and six of oats to the acre. Killeagh is a very long and narrow townland.

S.DD. Boighín Ruadh—"Little Soft Red Bog"; a bog or sub-division of considerable area, near the mountain summit, which produced an excellent brown turf.

Féith na Beárna—"Vein of the Gap." Féith has been already explained as the designation of a green, grassy line in a mountain bog indicating the course of a spring.

KILLUNTIN, Cill Fhionntain—"Fintan's Church." Area, in two divisions, 91½ A. Site of the ancient Celtic Church which gave its name to the townland is now occupied by Killuntin House. A man who saw the old graveyard sixty or seventy years since describes it as surrounded, *more Hibernico*, by an earthen fence of the usual circular type. No remains now survive.

S.DD. Móin na Snathaire—Meaning unknown; perhaps M. a Snámh-aire. It is the name of a sub-div. and the site of a former village.

Páire na gCaorach—"Sheep Field."

"The Black." (See under Inchinanagh, *antea*).

KNOCKAUNLOUR, Cnocán na Lobhar—"The Lepers' Little Hill." Lepers may have lived there, or the lands may have been part of the endowment of an hospital for lepers. Knockaunacarren seems to have been an older name; at any rate it was the name given to the Ordnance Surveyors by R. G. Champion, Esq. Area 545 A.

S.DD. Comerboy Bridge (O.M.) on south-east boundary. Cumar Buidhe—"Yellow River Confluence."

The Cnocáns (Cnocáin—"Little Hills"); the fields surrounding a natural Dún, or gravel mound, on Ford's farm.

Páirc an Atháin—"Little Ford Field."

Biolarach—(See under Glenville above); a well.

Seana Phúna—"Old Pound"; the name of a field. The "Pound" was more than a mere place of internment for straying animals or the sheriff's seizures. It was also the temporary depository of the tithe-proctors' prey; and the word was used locally in the very wide sense of a safe enclosure or yard for cattle.

Gort Dubh ("Black Garden"), Páirc a tSeagail ("Rye Field"), Páircín a Round or P. na Rann (?), Fáitheo ("A Lawn") and Féithín ("Little Green Vein")—a series of interesting field-names.

KNOCKADOOBY, Cnoc Uí Dubhartaigh—"O'Doorty's Hill." O'Donovan, who writes the qualifying term *Dúrta*, says the meaning is very uncertain. I, however, found the name as above. Area, 358 A. The townland is entirely uninhabited, and its name is almost forgotten in the locality.

KNOFFOG, Cnapóg—"Hillock." Area, 358 A.; almost uninhabited.

LACKENDARAGH, Leacan Darach—"Glen-slope of the Oakwood." Area, in three divisions, 2022 A. Observe the use of the oblique *Leacan* for the nominative. There is one *lios*, in tolerable preservation, on Murphy's farm.

Lackendaragh (D. S. R.).

S.D.D. Céim Carraige—"Rock Pass."

Bóthainn Dearg—"Little Red Road"; on south side of townland.

Tuar a Bhotháin—"Cattle Night-field of (with) the Shed."

Cairn—"Stone-pile"; the name of a small sub-div.

Clais Uí Chathail—"O'Cathal's Trench."

Carraig an Aifrinn—"The Mass Rock."

"The Lawn" (*Dallán*)—A Pillar-stone; a mountain sub-div. of some fourteen acres.

Páircín an Aingéil—"Little Field of the Money"; in allusion to alleged buried treasure.

Various Field Names.—*Páirc na gCloch* ("Field of the Stones"; most probably pillar-stones); *Páirc na Sgeoch* ("Field of the White-thorn Bush"); *Páirc na gCúig* ("Field of the Pigeons"); *Páirc na gCoinín* ("Field of the Rodents"); *Páirc a Chumraigh* ("Field of the Hills and Hollows"); The Pounds; The Blucks; *Easfaun* (probably *Faoi-Fánaidh*) ("Below the Incline"); *Banóg* ("Little Field" ?), &c., &c.

LYSABROOK, Lethán a Bheanraigh—"Barry's River-fork"; so named from junction at this place of a small, nameless river with the Bride. Area, 495 A.

S.D. Cnocán—"Little Hill"; a sub-div.

MEENANE, Míneán—This is a mountain name of fairly frequent occurrence and signifies, according to O'Donovan,¹ a small green patch on a mountain. Area, 559 A. There was a lios, not noted on the O.M., in a field on Towhill's farm.

S.D.D. "Watergrasshill" (O.M.). Cnocán na Biolaraiġhe—"Little Hill of the Water Cress". Strictly speaking Biolarach is the stream which flows through the watercress, or in which the latter grows. It is not necessary to remind the reader how this place derives its fame from the former residence here of one who literally had greatness thrust upon him—Father Daniel Prout,

"Of Watergrasshill, the renowned P.P."

The good priest died in 1830, and is buried at Ballinaltig, a couple of miles from the village for ever associated with his memory. A stream, which rises in Bishop's Island, ran down the whole length of the village street, and in the old mail-coach days there was a pool for watering the horses. Watercress flourished in the stream and catchment pool in question, and hence the name. Immediately previous to the famine, there were one hundred and thirty inhabited houses in Watergrasshill, and a population of some five hundred and twenty.

Bóthairín Bhlaic—"Little Road of the Peaty-surfaced Place." The word Blac, occurring occasionally in mountain-names, is really the English "black," which is used as a noun to designate the dark soil of reclaimed mountain land.

Béal a Chreathaigh—"River Mouth of the Hurdle Bridge"; a sub-div. Compare the Latin, *crates*.

"Blackstone Bridge"; this place was a Mass-station in the Penal times.

Ladhar na nGleann—"Fork of the (two) Glens"; another sub-div.

Páire a Leasa—"The Lios Field"; in which was the obliterated rath already referred to.²

MONEYGORM, Muine Ghorm—"Dark Green Shrubbery." Area, 652 A. The place is now, and perhaps always was, better known as Tooreen (Tuairín)—"Little Night-Field for Cattle." Móin a Chumair ("Bog of the River Confluence"), and Na Cumaraġha ("The Hill and Valley-abounding Place"), seem to have been old synonyms; for instance, in the Surveyors' Sketch Map the place appears as Monacummer. At the date of the Ordnance Survey the townland constituted a single farm.

¹ O.S. Field Books, *passim*.

² The name "Lios Field" is of extremely frequent occurrence, like "Big Field," "House Field," and "Road Field." It will not therefore be recorded for the future, except in special cases.

S.DD. Tooreen (O.M.)—Tuairín (as above): applied more particularly to the village, and popularly, by extension, to the whole townland.

Tuairín Beag—"Small Cattle-Field"; a sub-div.

Cnocán an Fhuaráin—"Little Hill of the Spring (Well)."

Turtóg 'Ard—"High Earth-Bank."

Cnocán—"Little Hill."

Clais—"Trench."

Druim na Réidhe—"Ridge of the Mountain Plain."

MULLENABOGREE, Múilsam na Buithrige—"Glen of the Roaring (or Groaning)," according to O'Donovan. Richard A. Foley suggests Maoilim na Bó Raithaige—"Bare Hill of the Brindled Cow." There is neither trace nor tradition of a mill, and, as the place is mostly mountain recently reclaimed, it is very improbable that it ever had such a structure. Possibly, as O'Donovan suggests, the name is derived from a "fairy mill." I also got the name as Mullenn a tsuadhábh, but as I found little corroboration I attach no importance to it. Area, 885 A.

S.DD. An Chlais—"The Trench"; a huge natural excavation.

Luibh-ghlas—"Green Herbage"; a field.

"The Blacks"; some small fields; see *antea*, under Meenane.

Paireín Tobair—"Little Well-field."

TINAGERAGH, Tigh na gCaorach—"Sheep-house." Area, 468A.

There are three houses on the townland and one of these is quadrangular in plan. Of the others, one is double-ramparted. The square lios was stone-lined, and the largest of the circular specimens had souterrains. The poet John O'Murphy (NA Ráiceanach) wrote an ode to Thomas Barry of Tinageragh. Another member of the Barry family (styled "of Watergrasshill") who had fought at Fontenoy in 1745, died in 1822, aged 113 years. He is described as 6 ft. 2 in. in height, and as walking erect to the last.¹

S.DD. S. Stephen's Well (O.M.): no stations are now performed, but sixty years since they were reported "to have been made there formerly."

Seana Bhaile—"Old Village Site." This is a name of frequent occurrence, and is met with in places where there is no other living tradition of the village's existence.

Láirín (Sugán)—"The Priest's Loop"; a curve, or bend, in the road, with a waste space attached. It looks like a *cozi*, or early church site; but there is no tradition of the latter beyond a hazy popular notion of some uncanny association.

¹ Windele MSS. R.I.A. 12, I. 8.

² Field Books, O.S.

Páire a Randí; meaning unknown.

TOORGARRIFF, Tuar Garbh—"Rough Night Field." Area, 644 A.

S.D.D. "Tower Hill" (O.M.)—This is probably a very incorrect rendering of Teamhair, a hill. Indeed, the townland name may be Teamhair Garbh.

Seana Bhaile; a field. See under Tinageragh above.

PARISH OF BALLYCURRANY.

The present parish is of very irregular outline, of less than average size, and of scarcely average interest archaeologically. It derives its name (which is at least seven centuries old) from the townland upon which the church stood. The district embraced is hilly and somewhat off main routes—two facts which are to advantage from our present point of view. Perhaps the local names are correspondingly well preserved, and of interest above the average. Close to south boundary of the parish, and on summit of a glenslope overlooking a stream, is the ancient parochial graveyard, within which was the church. Of the church itself nothing remains; its approximate site is occupied by three Wilson family vaults. Appropriation of ancient church interiors and such quondam sacred places was one of the petty aggressions of the Cromwellian and Williamite gentry. Appropriation was, under the circumstances, quite bad enough; but these parvenus went further. They pulled down what remained of the old walls, and used the materials to build themselves vaults, and, of course, in their day none of the native stock dared say them nay. The Ordnance Surveyors state that the foundations of the church were dug up in 1810. The Royal Visitation in 1615 found the church and chancel fallen even then.

TOWNLANDS.

BALLYBRANNAGH, Baile na mBreatnach—"Walshes' Homestead." Area, in two divisions, 314 A.

There was one lios, now destroyed, on FitzGerald's farm. There are also the remains of an ancient church, called *Seana Teampuilin*, standing within a small enclosed cemetery. In middle of the field adjoining the churchyard is a large circular lios in a good state of preservation.

S.D.D. "The Sheepwalks"; this is a 60-acre field.

Carraig na gCon—"The Hounds' Rock"; the name is applied to an elevated field some four acres in area.

Ath an Ísil—"Ford of the Low-lying Place"; on the boundary with Condonstown.

Seana Theampuilin—"Little Old Church"; the ancient religious building referred to above. It was evidently not a parish church, but either an

ancient Celtic foundation or a votive chapel of post-invasion times. The foundations of the building are fairly traceable, and show the church to have been some forty-eight feet by twenty-one feet internally.

Páire na Claise—"Field of the Trench": a field-name of rather frequent occurrence.

Páirein na Cuinge—"The Field of the Swingletree." I am not quite sure of this name; my informant had but little Irish.

"The Mollies." The name is applied to a stream, and is supposed to be derived from two or three old women who lived close together on its bank.

BALLY-RANNY, Balle Uí Cearúigh—"O'Crane's Homestead." O'Donovan makes it B. Cramach, "Tree-surrounded Homestead," but I give the name as I heard it. Area, in two divisions, 309 A.

Balycaranich (Tax. 1291); Balyncraney (Inq. Eliz.); Ballycarany (Visit. 1615).

S.DD. "The Blacks"; a field.

"Mass Path Field"; a field through which leads a path used as a "short cut" on Sundays.

An Chill; a field which adjoins the graveyard.

"Lady's Well", a lady-well at foot of the glen near the graveyard. The well, which is held in much reverence locally, is fed by a spring filtering from the hill behind. It is at present covered with a roof of mason-work, and in front and around are ranged some rudely-carved structures of stone, the pious work of an aged man named John Barry. Votive rags, &c., adorn an ancient thorn tree overhanging the well, and "rounds" are still made on August 15th. The concourse, in fact, on the patronal day is so great that it becomes "a pattern." The water is popularly believed to be specially efficacious in cure of ague and sore eyes.

Poll a Chéat—"Cat Hole": in stream, on west side of townland, where a bridge was erected by subscription in 1810.

BALLYNACLASHY, Balle na Claise—"Homestead of the Trench": doubtless from the great natural trench or glen (it has no bog or stream at base) which runs north-east and south-west through the townland. Area, 405 A. There are two lises.

Ballinaclashie (Inq. Car. 1 and Inq. Eliz.).

S.DD.—"Glenview" (O.M.).

"Gwynne's Well."

Ceathrúnaí Daghite—"Burnt Quarter": a sub-division, of some forty-five acres.

BALLYSTONNEN, Balle na gCloich—"Homestead of the Standing Stones"; none of the eponymous pillars survive. That the name is derived from pillar,

rather than field stones is deduced from the fact that the natural surface (heavy clay) is practically stoneless.

S.D. Loch Feibil—Meaning unknown; perhaps “pebble pond”; the name is now applied to a field.

BALLYNAKILLA, Baile na Cille—“The Church Homestead.” Area, 509A. I failed, after minute investigation, to find traces or tradition of church.

Ballynakill (B.S.D.).

The following place-name rhyme—found in many places as well—was quoted by a local Irish speaker. It really was originally applied to Ballycotton by the Irish poet, Pierce FitzGerald:—

Baile na Cille, baile beag, briste,
 Agus a thón le huisge,
 Agus mná gan tuisgint ann.

There were two lioses, but both are now levelled, and Mulcahy’s house stands on the site of one.

S.DD. Sliabh Léid—Meaning unknown.

Tobar a Chaipín—“Well with the Little Cap (of masonry)” ; the well has no cap now.

Páire na bFotharach—“Field of the (House) Ruins.”

Páire na dTrí gCúinne—“Three-cornered Field.”

Páire na Claise—“Field of the Trench.”¹

Leaba na Bó Báine—“The White Cow’s Bed.” “The White Cow,” in this instance, is clearly a legendary animal. She appears—withstanding the sobriquet of “white”—to be the fabulous Glas Ghamhnach or azure-coloured heifer, whose yield of milk was so copious that she filled every vessel, till a mischievous and irreverent woman brought a sieve. Compare Bóthar Bó Finne, &c., on Woodstock, par. Carrigwohill. No doubt the original leaba was a stone or depression, but the name is now extended to a sub-division, mostly mountain and unreclaimed land.

BALLYVATTA, Baile Mhata—“Matthew’s Homestead.” Area, 575A.

S.DD. A number of field names—Páire na Cruithneachta (The Wheat Field), Loch Buidhe (Yellow Pond), Ath Doinhin (Deep Ford), Leacht (Stone Pile), Móinhear Mór (Big Meadow), Ath na Gaimhe (Sand Ford), Páircín an Imris (Little Field of the Litigation), Garraidhe Dearg (The Red Potato Field), Seana Bhuaile (Old Milking Place), &c.

CLASH, An Chlais—“The Trench.” Area in two parts, 76A. There are also

¹ Names like this and the preceding are of so frequent occurrence that, except in special cases, they will not be recorded.

two small coterminous townlands of Clash in the adjoining parish of Lisgoold. On the present townland is one lios.

CONDONSTOWN, Baile an Chúndhúnaig. Idem. Area, 71 A. There were formerly two lioses, but both have been thrown down.

DOONEEN, Dúinín—"Little Fort"; perhaps from the rounded hill in middle of the townland.¹ Area, 185 A. I found here the following place-name rhyme:—

"Dúinín an dá mhuilleann,
Clais na clocha finne,
Léim Lára an tsearraig,
Agus Baile an Sceiche gile."

There are two lioses or remains of them.

S.D.D. Tobar na Daibheche—"Well of the Vat"; close to the well is a "Folacht Fiaidh" or prehistoric cooking-place, and about here flints are found in some quantity.

Páire na nGleann—"Field (at junction) of the Glens."

"The Mill Field."

Páire an Amhain—"Mass Field"; not from celebration of Mass therein, but from a "Mass-path"² through it. "Grove Mór"; a field.

Clocha Finne—"White Stones"; some stones in Leamlara Glen, on this townland. They are referred to by John Windele (MS. 12. 1. 3. R.I.A.).

KILLEAGH, Cill Aodha—"Aodh's Church." I could find no native Irish speaker in the townland, and there was no evidence forthcoming from any other source to determine the true name beyond doubt. O'Donovan makes it C. Phiaich, but I understood the word as I heard it, to be Aodha. Area, 147 A. The *cell* is on Mr. Herd's farm, to north side of an old laneway which leads from the farmyard in direction of the boundary stream. The enclosure, which is about $\frac{1}{2}$ acre in area, is not quite rectangular, but inclined to circular in shape. It was approached by a few yards of branch lane. Within and around the enclosure lie some large blocks of rough stone, which perhaps marked graves, or formed part of an early building.

Killeagh (B. S. D.).

KNOCKAKEEM, Cnoc a Cheim—"Hill of the Step"; the reason of or for the name is not apparent. Area, 338 A. There is one large lios on the townland, and likewise a fine pillar-stone.

S.D.D. "Kansheen Bridge" (O.S. Field Book). This was a bridge of

¹ Fort-surmounting hills, in mountain regions or in gravelly country, are often called Duns. Often, too, it was, no doubt, the natural fort-like shape of such hills that suggested and led to their artificial transformation into true forts.

² See under Ballycranny townland, *antea*.

five arches erected, like its sister bridges of Doneen and Clash, by public subscription, in 1832.

“The Stone Field”; so called from the pillar-stone above mentioned which stands on Barry’s farm. The monument—of slate—is roughly lozenge in horizontal section, and measures some 6 feet 8 inches in height by about 8 feet in girth. It has no name, and was flung to this place from Ballynakilla by a giant.

Páircín a Churraig—“Little Field of the Swamp”; there is no swamp now, and but for its survival in the name we should not even suspect that it had ever existed.

LEAMLARA, Léim Lárach—“The Mare’s Leap.” There is an implied reference to some legend, unfortunately lost. The country people now know nothing of the Leap or the Mare. Area, in two parts, 556 A.

The second member of the name is variously written—lara, lary, larie, larye, and laragh in ancient documents. There was one lios of moderate size, now levelled, and there are, near Leamlara House, some remains of an early castle (with vallum) of the Barrys.¹ During tillage operations Mr. Barry’s ploughman recently unearthed a very beautiful flint-axe which is now in Mr. B.’s possession.

S.DD. Coolgarah (O. M.), Cúil Uí Gearrtha—“O’Gara’s Corner.” This is a well-known sub-div., regarded locally as an independent townland.

Ath na Gainmhe—“Ford of the Sand”; now a bridge at the north-east angle of the townland.

“The Piper’s Wood.”

Páircín an Asail—“Little Field of the Ass”; a sub-div. of some seven acres. It is remarkable, by the way, how very seldom the useful donkey gives name to any local feature.

Páirc na Sceiche—“Whitethorn Bush Field.”

MOANBAUN, Móin Bhán—“White Bog.” As a townland designation the name is modern; formerly the place was accounted a division of Ballynagloch. Area, 400 A.

S.DD. Gleann Meadhonach—“Middle Glen”; a sub-div. of 100 A.

Cnocán na Fionnóige—“Little Hill of the Skaldcrow.”

Móin a Tuairín—“Bog of the Little Cattle-Night-Field.”

Páirc Dubh—“Black Field.”

Páirc na mBollana—“Field of the Large Round Stones.”

Cúil-Mhóin—“Bog Corner.”

Móin Bhán—“White Bog”; a field from which the townland gets its name.

¹ See Cork Archaeol. Journal, vol. xix, p. 35.

Inse mhór—"Large River-holm."

Poirtín—"Little Embankment"; a field.

Leacan—"Glen-slope"; a field.

PARISH OF BALLYDELOHER.

Ballydeloher parish is, like Ardnageeha, within the Diocese of Cork. It is of small extent, and generally of very hilly character. Its name, which it does not at present share with any townland, is ancient; we find it, under the form Bally-daloythyr, in the Papal Taxation of 1291. The taxation form, supplemented by the local pronunciation, furnishes a key to its derivation—Balle Dailhe Luachra—"Homestead of Black Rushes." Present-day features offer little explanation of the name. There is neither bog nor morasses where rushes might be found: the present Brookville, however, before drainage, must have produced them in plenty. "Black" rushes appear to be the withered stalks. In this connexion it may be well to state that Luachairre also signifies bad weather, and Dabh Luachair is used figuratively for the dark season of the year—February. Mr. Richard Foley, whose local knowledge is exact and minute, thinks the name is Balle Uí Dubhluachair, "O'Deloghery's Homestead." Tradition, as expressed in the name of the Glebe (Kilruane and Holy Well (Cedar Ruane), attributes foundation of the church to a St. Ruane or Rudanus. Speculation as to identity of our present Rudan is futile, almost certainly there were many saints and church founders of the name. The church, which consisted of nave and chancel, was standing, though ruinous, in 1615. To-day nothing remains of the building, which must have stood to south of, and non-parallel with, the present small Protestant church. Greater part of the parish is demesne land, hence antiquaries are few, a holy well, a pillar-stone or two, and some lioses exhaust the list.

TOWNLANDS.

BALLYVISTRATE, Balle Mhístéil— "Mitchel's Homestead." Area, 250 A. There are three lioses—one each oval, circular and quadrangular, and one pillar-stone.

S.D.D. Bán Bhuide—"Yellow Field."

The Close Dove; a field. Dove is almost certainly for Dubh, black.

The Stone Field", from a pillar, 5 feet high—8 feet in girth, which stands therein (on Fenton's farm). Within "The Stone Field" was a souterrain, now closed up, which connected with a lios now prostrate.

¹ Canon Lyons, *Cork Archaeol. Journal*, vol. iii, p. 65.

² Royal Visitation.

BLOSSOM GROVE, Rath an Fhaoitigh—"White's Rath"; up to fifty years ago there were three raths on the townland, but not one now survives. Area, 409 A. The townland is of curious outline—long and wedge-shaped; it extends along whole length of east boundary of the parish and half the length of the north boundary.

S.DD. Cnocán na Féola—"Little Hill of the Meat."

Bán na gCloch—"Field of the Stones"; almost certainly dallans which have disappeared.

Bán na Móna—"Turf Field."

Páire an tSimné—"Chimney Field."

Páire 'Atha na Sac—"Sack-Ford Field." The name 'Ath na Sac occurs with curious frequency. Cf. "Place Names of Decies"; compare also, Glennasack, par. of Ardnageehy, *supra*.

Bán 'Ard—"High Field."

Poll a tSaighdiúra—"The Soldier's Hollow"; a dip in the avenue.

Poll a Mhadra—"The Dog's Hole"; in the river.

Folacht Fiaidh; a prehistoric Cooking-place on Fenton's farm.

BROOKHILL, Baile na Luachra, B. Duibhe Luachra, or B. uí Dubh Luachair, as above—"Homestead of the Rushes." Area, 60 A.

BROOKLODGE; as last; area, in two parts, 418 A

On the townland is the ancient graveyard, and within latter the site of the ancient parish Church. Far as a cursory examination could ascertain there are no inscriptions or monuments of antiquity in the graveyard. At the opposite side of the road, on Reardon's farm, is the Holy Well, covered overhead by a flagstone lintel five feet in length. "Rounds" are still made on St. John's Eve, and thence to the end of June. At date of my visit there were votive offerings in quantity, including rags, buttons, and iron nails.

S.DD. Macha—"Milking Place"; a sub-div. containing about 100 acres.

Kilroan Glebe (O.M.).

Holy Well (O.M.).

"The Foundation Field."

"The Castle Field" and "The Fish Pond"; on Roche's farm.

Bothairín na gCorp—"Little Road of the Corpses"; an old road, now partly obliterated, which led to the graveyard.

BROOKVILLE, Baile na Luachra, &c.—as above. Area, 117 A.

BUTLERSTOWN. Baile an Bhuiltearaigh—Idem. Area, in two parts, 369 A.

S.DD. "The Boat Field"; from its shape.

Móinteán—"Little Bog"; a field of 11 A.

Lorscín—"Little Burned Place"; a field of 13 A.

Cluain—"Meadow"; a field of 15 or 16 A.

Bannashábó (perhaps Bán na Sean-Bháó—"The Old Cow's Field").

CALEHANE. Coill Seaghain—"John's Wood." O'Donovan makes it Caol Sheain ("John's Marsh"), but the word is not Caol, and there is no marsh—the place is a ridge summit. Area, 135 A.

The townland which is all included in one farm, was formerly known as "the Rock Farm."

SIDD. Cathair Mór—"Great Stone Fort"; the fort has completely disappeared, and the name is applied to a field of some 15 A.

Páircín Cruadh—"Hard-surfaced Field."

"Jackey's Well."

CORBALLY. Corr a Bháile—"Round Hill of the Homestead." See Corbally, Par. of Ardaraeochy, *supra*. O'Donovan generally translates this name "Old Town," which I feel sure is wrong. Canon Lyons states the form should be Coradh-bháile, and that the first word means the encircling wall of a homestead.¹ Area, in two parts, 224 A. There is one small lios in the townland.

S.D. Droichead na h'Adhara—"Bridge of the Horns"; on boundary with Carburytown. I was informed that the name was given from the branching, at this point, of two roads before construction of the "New Line," but the explanation is not convincing. More probably the name was derived from some ornaments of stone or masonry with which the bridge was formerly decorated.

RIVERSTOWN. Balle Ruism—"Homestead of the Little Wooded Bluff." The same Balle na h'Abhann is also given, but this is merely a literal translation of "Riverstown." Area, 56 A. Greater portion of Riverstown lies within the adjoining parish of Templeusque.

SIDD. "The Pails"; two holes in which deer were formerly kept. Paal here is evidently the Irish páil, a paling.

Inse na hEórna—"River-Holm of the Barley."

PARISH OF BALLYSPELLANE.

The present parish is, like the last, of small extent. It belongs to the Diocese of Cloyne, and, for the greater part, it consists of elevated country traversed by glens of considerable depth. Place-names are above the average in number and of at least average interest. Antiquarian remains are, however, very few; they are practically confined to the ruins of an

¹ Journal of Cork Archaeological Society, vol. iii, p. 65.

ancient church and three or four lioses. It looks indeed as if the region were but sparsely populated, or in great part uninhabited, in ancient times. The parish name is not ecclesiastical in origin, but is derived from the townland on which stood the ancient church. Though non-ecclesiastical in derivation, however, the name is of very respectable antiquity as designative of the church; we find it under the form "Balyspellan" in the Taxation of 1291, and under the form "Ballispillan" in the Visitation of 1615. We are informed, moreover, by the Visitation that the Rectory belonged to the abbey of Buttevant and Tracton.

TOWNLANDS.

BALLYSPELLANE, Baile Uí Spealáin—"O'Spillane's Homestead." Area, in two parts, 710 A.

"Balyspellane" (Inq. Cas. I). "Ballyspullane" (Depts. 1652).

Towards south boundary of the parish, and on this townland, stand the scant remains of the ancient church. These consist of a fragment, 6' high × 6' or 8' wide, of the west gable, and the bare foundation course of the north side wall of the nave, together with a small portion of the south-west angle of the chancel. The total external dimensions of the church would be about 17 yards by 6. The surrounding cemetery, only about one-half of which has been utilized for burials,¹ does not contain much of interest. To south of the church ruin is a small standing-stone inscribed:—"I.H.S. Here lie the Body of The Rev. Dominick Rohan, Who Died November 18th, 1780, Aged 58 years." Immediately to north of this tombstone is another monument, so buried in the earth that I was unable to read its legend, commemorating a second priest, probably one of Father Rohan's predecessors. On the townland are two lioses—one, of small size and bisected by a road, the other a larger specimen, represented by only an arc of its former circular rampart. On Pat Greany's farm is one field in which I was told there was once an establishment of monks. Windele saw (May 5th, 1844) five *foluichts fiaidh* in contiguous groups at Ballyspillane.

¹ Explorers of old cemeteries will have noticed how frequently the northern part, or side, of the sacred enclosure remains unoccupied. Tradition and Church symbolism supply the explanation. The side of the graveyard to north of the church building was the side of the Gentiles and reserved for interment of infidels, &c. Long after its symbolism had been forgotten, the people continued the practice of interment on the south (or Epistle) side only, and in old Irish graveyards still—for no reason beyond reverence for ancient custom—burial on the north side of the churchyard is a thing to be, if possible, avoided.

S.DD. "The Brown Bog."

"The Inches"; by stream side, on south boundary of townland.

Tobar na Cuaiche—"The Cuckoo's (or the Goblet) Well"; this well had some reputation for sanctity; "rounds" were formerly made at it, but they have been discontinued for a long time.

Páire na gCapall—"Horses' Field."

Cnocán Rathail—"Rahilly's Hillock"; this is a sub-division lying towards the northern end of the townland.

Páire a Dalláin—"Field of the Pillar-stone"; the name-giving *dallan* has been removed into the next field.

Páire an Chroicinn—"Field of the Skin (or Hide)."

Páire na Céardchan—"Forge-Field."

BARNASHILLANE. Barr na Sileán—"Hill of the Water Drippings." Area, 78 A.

"Barnasallere" is the form in the Down Survey Map, where, by the way, the place is given as united to Ballyspellane, or part of the latter. The whole townland is at present comprised in a single farm.

ELFORDSTOWN. Baile an Elefórtáig—Idem. Area, 218 A. On the townland there was formerly a lios of medium size, but this was levelled some time since.

S.DD. Lios Ard-Ratha—"High-Rath Lios"; this was the lios which has disappeared. The name is not necessarily tautological; it rather suggests a difference in meaning between lios and rath. Compare Lios Ratha Diarmuda at Ballygarvan, &c.

Cnoc na Muc—"Hill of the Swine."

GLENATHONACASH. Gleann a Tónacáis—"Glen of the Sliding (Rock)" Compare Barnatonicane, parish of Schul. Area, 307 A. Locally tónacáis is understood to be a rolling rather than a sliding. Application of the name is explained thus:—Three giants dwelt respectively on three points of the neighbouring hills, while their sister, who acted as laundress to the three big brothers, dwelt on a fourth peak. From her lofty station the sister was able to fling to the three brothers anything they required in the way of clean garments at each week end. Once the aerial service broke down, and the parcel intended for one of the brothers fell short into the valley. The giant affected by the loss suspected something amiss; he instantly repaired to his sister's mountain peak, only to find his worst fears more than confirmed, and the lady in a condition unbecoming, to say the least of it, an unmarried female. The woman fled before his wrath, but the giant overtook her at head of our glen. He beat her grievously, and kicked her, whereupon she fell, and, rolling down the valley, became transformed into a

great boulder, which can be seen there still—in the stream-bed at bottom of the glen—to confirm the story, and confound the sceptic.¹

S.D. Seana Bhaile—"Old Village"; the name is applied to a field.

Páirc na bhFeara-chat—"Field of the Wild (or Enchanted) Cats."

GORTNACRUE. Gort a Chrú—"Field of the Hut." O'Donovan makes it "Field of the Blood." Area, 454 acres. "Gortcrue" (D. S. Map).

KILLEENDOOLING. Cillín Dubhláinn—"Dowling's Little Church." Area, 195 A. All my efforts failed to discover trace or tradition of the early church-site, and John Moore, an old resident, aged eighty years, says he has been inquiring for the name-giving ceal or cilleen all his life, but has not found it. There is one large lios, partly levelled, on Maurice Ring's farm (Páirc a Leasa).

S.DD. Páirc na Coille—"Field of the Wood."

Cnoicín Geárr—"Little Shortened Hill."

Clós Méarach—"Finger-formed Close."

WALSHTOWN. Baile an Bhailise—"Wallis's (or Walsh's) Homestead." The Co. Waterford Walshes also Gaelicised this name—Bhailis, while the Kilkenny, &c., families of the name make it Breathnach. Area, 52 A.

There are really four townlands of the name in the barony. These all adjoin, and three of them (in the parish of Templenacarriga) were doubtless once united. The present small division, lying within a different—though adjacent—parish, can hardly ever have formed member of a union with the others. On Walshtown (whether on the present portion or on the other, I cannot say) was a cistvaen or dolmen composed of nine large stones supporting a capstone. The monument was demolished by one Pat Barry, who survived his act of vandalism only three months.²

S.D. "The Mears"; a rather extensive sub-division, embracing three or four large fields.

PARISH OF BRITWAY.

This parish, which lies along the east boundary of the Barony, is of about average size, and of hilly (almost mountainous) character. Its place-names, also, are of about average interest and number. There are many antiquities, including a very interesting Hiberno-Romanesque church, several pillar-

¹ Another version of the legend makes the brother a saint—Colman of Cloyne, to wit— and the sister, another saint, who for her humility was able, unscathed, to carry burning coals in her apron. One evil day, however, she took complacency in sight of her new boots; thenceforth she could carry the fire no longer. The apron lost its virtue, and became ignited; in consequence the fire was lost, and Colman, for whom the sister acted as cook and oecominus, was left dinnerless. For her sin of vanity and failure in domestic duty, the woman was changed into a stone, &c.

² Windele MSS., 12. I. 3.

stones, a well-known and much-frequented holy well, numerous lioses, and some cill, or ceal, sites. The parish shares its name with the townland on which the ancient church stands; but whether it is the church which gets its name from the townland or the townland from the church, there is no evidence to show. Moreover we are in doubt as to the derivation of the parish name.

TOWNLANDS.

ARDRA, 'Ard Ráth—"High Lios." There were six circular lioses—three of small and three of moderate size. The particular lios which gave its name to the townland still stands upon, or close to, the eotermious boundary of Carroll's and Scanlan's farms. **Area, 390 A.**

"Ardra" (Inq. Eliz.).

On Carroll's farm are two dallans, and there is a *ceall*, nameless, but still used for burial of unbaptized infants, on Scanlan's.

S.D.D. Bán a Chaim—"Field of the Dam (or Mill-stream)." "Corn" seems to be used here in the sense of a mill-dam.

Clais an Aitrim—"The Mass Trench"; a natural depression used as a place for Sunday worship in the Penal days.

BALLYARD, Baile 'Ard—"Elevated Homestead." **Area, 207 A.**

There are two medium-sized lioses—one circular in outline, and the other oval.

S.D. Bóthairín Nua—"New Little Road."

BALLAHEEN. Beil Leicín—"Little Flag-stone River Mouth."

O'Donovan makes it Bealach Fhinn, which certainly is not what I heard. Apparently here, as elsewhere, O'Donovan based his interpretation solely on the Anglicized form. **Area, 332 A.**

S.D.D. Garridhe Ruadh—"Red Potato-Field", a sub-div., some 60 A. in area.

Currach an Ime—"Marsh of the Butter"; a field in which is a well.

Páirc na bhFothrach—"Field of the Ruins."

BRITWAY, Breimbach or Bréach. Meaning somewhat uncertain. Canon Lyons translates it "wolf," and O'Donovan makes it Breach Magh—"Wolf Field." The form "Bregwach" in the Taxation of Pope Nicholas suggests that O'Donovan's rendering is correct. Windele (MSS. R.I.A. 12. I. 3.) records Brittas and Biniach as alternative forms.

"Bregwach" (Taxation, P. Nich., 1291). "Brittway" (D.S.).

The ruins of church of Britway—perhaps the most interesting object of its

¹ Journal of Cork Archaeological Society, vol. ii, p. 191.

² Field Name-Books of the Ordnance Survey, Mountjoy Barracks.

kind and period in Co. Cork—stands within its ancient and much-used cemetery. The building, which consisted of nave and chancel, was a ruin as long ago as the beginning of the seventeenth century.¹ In the west gable of the ancient church is a semicircular-headed doorway of Hiberno-Romanesque character, the arch of which is curiously relieved or supported by a rough tympanum resting on a flat lintel. Perhaps the lintel was a later insertion to save the arch. The gable, which is nearly perfect, is well worthy of preservation by the Board of Works or the County Council; it has been well described by Petrie as one of the most interesting remains in the country, and has the characteristic antae, or curious prolongations of the side-walls, so distinctive and well-known a feature of Celtic churches. These project about one foot. The nave is about 31' long by 18' broad, and the corresponding measurements of the chancel are 22' 8" × 13' 8". In the north side-wall of nave is one small and widely splaying window—its round head cut of a single stone—measuring 3' 5" high by 18' wide below and 16½" above. Other measurements are:—thickness of walls, 3'; height of door, to tympanum, 7' 5", or to lintel 6'; width of door, 2' 10" below, contracting to 2' 7" above. The rude lintel projects on the face some six inches. Masonry throughout is fine ashlar, the material being a beautiful yellow sandstone.

Except the gable, comparatively little survives that possesses any special interest. Built into the western boundary fence is a cross-inscribed stone, 1' 6" × 1', and in the cemetery are a couple of interesting ancient inscriptions. One of the latter commemorates:—

“D. Edmund Barry
Pastor de Castlemagn^r
Vir doctrina et pietate
celebris obiit 8^{va} Feb^{ry}
Anno 1765 Aetatis
suae 48 Sacerdotii
20 ~.”

Mr. R. A. Foley informs me that in this cemetery was buried (July, 1738) the Irish poet, Liam Ruadh MacCotter. Here also repose the ashes of another Gaelic poet and scholar, Rev. Con O'Brien.

In a field to east of the graveyard are two or three flagstones, arranged as if they had once been the end of a cist. Their position has suggested to the people the idea of a chair, and they have named the monument St. Brigid's Seat. Within another field, separated from the church by the public road, is

¹ Visit. Book, 1615.

the Holy Well, popularly dedicated to St. Brigid. The Holy Well at Ballyroberts, a couple of miles to north of Britway, is likewise (*teste* Windele) dedicated to St. Brigid under the name of Brioch, and at Rosslare, Co. Sligo, there is, according to Lewis,¹ a chapel called St. Breoch's or Brigid's. Possibly the association of St. Brigid with the well was suggested by the name Britway, which was believed to have some reference to the patroness of Ireland. The well is still in high repute—"rounds" are being constantly made and votive offerings are much in evidence. The well itself is surrounded by a circular wall of modern masonry, on the outside of which are arranged a series of prayer-stations nine in number.

S.D. Bán a Teorna—"Boundary Field."

BALLYVOLANE, Baile Uí Mholáin—"O'Mullane's Homestead." Area, 361 A. The townland is nearly all demesne land.

"Ballyvolane" (Depns. 1652).

S.D.D. Tobair an Ime—"Butter Well"; because the water was suitable for butter-working.

"The Pound Field."

BALLYDAW, Baile Dáth—"David's Homestead." David was a common Christian name amongst the Barrys and the Powers. Area, 55 A. Only a small portion of the townland is in the present parish. Greater part of it, or another townland of the same name, lies within the neighbouring parish of Castlelyons.

Ballydaw (D.S.R.).

S.D. Cnocán Ruadh—"Little Red Hill."

BALFAHERNA, Baile Fothna—"Covert Summit." O'Donovan makes it B. Fothannain (thistle), which certainly is not the name I heard. Thistles grow only on good land, and most of this large townland is bare and wind-swept mountain. Area 967 A. There is one linn, of medium size and circular outline, on O'Regan's farm.

S.D.D. Cnocán na mBuachaillí—"The Cowboys' Little Hill."

'Ard Glas—"Green Height"; a sub-div., of some 400 acres.

Tobar an tSasanaigh—"The Protestant-Farmer's Well."

Leacán a Mhadrach—"The Dog's (Wolf's) Glen Slope," a sub-division containing about 60 acres. Observe the locative in place of the nominative, case.

"Bilboy"; a hill.

COOLEKNEDASE, Cúil Cneadáin—"Knedan's Corner," according to O'Donovan while I think I heard Cúil an Fheadáin—"Corner of the

¹ Topograph. Dict., ii, p. 538.

Streamlet." Dan Twomey, a highly intelligent Irishman, pronounced the name for me. O'Donovan, however, makes it C. *Uniadáin*—"Knedan's Corner," and the pronunciation of Mrs. Desmond, of Curraghdermot, agrees with this. **Area, in two parts, one of which is all wood, 183 A.**

The separated parts of the townland are not coterminous. On Coolknedane North there is a circular lios of medium, or average, size. On Coolknedane South is a group of three pillar-stones (four feet high) in line.

CURRAGHDERMOT, Currach Diarmada—"Dermot's Marsh"; a large townland, comprising a considerable area of mountain. **Area, 719 A.** Here, in the late eighteenth century, lived one of the lesser Irish scribes, Cotter by name. There are some antiquities on the townland, scil—*a cill, or ceal, site, a half-lios on the mountain, three pillar-stones, aligned and about four feet high, in the same locality, and three medium-sized lioses. All three lioses (or two of them) are, I believe, on Dowley's farm.*

S.D.D. Two Pot House. (O.M.) This is a lonely cross-roads on the mountain top. It derives its name, and whatever distinction the latter confers, from a public-house, or shebeen, which once stood here. This wretched establishment was so low that a tall man could not stand upright within it, and there were two pots on the chimney; whence the name. Another account, collected seventy years ago by the Ordnance surveyors, traced the origin of the name to the use, by the patrons of the house, of only two drinking-vessels, one of which was a two-pottle, or gallon, measure: **A man was hanged here between two butts (carts) for participation in some *carawath* outrages.**

Páirc a tSuidheacháin—"Field of the Sitting-Place"; from some rough seats of stone, occupied on Sundays by the rude forefathers of the hamlet, while they discussed the crops, O'Connell, and Repeal.

"**The Ceal (Cill)**"; **A corner of boggy land near Mrs. Desmond's—a very unlikely place for a church site. Local belief, however, is positive that the place was a cill, and, in a matter of this kind, I take tradition to be sufficient evidence.**

Cnapóg—"Little Hillock"; a sub-div. comprising upwards of 100 acres.

Móin na gCóir—Meaning unknown. The name is applied to the little bridge beside the cill site above mentioned.

"**Firmount.**" (O.M.) **A modern fancy name, less foolish than the general run of such names; there is a mount in the present case, and a few firs. The name designates a sub-division of considerable extent.**

KNOCKNAGARE, Cnoc na gCaor—"Hill of the (Rowan) Berries." I give the name as I got it, though I have some doubt of its accuracy. O'Donovan also renders it **Berry Hill. Area, 48 A.**

S.D. "Knockanaar" (O.S. Field Book). Cnoc an 'Air—"Hill of the Slaughter." There is a legend of a battle and of great carnage, which are alleged to have taken place here.

KNOCKNASKAGH. Cnoc na Sceach—"Hill of the Whitethorns." I also got C. na Sceiche. Area, 83 A. "Knocknyskehe" (Inq. Eliz.).

S.D. An Dallán—"The Pillar-Stone"; this is about seven feet high by some four feet in width.

KNOCKNAGLOHALL: this is another instance of a place raised to townland rank, apparently without warrant. The name seems unknown locally; at any rate, after due inquiry, I failed to find it. It would probably be Cnoc na gCloc nGeal—"Hill of the White Stones." Area, 81 A.

PORTAVARRIG. Port a Bharraig—"Barry's Bank." Area, 12 A.

II.

THE POST-ASSAYING FOUND ON DATED PIECES OF PLATE IN
THE COLLECTION OF TRINITY COLLEGE, DUBLIN.

BY REV. J. P. MAHAFFY, D.D., C.V.O.

Read APRIL 23. Published MAY 23, 1917.

IN the summer of 1916, our member, Mr. Dudley Westropp, a noted expert in old silver plate and its history, undertook to catalogue and describe the great collection still preserved in Trinity College. I say *still*, for the records of the College testify that far more has been sold long ago than the amount we now possess. The remaining collection is, however, very rich in eighteenth-century Irish plate, not without some splendid examples of an earlier time. Without this preliminary research of Mr. Westropp—to which he brought the inestimable value of his deep knowledge and wide experience—not one word of this paper would have been written.

But, among other unexpected conclusions, his inquiry brought out the fact that in many cases the inscription giving the donor's name, arms, and the date of his gift, did not agree with the hall-marks stamped upon it. Notably, the one hall-mark held to be decisive by experts is the *Hibernia* on its oval shield. This mark was ordered to be stamped upon all plate sold by any maker of, or trader in, plate after the passing of the Act in the third year of George II (1729–30), as evidence that 6*d.* per oz. had been paid for duty to the Crown. It was added to the previous mark of genuineness (the crowned harp), and, with the maker's initials, and the letter marking the year,¹ gives the full trade record of every piece on which these four marks appear. All that can be added is an inscription giving the donor's name and style, and the date of his gift, which may, of course, be later than the year-letter, as he may have given a piece he already possessed; but usually represents the year of, or the year after, the manufacture. At all events, as the *Hibernia* was a new mark, added for a special purpose and by special legislation in 1731, it was naturally held by all the

¹ This was a letter of the alphabet, commencing with the A of 1638, and starting with a new series, differing in form and shield, every twenty years. Hence the various periods are easily distinguishable.

experts that this mark determined at least the oldest possible year, the *terminus a quo*, for the making of the piece.

Even a superficial study of the College plate by anyone who knows the history of that corporation is enough to show that such a cut-and-dried solution presents great difficulties. There are many objects in our collection whose inscriptions tell us that they were the gifts of students or Fellows of the College, with dates ranging from 1690 to 1730; and we can verify from our books that these correspond with the years when the donors entered or were living in the College. How are we to reconcile this evidence with the fact that on almost all these gifts we have the *Hibernia* plainly stamped?

The solutions offered by Mr. Westropp, to which we must give every attention, were two. Either (1) the money subscribed for the plate was laid by, and the actual piece not manufactured till half a century or more later; or (2) the original pieces given at the time specified in the inscription were so battered by use that they were sent to the silversmith, who either remade them or furnished new pieces on the model of the original gift, and had them stamped with the proper marks of the new manufacture.

To a student of the history of the College, and of the habits and tastes of eighteenth-century art in Dublin, neither of these solutions seems satisfactory.

The whole question of the gifts of silver to the College has never been treated in any of our histories. We have records of handsome gifts of money, or bequests, from bishops and College dons, such as the gift of £20 from Bishop FitzGerald (1629) and the bequest of £50 from Vice-Provost Gilbert (1751) for chapel ornaments; and we know that these benevolences were carried out according to the wishes of the donors and without delay.

But there was from the very foundation of the College another kind of gift, if I may so say, a compulsory gift, of silver. In our earliest matriculation fees, various items were paid to various officials; the only additional fee which was paid to the College was a gift of *argent*, which was fixed at 12s. for a pensioner, £2 for a Fellow Commoner, and £6 for the son of a nobleman.¹ In the last case the value of this tax was often, but not always, exceeded. Rich fathers liked to give a handsome cup or tankard to the College. The usual form of gift for pensioners was a silver spoon, of which the College soon owned many scores. But if pensioners had no convenient way of getting spoons or other small silver gifts, they paid their 12s. (which, of course represents three or four times the sum in value now), and this money was simply put into the "College trunk," with other moneys, and so

¹The latter sums were afterwards increased or varied, without altering the original 12s.

used. There was no such thing as laying apart any of these contributions as things of sentimental value. Of this we have the clearest evidence. The College plate, in the days when there were no banks, was the College money, just as the jewels of Oriental grandees are said to represent their investments. Accordingly, when a crisis such as that of 1641 arose, and the College could not recover its rents, the sale of parcels of plate is recorded with stolid iteration. We know also that the only resisting force to this clearing-out of the College property arose from Bishop Anthony Martin,¹ who was then Provost, and to whom we probably owe the survival of our splendid chapel plate, the best of which was already in the College.

It may be said that this was a case of necessity, and that necessity often plays havoc with sentiment. The answer is ready. The events I have just cited took place in the years 1641-9. During the Cromwellian occupation, indeed, there seems to have been a cessation of the habit or rule of the College to require this tax at entrance. But with the Restoration (1660) the old practice revived; and between the years 1660-85 a great quantity of plate again accrued to the College. With what sentiment was it regarded? In 1685, under James II, the College, after some difficulties with the King and his advisers,² carried through the proposal of selling 4000 ounces of plate (excluding the plate used in the Chapel), in order to buy with it an estate in the Queen's Co. Not only was this transaction completed, the College receiving roughly £1000 for the silver, but there is extant a list of the cups (about 140), tankards, and spoons, with the names of the donors, which then were disposed of to a goldsmith. These names and gifts, with hardly an exception, are from the previous twenty-five years. The donors were, therefore, almost all alive, and must have known this public transaction. Yet we do not hear of one word of protest or complaint. Nay, even this did not prevent a new influx of plate commencing with 1690, from which, and the following years, we have preserved many fine examples.

Nor was the behaviour of the College in this matter peculiar, far less solitary. We have examples both of public bodies, such as the Goldsmiths' Corporation (in 1708), and of private individuals, such as Lord Mornington (1759),³ disposing of their plate, as we should use money deposited in a savings bank.

Dr. Stubbs, writing his *History* a generation ago, does not express one

¹ Cf. my *Epoch of Irish History*, p. 287.

² The story is given in detail by Dr. Stubbs in his *History*, pp. 125 sq.

³ The College bought plate from him for £660. The Goldsmiths used theirs to furnish their new Hall, built at that time in Werburgh Street.

word of regret at the loss of this treasure, which would now be worth many times its then value. He always regarded it as a sound money transaction, seeing that the estate then bought had for 160 years back been worth £400 a year to the College. But he could have defended the action of the Board on far sounder historical grounds. Not more than forty years had elapsed since Charles I, when at Oxford, had commandeered all the plate of its Colleges, and turned it into money. He would have treated Cambridge in the same way, had he not been baulked by the Puritan atmosphere of the place, and the concealment of its treasures. The policy of James II had already shown the danger of confiscation with which Protestant property was threatened; and the difficulties raised during the negotiations by Chief Justice Nugent, one of which was the charge that the goldsmith "had been buying stolen plate which belonged to the King," and the threat of prosecuting the Provost and Fellows (Stubbs, p. 137, show plainly whither the King's advisers were leading him. The precedent of Charles I and Oxford was before them; and no sooner was the College actually seized by an armed force in 1689, than the remaining plate was carried off to the Custom House, and only saved by the friendly care of its officers, and the prompt survening of the victory of the Boyne. The policy of the College was, therefore, quite justifiable. If they kept their plate, it would be seized and melted down; if they turned it into landed property, this might be confiscated, but could be recovered again, whenever the King's Acts were reversed.

Still less can I adopt the second explanation, that the College sent pieces of plate battered by ill-usage to be repaired or remade in the style of the original gifts by goldsmiths at dates varying from 1750 to 1785. This is contrary to all that I know of the habits and feelings of the eighteenth century and its art in Dublin. The fashions of making plate, making furniture, and of decorating houses, developed rapidly during that very prosperous and, as we can now admit, artistic century in Ireland. The old was constantly being declared antiquated, and therefore ugly, and being replaced by the new. I can quote plenty of examples of this; one (relevant) will suffice. On December 14, 1774 "It was this day ordered by the Board [of Trinity College] that the service of plate belonging to the College (consisting of plates and dishes) be melted down and wrought up anew, this being necessary in order to make it useful and ornamental to the College." Fortunately this order was not carried out, for we still have the service, then scorned, in use, almost all of it dating from 1733—forty years earlier. Household plate was constantly being replaced by new plate in the style which had come into fashion since it had been made. It was the same in architecture. If you had asked the decorators of first-floor drawingrooms in Leinster House or in

Powerscourt House¹ to copy the twenty years older stucco-work of the ground-floor rooms, they would at once have answered that such decoration was now antiquated and out of fashion. Very likely they despised it. We might as well now ask a lady to dress in the fashions of thirty years ago. In an artistic and productive age these changes are very rapid. The decorators of the Theatre in Trinity College, designed in 1775 by Stapleton, who was working under Adam influence, would not for a moment have thought of copying the decoration of the Provost's House, carried out next door in 1760. Unless, therefore, I could find explicit evidence that the silversmiths of 1750-90 were ordered by the College to reproduce the old dated gifts in form and style, I still maintain that when this style is confessedly archaic, and the date of gift clearly set upon any article, we have the original thing, in spite of the grave difficulty of the *Hibernia*, which it is the main object of this paper to solve. How great the difficulty was, I did not appreciate till I had gone a long way into this inquiry.

When studying parallel cases in Oxford and Cambridge Colleges, I came upon this passage in Provost Shadwell's Register of Oriel (I, p. xi: "It was the frequent practice to sell or exchange pieces of plate worn out, or no longer in fashion . . . Even between 1600 and 1640 many pieces had been parted with in this way. All but a very few have been replaced by more modern articles, though the inscriptions have been in most cases carefully transferred." Among the old papers in our Muniments Room I had seen long ago two pages dealing with plate, and had not understood their meaning. Quite recently, after long search, I found them again, and they throw a curious light upon the history of our plate. From these pages, which contain but a part of the transaction, it appears that the College, becoming rich in the course of the eighteenth century, determined, at a date which we can fix with much probability at 1731-2, to have at least 900 oz. of their older cups (of which they had a multitude) melted down and turned into articles useful for the College dinner-table. They were beginning to entertain the Viceroy and other grandees more and more handsomely, and wanted useful silver plate to adorn the table. Hence they had older cups turned into knives, forks, salvers, candlesticks, preserving, however, the donors' names and dates in an abbreviated form, which is given in the list in each case on the right hand of the coat of arms. We still have a considerable number of the newer objects so acquired, with the inscriptions on them then added; and as the latest of these melted-down gifts dates from 1730, there is no reason, so far as all these are concerned, why the *Hibernia* should not naturally appear on them.

¹ The details are to be found in vol. ii of the Georgian Society's volumes.

and mark their earliest possible date. With most of them Mr. Westropp was quite satisfied on this point. He considered, with his long experience of such things, that most of the objects with early donors' dates were not of the style of the donor's time, but were honest products of the post-*Hibernia* epoch.

But yet I was not satisfied. For there were some of the pieces so manifestly very early eighteenth- or even seventeenth-century work, of the age of their donors, that the *Hibernia* still seemed to me very suspicious; and I could not accept Mr. Westropp's solution, that they were the result of antiquarian sentiment, reproducing a bygone style. The hypothesis, therefore, that the College received money for plate during the years 1690-1730, and put it by in order to carry out the donor's wishes fifty years later, when he was dead and gone, still seemed to me untenable.

In my perplexity I submitted my difficulties to Mr. A. Lebas, whose ancestors have long been goldsmiths in Dublin, and who is now the valued assay master of the Goldsmiths' Corporation. He came to see the College plate and offer his suggestions. He entirely agreed with me, that some at least of the older gifts were in the style of the donors' college days, and that a middle eighteenth-century craftsman would have protested (if it were necessary) against copying the bygone fashions of an older generation. But Mr. Lebas also found new and important evidence of rehandling which had escaped Mr. Westropp. All the salvers of the 1730 transaction show upon their under surface the plain marks of having been scraped by the assayer, evidently after they had left the maker's shop. For no goldsmith would turn out a piece with this obvious damage upon it. When I see that this scratching, which I propose to call *Post-assaying*, is only manifest on flat surfaces, I do not for one moment hold that objects such as candlesticks or tankards may not have been similarly treated; but these can be assayed round the foot or in other places where the scratching is not visible. Let me here add that this post-assaying appears on the very objects which could hardly be battered by use. Who could batter a salver out of shape?

To those not familiar with the process of assaying I may briefly describe it, as carried out now every week in the assay office of the Goldsmiths' Corporation. Every new article in gold or silver comes in from its maker in the rough with nothing stamped upon it but his initials or maker's punch, without which identification the assay master will not receive it, as he is bound only to assay for members of the corporation or people licensed by them. It comes in the rough for the master then scrapes it in one or more places with a narrow scraper, thus taking off some of the material. This silver dust, technically called *dust*, is then gathered and exposed to the

proper chemical tests of its purity. If it satisfies this test, he then stamps the piece with the hall-marks, viz., in Ireland, with a crowned harp, a date letter, *Hibernia*, and, after 1807, with the reigning king's head. It then goes back to the maker, who polishes the assayed surface to make the object fit for sale. An ugly scrape on a smooth surface would not be tolerated by any buyer.

Now the salvers in question show the reverse order of treatment. The ugly scraping of the assay master was evidently inflicted on the piece after it had left the maker, and in the present case long after. How can we account for this strange phenomenon? I believe I have found it in the legislation of the day, accompanied by the well-known fact that even after the establishment of banks in Dublin old plate was looked on as merely bullion, and frequently sold as such by the owners.

The Act of 3 George II (1729-30), cap. x, imposed a new duty of 6*d.* per ounce on all manufactured silver, payment of the duty being attested by a special stamp or mark, to be approved of by the Goldsmiths' Corporation. It is very curious that in the minutes of the corporation of that date there is no mention of any discussion or decision as to the particular mark, though the Act is seriously considered by them in their minutes, and certain queries made about its interpretation. Moreover, a great quantity of plate was assayed just before the Act came into force, in order to escape the new duty. As a matter of fact, a figure of *Hibernia* sitting, with her harp beside her, on an oval shield, was the mark adopted and used without change for many years. But the Act imposed this new duty only upon the importers or makers of this plate, to be paid by them. Section xxxii proceeds:—"And it shall be enacted that during the said term of twenty-one years no goldsmith, silversmith, or any other person whatsoever, working or trading in wrought or manufactured gold or silver, shall sell or expose for sale, barter, or exchange any manufacture of gold or silver unless it be so small as not to be capable of receiving a mark (viz., silver wire, or things under four penny-weight) until such time as such plate, vessel, or manufacture of gold or silver shall be assayed, touched, and marked in manner and form hereafter prescribed in that behalf, upon pain of forfeiting the value thereof." &c.¹

¹ There are many more minute details about the appointment of an assay master, his duties of keeping a book with the names of those who came to him, his obligations, and the penalties to which he was to be subject; but in all the Acts there is no explicit mention of the duty of a silversmith in the case—which must have been very frequent—of the buying or the mending of old plate. It is certain that the Act intended no plate to come out of his house in the way of business without paying the new duty; but what amount of mending compelled or entitled him to put on his own mark with the *Hibernia*, and if so, what became of the older maker's mark? Mr. Lebas does

In the queries raised upon this Act in the Goldsmiths' Records for 1729-30 (p. 272*a*), they make three points:—

1. Whether any plate wrought before the new Act that has not paid the duty can be sold, or exposed for sale, by public cant, at a higher price than its bullion value, without paying the duty?

2. Whether the word "trading" does not include auctioneers, usurers, and all people that sell plate above the bullion value?

3. Whether any plate, new or old, standing in a goldsmith's shop shall be deemed "exposed for sale," so as to incur the penalties of the Act, though it does not pay duty till the customer offers, and, generally, what is meant by exposing for sale in the Act?

This Act imposing the new (*Hibernia*) stamp having been enacted to last twenty-one years it occurred to me—it seems not to have occurred to the experts — to find out what steps had been taken to continue that Act. The *Hibernia* appears on Dublin plate all through the century, and, therefore, its use must have been re-enacted.

As Mr. Westropp noted (p. 553 of Jackson's book), £121 of plate passed the assay-office in the quarter before the coming into force of the Act, and

not think that the older maker's initials were interfered with, as they are not now so treated. Indeed, they are so many and so difficult to distinguish that they seem only to have been intended to identify the makers for the assay master at the time of issue. For example, there are several J. L.—John Loughlin, John Letablere, John Locker; several J. W.—Joseph Walker, John Williamson, John Wilne, John Whittorne (whose mark Mr. Westropp *op. cit.*, p. 564) cannot distinguish from the others). There were also sons or grandsons with the same initials as the first of the name, and keeping up an unchanged mark. I take the silversmiths to have cared very little about any confusion between them in after years, except in the case of a peculiar or splendid work of art. Thus the magnificent gilt alms-dish in the College Chapel (No. 2) is marked *Let.*, not J. L., with a little crown over it, which was the ordinary mark of John Letablere. A few makers had a peculiar monogram; a few signed in italics, not Roman capitals; a few had some little crown or rosette added to their initials. This is specially forbidden in an order of the Goldsmiths' Corporation, dated October 30th, 1731 (as it might be mistaken by unwary buyers for the hall-mark); but the order, like many others of the corporation, was systematically violated. In the present case we can guess what happened. The first design for the new punch probably contained a crown, on the analogy of the crowned harp already used. Had this been adopted, and the maker's mark with the crown also used, the buyer might well be in doubt as to the value of these marks, and two might be accepted as sufficient. So some clever person bethought him of a solution, and produced the *Hibernia*, with a bare head, sitting with her harp beside her. When this was adopted, the difficulties of remaking many already well-known private punches would be such that the resolution of October 30th, 1731, was allowed to go asleep. But the majority had no such distinctive marks. The careful list of those identified by Mr. Westropp does not pretend to be complete. There are masters of the Goldsmiths' Corporation whose initials cannot be identified on any extant plate. Any dating, therefore, by these initials is most precarious, and can only be accepted as provisional.

only £21 next quarter. This is the only effect I can find noted in the records.

There were in December, 1739, complaints that it was ineffectual, and a messenger sent from the House of Commons to the Goldsmiths' Corporation to ask what could be done. The adoption of a clause in 12 George II (England) is suggested by the committee appointed in August, 1741 (p. 147). Hence there was an agitation going on in the House of Commons during 1739-41 on the reform or tightening of the law of 1730.

In 23 George II, cap. v (1749), it is enacted that, as the Act of 1730 is about to run out, the same law and its duties are imposed for twenty-one years more.

But in 25 George II (1751), caps. xx and xxi, we hear a very different story. The preamble is most instructive. "And whereas silver plate is often sold without being assayed, touched, and marked, the buyers, to avoid the payment of the duties imposed by the said Acts, *relying on the credit of the silversmith*, that the same is conformable to the standard therein mentioned, by means whereof great frauds have been committed by the workers and sellers of plate, and the duties imposed thereon diminished; for remedy whereof, and the better to secure the payment of the duties imposed by the said Act, it is further enacted that from and after May 1, 1752, *no person shall buy, take, or receive by way of purchase, barter, or exchange any wrought or manufactured gold or silver plate, or manufacture of gold or silver, of or from any goldsmith, silversmith, or any other person whatever working or trading in wrought or manufactured gold or silver (unless under four pennyweight), not being assayed, touched, and marked by the assay-master as prescribed in the Act of George II, third year, at the time such gold or silver plate shall be delivered to the buyer, upon pain of forfeiting the value thereof, to be sued for and recovered in the manner prescribed for sellers of such plate in the former Act, which said penalty hereby laid upon the buyer, as well as the penalty laid upon the seller by the former Act (George II, 3) shall be to the sole use and benefit of the informer.*" And, subsequently (caps. x and xxii *sub fin.*), "and also the person who, for the time being, shall be empowered to assay wrought and manufactured gold and silver according to 3 George II, shall once a year, or oftener, if required by the said corporation" (of goldsmiths) "lay before them a true account of all such plate, and the number of ounces thereof, as shall have been assayed by him within the interval, together with the names of the owners or proprietors of such plate, or of the persons who brought or sent such plate to be assayed, and the days and times of the stamping thereof, and the duty received for the same."

The direct effect of this Act was to stop any private sale or negotiation in unmarked plate. As the informer got the benefit in case any violation of the law was discovered, every private owner of unmarked plate was in the hands of every member of his household.

But if society took the same views of old plate as we do, the law might hardly touch them at all. Old plate is with us a treasure which few people care to sell. It was a very different affair in the eighteenth century.

I have already described the various transactions which show that in those days private owners of plate were constantly, and without any sentiment, turning it into cash.

At all events, the position of owners of unassayed plate after 1752 was this, that to give it its value it must be assayed before any attempt was made to sell or exchange it. Accordingly, the older pieces in the possession of the College were sent to the assay-office. But, as the assay master was forbidden by his corporation to assay any plate which did not bear the marks of a known maker, or of the man who brought it there, the College naturally employed a goldsmith to carry out the process for them. With his or perhaps his father's punch on it, the unmarked silver was submitted to the assayer, who put upon it, of course, the crowned harp and the *Hibernia*, having had the tax of 6*d.* per ounce paid to him.

But what about the year-letter? He had no evidence in what year the piece was made, for the inscription upon it if there was one, only gave him the date of gift. In the cases of plate made for a different purpose, as the College plate in 1741, he had evidence that the date was false. Moreover, the punches for each year-letter were systematically destroyed at the end of each year, and never laid up in store. Hence it is that in all the post-assayed pieces I have examined the date-letter is very properly omitted.

This is my explanation of what happened to our plate, and it accounts, I maintain, logically and reasonably for the facts. This *post-assaying* or *late-assaying*, must have been carried out gradually and quietly, for I can find no direct statement of the practice. It was done to make the unmarked silver saleable, whenever the College should desire to turn this part of its property into money.¹

But Mr. Westropp, when examining the College plate, raised another difficulty. He admitted, indeed, that some of these post-marked pieces were

It is very remarkable to report that the old plate-book of the College, which is often referred to as giving details of the acquisition and sale of plate, has disappeared. I fear beyond hope of recovery. If it ever turns up, we shall find in it many questions definitely answered, and shall know whether our guesses and hypotheses are true or false. Possibly the two leaves I have quoted were once part of it.

strictly in the style of about 1700, so much so that I was able to guess that the cup given by Peter Ludlow, and inscribed 1791, must have been misdated a century by the engraver, and that it really came from 1701, when the only Peter Ludlow we ever had on the books was just taking his degree, and in this case the fluted surface of the object allowed the assayer to scrape it without injuring a smooth surface. I hold that this is the case with the two soup tureens and covers given by Bishop FitzGerald (of Clonfert) in 1722. They are certainly wholly different from the style of 1750-60, and were, I hold, not remade, but only assayed at the latter date. But in the case of the many salvers we possess which have plain marks of post-assaying, Mr. Westropp holds that the style of these objects is not the style of 1700, but that of 1750-70. In most of these cases his negative opinion has clearly been proved right by the document I found and have cited; and yet, in spite of his great knowledge, I am disposed to join issue with him here on some points. His most definite argument is that our large salvers would have been set on one central foot or support, as in the case with our Abercorn salvers of 1705, and not on four lions' claw feet. Our modern form of salt-cellar, which replaced a larger "salt," as it was called, indicates the same change. But I do not think we have evidence that this change was not as old as 1707, when one such salt-cellar is dated. That salvers should have commonly assumed the form of flat silver plates with a decorated border, is obvious from the fact that we have patens and alms-plates in the chapel, dating from 1666, which are in that form. It is not impossible that claw feet may have been added in some cases afterwards; but the existence of an elaborate inscription on the back of the Huntingdon salver, which dates from 1692, on a surface which bears clear marks of post-assaying—this instance proves to me at least that a central foot never formed part of it.

There is no greater satisfaction than having a conjecture supported by subsequent expert evidence. In reply to a note from my friend, Mr. West, to Messrs. Crichton, of Bond Street, they say: "We have seen salt-cellars about 1720 with three legs, and salvers as early as William and Mary with four legs, but we think the three-legged salvers must have come in between 1720 and 1730." This agrees exactly with the date of our early gifts. Our two large salvers, given 1692 and 1713, are on four legs; our earliest dated salt-cellars are of 1707. In these cases, therefore, any theory regarding style is not conclusive, and such theory must sometimes be modified in the face of the facts adduced. The experts think they can distinguish the crowned harp of 1750-60 from that of 1730-40, and appeal to the pictures of these marks given in Jackson's well-known book. So long as I thought that the *Hibernia*

alone was added to older marks, I held this assertion of variations in the main hall-mark very doubtful, as I for one cannot perceive any gradual change or development, still less any new fashion in the crowned harp and its shield. But I need not argue this matter now, as I think it more likely that the objects post-assayed had originally no marks at all, or only the maker's punch. It makes no difference, however, to my argument whether they had or not.

As regards the objects, such as salt-cellars and candlesticks, of which we have many with date and name of donor long before the *Hibernia*, but on which no marks of post-assaying now appear, these are cases not of remaking an older gift without changing its purpose, but rather of turning an older piece into something wholly different, but more useful. Thus the Bursar may have argued: we have too many cups and not enough salt-cellars: let us turn some of the one into the other. I think we have a big example of this process in the long dinner-service still in use, of which almost all the plates and many of the dishes are hall-marked completely and show the Gothic R of 1733. They have the College arms, and no other inscription, name, or donor's arms on any one of them.

There are many other interesting questions arising out of the study of this great collection, with which I cannot now trouble the Academy. But as I am preparing to write a detailed history of the College plate, those who are not weary of the subject will, I hope, find the further materials I have discovered, and my estimate of them, in that volume.

Apart from mere archaeological interest, the subject has a practical value to all owners of, and dealers in, plate. Hitherto an earlier inscription than 1730 on a piece of plate was supposed to be at once proved false by the appearance on it of the *Hibernia*, and so far the inscription was assumed to be of a later date. If my argument be sound, it is sometimes at least not the inscription, but the *Hibernia*, which is the misleading evidence; and such cases probably occur in other collections as well as in that of Trinity College.

This discussion has been so intricate that the Academy will gladly hear from me a summary of the views which I have endeavoured to lay before it in detail.

From its very foundation the College had received a tax of plate, or of money for plate, from every student according to his rank.

The plate so accumulated, especially before the existence of banks, was simply regarded from its money value, without the smallest sentiment. Hence in one crisis (1642-8) the College lived by selling its plate, or having it made into coin. When another danger—that of confiscation—threatened (1685) a great store of it was sold to a goldsmith, and with the money an

estate was bought. Owing to these two clearances of the College plate, nothing remains to us of that date except the vessels given by the donors for the service of the Chapel, which have survived to the present day.

Since then a third revolution (1730) has been disastrous to this precious possession, but not so wholesale in its consequences—it was only a revolution in taste. When the College was rapidly increasing in wealth and hospitality, and required plate for its dinner-table at feasts, which became more expensive all through the eighteenth century, it was found that there were far too many cups and tankards, and insufficient dishes, plates, and other table ware. We have many pieces for table use which were then made, but on which the names of the original donors of the now melted pieces are commemorated. This was not possible in such a transformation as from cups and spoons into a set of dinner plates, which therefore only show the College arms. But as the rest were professedly old gifts only changed in form, the College seems to have evaded the payment of the new tax on silver, and to have saved this expense. Hence the action of the College in 1730. But in 1752 a more stringent law made it desirable that articles previously unassayed or marked should undergo the process, or else they would have no saleable value. Then the objects in the collection which were not marked, or shown to be gifts of ancient date, were sent to the assayers, and of this the salvers of 1730 show plain marks.

A few much older fluted cups and a pair of old soup-tureens underwent the same process, and so appear to have been made after 1730, whereas their style shows them to be of the date of their gift.

The main result is to show that there was such a thing as *post-assaying*—that an object issued without marks could be sent long afterwards to the assayer, who put on it the legal marks, but not the date-letter, which would have implied a falsehood.

If, therefore, as I am convinced, we have several pieces much older than 1730 in style, not to say older than 1752, marked with hall-marks of the latter date, the *Hibernia* ceases to be a conclusive evidence of the date of manufacture of any piece of plate, though it is of course a strong presumptive evidence, which must be disproved by clear arguments.

Since I wrote these words, a closer examination of our plate, in which I followed Mr. Westropp's careful catalogue, has completely convinced me that, in the older pieces of our collection, with donor's name and date of gift plainly visible, which were post-assayed, the year-letter was not omitted by accident or negligence, but on deliberate purpose.

Here are the facts on which I base this startling statement. In our collection of *inscribed pieces*, with donor's name and date of gift, we have up to the year

1800 (I omit more modern gifts), in all 158 pieces, great or small. Of these thirty-two¹ are fully marked, with the date-letter agreeing, or at most within a year or two, with the date of gift. But we also have 126 with hall-marks (especially the *Hibernia*) not agreeing with the date of gift, but long posterior. *Not one of these has a date-letter upon it.* I know that most silversmiths believe that this date-letter is so often absent from pieces of old plate as to show that the silversmiths and assayers were very careless about it, and that the strange fact I have discovered may be a mere accident—at all events, in the present case, a very strange accident. I undertook, therefore, to examine the *non-assayed* pieces we possess. Of these four have no hall-marks at all, and may therefore be discounted. There remain 230; of these, thirty have no date-letter.² But the remaining 200 have it. This surely proves to any fair mind that it was the rule to put on the date-letter, and that the omission of it in the vast majority of inscribed pieces can be no mere accident. How, then, are we to explain the facts? If my view be correct, in this very simple way. When the Act of 1751-2 made it expedient for all owners of old unmarked plate to have it assayed and marked with the *Hibernia*, the men who undertook this task wished it to be plainly known that they had not re-made or new-made the old plate, but only assayed it. They therefore very properly declined to put on a date-letter which gave the lie to the date of gift.

This applies also to the new pieces, made as we know from old plate about 1750, probably just before the passing of the Act of that year. But in the long dinner-service of dishes and plates, made as I believe from old College plate also, in which it would be impossible to separate and specify the donors' names, on this long service, consisting of seventy-nine articles, which was made in 1733 by Matthew Alanson, the year-letter (Gothic) R is plainly marked. This was the service thought so old-fashioned by the College in 1774, that a resolution which I have already read was passed by the Board, that it should be melted down, and re-made into a service more elegant or dignified for the improved taste of the age. Luckily this fell purpose was never carried out.

I cannot conclude without again expressing my obligations to Mr. Westropp for his admirable patience in cataloguing our collection. It was only when I began to study it myself, by the light of his pioneer work, that I was fully able to appreciate the inestimable value of his labours.

¹ There are also an old aims-dish and a paten, with donors' names, dated 1665 and 1669, which have only the maker's punch.

² There may be good reasons for this, as may appear on further study.

III.

THE ANCIENT SANCTUARIES OF KNOCKAINEY AND CLOGHER,
COUNTY LIMERICK, AND THEIR GODDESSES.

BY THOMAS JOHNSON WESTROPP, M.A.

PLATE I.

Read JUNE 25. Published AUGUST 27, 1917.

THE study of the great forts of the Dalcassian kings and the cemetery of the Ernai on Sliab Cláire¹ opened up many questions of interest touching not merely the earliest semi-historic legends, but complex problems of topography and of the religion of the pagan Irish. An elaborate monograph might have been attempted on the sanctuary of the great and beneficent goddess 'Aine. I think, however, the time has scarcely come when such could be completed with really satisfactory results. I may, however, give, along with the first account of the interesting remains (there and at what one can hardly question to be the site of the great 'Oenach Cúli or 'Oenach Clochair) some notes to indicate the lines on which the subject has been studied. It is very important that the sites of the Irish sanctuaries should be identified and described.

As briefly as possible let me recall that it is well established that 'Aine was of the god-race of the Tuatha Dé Danann; but so far she has not been identified with any Gaulish deity, and probably, as her legend implies, she was venerated by races established round her hill before the Dergthene subdued the district. Our literary material begins with the *Sanas Chormaic*, circa A.D. 890-910, of a period when hatred of the Norse religion had not been fostered by Danish violence into an attempt to obliterate the divinity of the early Irish gods in Christian literature. It precedes the labour of that school of euhemerists (from 970 to 1170) who confected the valuable ancient legends that they found into a patchwork of false history, and that long list of High Kings which, in the hands of "scholars" and uncritical "historians," became the opprobrium of early Irish historical studies.

In the genuine literature we can see very clearly that there was no "orthodox" standard of pagan belief; different tribes, though worshipping the same gods, gave them a different parentage;² Gaulish gods, worshipped

¹ *Supra*, vol. xxxiii, p. 492.

² There was no arch-druid as in Britain, so each tribe had its own god-myths.

of old on the continent, are there—Lug, Nuada, Cernunnos, “the horned.”¹ Cathubodua and the war goddesses, Segomo, or Camulos, the war god, and many others: but along with them are non-Gaulish gods, so far as we know peculiar to Ireland, Oengus of the Brugh, his son, Bodb Derg, Donn, under his different place epithets (like the *Bauls* of Western Asia),² river-, hill-, and lake-gods, Dechet, Deda, and his relative Febra, Cáin and his wife Aife, ‘Aine, Clíu, and the river-goddesses Sinann and Boand “of the silver forearm.” The latter goddess was worshipped with the “great god” Nuada, “silver hand,” at Sídh Nectain, and was wife of that Nechtan whose other wife, Cúil, gave her name to ‘Oenach Cúil. Clíu, from whom our district was called *Clíu* (as were ‘Aine Clíach, Sídh Clíach, and Crotta Clíach), was a supernatural harper on the “double harps of Clíu,” Crotta Clíach, of which perhaps we still see the outline in two concave *comms*, with frames and strings of water-courses, on the flank of Sliab gCrott, the huge mass of Galteemore.

In connexion with Cláire and Aife, the contradiction to the assertion in my former paper that Sliab Cláire is Sliab riach, necessitates a statement of my authorities. The objectors only quote one of O’Donovan’s notes, forgetting that he regarded Slievercagh as Sliab *Cláire* until his desire to date the undatable dolmens made him identify as Oilioll Aulom’s tomb, (“A. D. 236”) on “Sliab Cláire,” the Bronze Age dolmen on Duntrileague Hill, as he did the Clochogle dolmen in Co. Mayo with the tomb of the Maols, about A. D. 650.³ He at first held that *Cava Mór*, of Sliab Cláire in the Knocklong legend, was Slievercagh,⁴ and is evidently right; for would anyone, looking at the great *head* over Dún gClaire, turn to the low, rounded hill at Duntrileague, not far away, and call the latter the “Great Head”?

The records are against Duntrileague in this. The Agallamh,⁵ within a few lines, speaks of “Sleibhe Cláire Genn Fheabhrát” and “Dun air Sleibhe, now Duntrileague,” as separate places: one the burial-place of Oilioll, the other that of his son, Cormac Cass. Everywhere they are spoken of as different places, though the author loved to give *alias* names.

¹ Baal Amos, the Irish god, was horned, and perhaps bull-headed. D’Arbois de Jubainville (“*Ir. Myth-Cyclo*”; ed. R. I. Best, pp. 114, 218).

² Donn Dumach of the sandhills, Donn of Uisnech, Donn of Firinne, like Baal Peor, Baal Meon, and Baal Hermon.

³ From the anachronistic Life of St. Cellach (*Silva Gad-elica*, Standish Hayes O’Grady, vol. ii, p. 66); Ordnance Survey Letters of Mayo (ms. R. I. Acad., 4E 18, pp. 73, 78). Col. Wood-Martin first saw the fallacy (*Rude Stone Monuments of Ireland*, p. 236). Mr. H. T. Knox demolished the chronology (*Roy. Soc. Antiq. Ir.*, vol. xxvii, p. 430).

⁴ Ordnance Survey Letters (ms. R. I. Acad., 14E 9, vol. i, pp. 209, 257); he cites “*Forbais Drama Damhazore*.” See also note under 1579 in *Ann. Four MM.* Note, p. 2150, where he makes Slieve Claire to be Duntrileague.

⁵ *Silva Gad.*, vol. ii, p. 123; cf. vol. i, pp. 108, 109, and 114; and vol. ii, p. 123. O’Grady’s translation gives “*Shevercagh*” for the *Shebh Cáin* of the original.

The Four Masters, under 1600, tell how the Sugán Earl “came through Aherloe to Bearna Dearg,¹ passing to the *east* of Sliab Cláire.” One passes to the *south* of Duntrileague, and to the *east* of Slievereagh by that route. Yet O’Donovan actually appends to this his note of identification with Duntrileague, which it absolutely refutes. I was told by an objector that the fort name “Dunglaura,” Dun gCláire, was not found by O’Donovan on the ground, but invented for the new maps. Colonel Whitlock, R.E., most kindly gave me a copy of O’Donovan’s own note, in 1840, which shows that he found the local names “Doonglara” and “Lisdoonglar” among the peasantry on Slievereagh. For that matter, O’Donovan records “Lis dun gClaire” as a modern local form (1847) in a note on the “Book of Rights.”² Dr. Douglas Hyde gives me a modern folk-tale from Knockainey (not in the literary sources) in which “Feri attacked and burned Dunglaura”; and all this disposes of the easy, unfounded assertion that “the name was foisted on the new Survey.”

The Dind Shenchas of Cenn Febrat, which, as has been shown, agrees minutely with the mounds and rings on the hill,³ gives the heads as Cenn Febrat, Cenn Cuirrig, and Cenn Cláire;⁴ evidently the three outstanding peaks of the great plateau, over Kilfinnan, Cush, and Dunglaura. Cenn Aife is evidently Duntrileague Hill, at Glenn Aife, or Gleneefy.

The “Tripartite Life”⁵ says that St. Patrick “desired to remain *beside Clar*, at the rath of Corbre and Broccán,” and “left Colman of Kilnarath there.” Glenbrochain mote or fort, at the foot of the hill below Dun gClaire, is evidently “Rath Broccain”; Kilnarath, in 1189, was “near to Imelach Dregingi (Emlygrennan on the north slope of Slievereagh), where the Saimer runs from it”;⁶ Laraglaw or Templenalaw Church fulfils these conditions. Lastly, in the Down and Civil Survey (1651–1655),⁷ as on the present maps, the name subsists at Cnocklairy (Cnoc gClaire) or Cnocklarhy, i.e. the present Cnocklaura, not far from Dunglaura.⁸ The hasty dicta of John O’Donovan,

¹ The mouth of the pass south from Kilfinnan (Map 9, Co. Cork).

² *Leabhar na gCeart, The Book of Rights*, p. 92.

³ *Metrical Dindshenchas* (E. Gwynn, Todd Lecture Series), vol. x, p. 231; and *supra*, vol. xxxiii, p. 461.

⁴ Naturally, the important passes at the mountain have records of more than one battle—Cláire (A.M. 4169), Cenn Febrat (A.D. 186), and a historic battle (A.D. 750).

⁵ Ed. Stokes, p. 201. For Glenbrohaun mote, see *supra*, vol. xxxiii, p. 468; and O. S. Letters, p. 211.

⁶ *Calendar of Documents relating to Ireland*, vol. i, Charter of Prince John to De Magio Abbey.

⁷ D. S. Map, No. 53; C. S., vol. xxv, p. 5.

⁸ I was told that “Slieve Claire can be the name of any hill, for *clair* is a plain”! In fact, I only know of two hills of the name, in Westmeath and Thomond (Co. Limerick); *Sauas Chormaic* derives it (p. 35) from “Clu Aire, ridge of Aire.” No old authority gives it as *clar*, a plain.

whose identifications for this district are contradictory,¹ and in some cases impossible, are too often used by certain present-day antiquaries to oppose original search and progress in local topography. This needs strong protest on our part to try and prevent the dicta becoming stereotyped.

KNOCKAINEY (Ordnance Survey Map, No. 31).

First, as briefly as possible, let us see the traditions of this remarkable ridge. Many records about Clú or "Clíach" do not necessarily belong to it, though identified with it by compilers. The battles of the two "High Kings," Eochu, in "A.M. 3772 and 4422" (B.C. 1428 and 778) in Clú are the same event uncritically dated by various euhemerizers. The battles of Cormac mac Airt in "Clú" refer to the large district in south-east Limerick and its continuation in Co. Tipperary, reaching from Glin on the Shannon and Temair Luachra past the Galtees. The most important legend, evidently pre-Christian, is embodied in a comparatively late poem by Ua Chiarmaic's bard, about 1080-1120—"Aine's history tell to me."²

Five tribes of the Firbolg—"The Dilraighe, Margraighe, Sibenraighe, Calraighe, and Gargraighe"³—dwelt round the hill and got firewood from "rampart (*adulh*) girt Druim Collehoilli (hazel ridge) that dominates the Munster tribe called Mairtine, who were accomplished warriors." Uainide and Eogabál, sons of Donn, of Uisnech, sought to settle there and were repulsed. They had been advised by Nechtan [the god of Sid Nechtain and husband of the Boyne goddess] to win "a pleasant hill,⁴ the cool Cnoc 'Aine." The fair-haired daughter of Eogabál,⁵ 'Aine, promised to save bloodshed if the hill were given to her till the end of the world. The pledge was given, and by her spells she drove the five battalions into Luachair. The victors divided the hill: Uainide held the north, facing Uisnech, his old home; Ferfi (Eogabál's son) "the south, with his dwelling in a comely cairn"; Eogabál was at the western, and "'Aine at the eastern point." This has important bearing on the identity of the existing remains. The wives of these gods were Emer, Cacht [the *Bacht* of a later cited tale] and Eter; 'Aine was unmarried.

¹ See his unrevised letters and contradictory statements in O. S. Letters, vol. i, cited above.

² *Silva Gad. (Appendix), vol. ii, p. 575, from Egerton ms. 92f, 37b.*

³ Elsewhere the Dilraighe are called Chlraighe, the Gargraighe, Gregrraighe, and the Sibenraighe, Semraighe. (List of Aithech Tuatha, Egerton ms. 92f, 37b; *Revue Celtique*, vol. xx, p. 336).

⁴ i.e. "a ceremonial hill": cf. *Ancient Laws of Ireland, "Book of Acaill," vol. iii, p. 296bf, and the Tuatha Dé, in the "pleasant hills."*

⁵ "Durgabál" in *Agallamh*, p. 225.

A few points call for notice. I hope to study later the history and legend of the Mairtine tribe.¹ The saga of "Magh Leana" calls them "the champions of Clíu,"² before that battle, in the Bregian campaign, "circa A.D. 160." They were severely raided by the Norse in A.D. 845, both in south-west Co. Clare and in the Emly district, and disappear. The name Druim Colchoilli and the hazel thickets recall that Tara, too, was a "Druim Colchoilli"; "a pleasant hazel ridge." The "*pleasant hills*" were defined as "*ceremonial hills*";³ bundles of firewood were offered to "the king of the *sidh*," or sacred mound, at Rath Cruachan, and there is much early evidence for supernatural power (benignant) of the hazel, and (deadly) of the white hazel.⁴ The feast of nut-gathering was kept on Samhain, or All Hallows night, as we still burn or eat nuts.

The *Sanas Chormaic*⁵ contains (circa A.D. 890-910) probably the earliest extant mention of 'Aine—"Aine Cliach, the highest ground in Clíu, named after 'Aine, daughter of Eogabál, of the Tuatha Dé Danann."

Next in legendary order, the drunken raid of the Ultonians reached to 'Aine. Bewildered in the great oak woods, they asked Cúchulaind to "take their bearings." He and his charioteer, Lóg, ascended 'Aine's Hill (as they did in Muirthemne)⁶ to look around. The "Hound" points out the landmarks. "To the south is Cenn Abhrat Slebi Cáin" (Slievereagh); "to the north, Sleibti Eblinni" (Slievephelim); "the bright sheet of water is the *linn* of Luimneach" (the Shannon estuary); in the distant hills ahead was their objective, Curoi's great fort of Temair Luachra. I have seen from Knockainey all these hills, but not the river; still (as I only once saw it from Slievereagh, and know how many conditions of air, light, and tide are requisite to make it visible), I do not deny that it can be seen from Knockainey. The Ultonians set up pillars to shelter their horses from the snow,

¹ Annals Tighernach; Rev. Celt., vol. xvii, p. 416; Ann. Ulster, 1084; Four MM., B.C. 1412 and 1043; "Battle of Magh Leana," pp. 76-79; "Book of Lismore," f 172, at Clar, or Cooraclare, Corcovaskin; "Wars, Gaedhil and Gaill," pp. 15, 227.

² I presume of the supernatural harper Clíu—like Nía Segamain, "Champion of Segomo," the Fomorian "champions of the Sidh," and Mogh Nuadat, "servant of Nuada."

³ Ancient Laws of Ireland, "Book of Aicill," p. 296 n.

⁴ The hazel was a "chief tree," the white hazel a "shrub" (Ancient Laws, vol. iv, p. 147). White hazel smothers men with gas (Duanairé Finn, p. 136); hazel offered to the Sidh-King (Echtra Nerai, Rev. Celt., vol. x, p. 219); Chief compared to hazel (Proc. R.I.A., vol. iii, ser. iii, p. 549); heavenly hazel (Irish hymn to the Virgin); nut feast (Folk Lore, vol. iii, p. 500, and "Sick Bed of Cuchullin," Atlantis, vol. i, p. 371); Hazel of Wisdom (Dindsenchas of Tuag Inbir).

⁵ Ed. Whitley Stokes, p. 9.

⁶ Mesca Ulad, p. 15, and "Legend of Goll and Garbh" (Rev. Celt., vol. xiv, p. 401). In the latter case, they ascend merely to admire the view. The Irish long forestalled other nations in their admiration for scenery.

"so the *echlása* of the horses of Ulad still remain"¹; evidently the bard had heard of a group of pillars on the ridge. The army, then, went southward towards Cenn Febrát, and reached 'Oenach Clochair (now, as I hope to show, Clogher), though, being winter, it was not the time for the "fair."

The *Táin Bo Cualnge*² names "the three Eochaidhs from 'Aine," and Bruchnech from Cenn Abrat, and the three Cairbres from Clíu." The late "Battle of Ventry"³ includes "the three Eochaidhs of 'Aine" among the divine Tuatha Dé Danann. Fergus MacRóig fought seven battles round 'Aine.⁴ The best-known legend, already mentioned,⁵ tells how Oilioll Aulom, tending his horses on the hill, on Samain eve, when the *sidh* mounds opened, slew Eogabál⁶ and violated 'Aine⁷ who bit off his ear, whence the surname *Aulóm*, the earless. Her brother, Feri, avenged this by raising the quarrel between Oilioll's son and stepson, Eogan and Lugaid macCon, which resulted in the battles of Cenn Febrat and Magh Mucrama, A.D. 186 and 197.⁸ More probable legend suggests the cause of the quarrel in the passing over of Lugaid in favour of Eoghan in the succession to the kingship of Munster.⁹

Legend of later period tells how Cairbre Muse sang at Knockainey before King Fiacha Muillethan, late in the third century, and was given the land he could see from it, i.e. from Loch Derg (Craglea and Thountinna, flanking the end of that lake, are visible from 'Aine) to Cenn Febrat.¹⁰ This at least implies that musical contests took place there in early times. In about A.D. 380 the possibly historic account of King Conall Echluath,¹¹ consolidating his father's conquests, names the fort (*dún*) of 'Aine and that of Loch Gair

¹ A similar name, "Echlasc ech Conculainn" (goad of C.'s horses), is in Agallamh, p. 161.

² Ed. J. Dunn, p. 351. The section is probably an addendum to the old saga.

³ Ed. Kuno Meyer, pp. 13-15.

⁴ Ossianic Soc., vol. v, p. 265.

⁵ *Supra*, vol. xxxiii, p. 479.

⁶ Cf. *Dá Derga's Hostel* (Rev. Celt., vol. xxii, p. 308). The *sid*-king condemns men who wrought falsehood in the mounds to be slain by the King of Tara. Was the "king" a priest, like the "Rex" in Republican Rome? For the king-priest, as personifying a god, see Dict. Relig. and Ethics, vol. iii, p. 293. cf. Tacitus, History, ii, c. 61.

⁷ The Celts, like the Norse, showed little respect to their deities on occasion. Cormac may have been a monotheist, but he was aided by druids in preventing the gods from alighting in Ireland. Cúchullin broke the Lia Fail for not roaring under him, or, as some say, his candidate for the kingship. [Echtra Conla, Celtic Review, vol. v, p. 17; Book of Leinster, f. 9. Tara Hill, Trans. R. I. Acad., vol. xviii, pp. 48, 147; Metr. Dinds., vol. viii, Pt. i, pp. 21, 87].

⁸ See *Fianagecht* (Todd Lectures, vol. xvi, pp. 89, 43); *Silva Gad.*, vol. ii, p. 34, and Rev. Celt., vol. xiii, p. 438, for battle of Magh Mucrama.

⁹ "Battle of Magh Leana" makes this clear.

¹⁰ Keating's History, vol. ii (Ir. Texts Soc., pp. 100-101), however, says from Slighe Dala to Cnoc 'Aine.

¹¹ From Psalter of Cashel: cf. Keating's History.

(Gur), and Máig (Bruree). Last of all, we are told that St. Patrick visited Druim Collehoilli or 'Aine Clíach, about A.D. 440.¹ It is not named in the older "Lives," but the saint evidently liked to beard paganism in its sanctuaries and palaces.

In the historic period little bears on the remains. We hear of a battle of the Arada and Ui Fidgeinte there, and are elsewhere told that the Saimer River was the mearing of their territory,² and it flows not far to the south-west of the hill. King Mathgamain of Cashel, brother of Brian, ravaged the Ui Enna (O'Heney), princes of 'Aine, who got presents from the King of Cashel on May Day.³ Later, in the early twelfth century, the Ui Chiarmaic were its kings, in 1115 and 1123. Ruaidri, the last titular "High King," visited it in 1167 and 1168. After the death of Domhnall mór Ua Briain, King of Munster, in 1194, the Normans acquired south-eastern Co. Limerick, and established a castle and manor at Ainey. Castel D Any and its "fair," probably the ancient 'Oenach, are mentioned in 1226 and 1295, and also in the Desmond Inquisitions, 1583.⁴ The place rose again to some importance, and two castles were built by the Geraldines in the fifteenth century; but its interest centres in its legends, folk-lore, and the remarkable remains of the sanctuary of the goddess 'Aine on its hill.

IRISH GODS AND THEIR SHRINES.

The older theorists have made modern antiquaries afraid to use the words "god," "temple," or "sanctuary" in Irish matters. Still, keeping on scientific lines, it becomes necessary to render *Síd* as "god," or "god's mound." Nothing but confusion and false suggestion arises from any other form. The *demon* chariot or *fairy* chariot is better called the *supernatural* or *divine* chariot, for the other equivalents suggest rather the supernatural beings of the *Inferno* or of the *Midsummer Night's Dream* than gods like those of Olympus. "Banshee" suggests a hideous, ominous hag, not a bright, kindly, and glorious goddess, like Juno or Minerva, or, I may add, 'Aine of Knockainey, and Aibinn of Craglea.

A few notes on this obscure, but most important, subject, are necessary to our present study. 'Aine has been identified with the mother goddess Ana.⁵

¹ Agallamh, p. 576.

² Story of Mongan in "Imram Brain, The Voyage of Bran" (ed. Meyer and Nutt), p. 50.

³ Book of Rights, pp. 78, 87, 89, 93.

⁴ Inq. 10, "una feria tenebatur ad Any"; also 1587 (Fiant 5032).

⁵ Ana or Dana. See Sanas Chormaic, p. 4. The Kerry "Paps" ("Two breasts of Ana," "Dana" or "the Morrigu") and Es Danainne Fall, at Doonass, attest her cultus in Munster. The first name also attaches to tumuli at Brugh. Finn saw two *Síd*-mounds open at the Paps.

That her parentage is different (as we noted) proves little. The Celtic mythology suffered from a plague of alias-names, which obscure the identity of the various gods, so many risks beset questions of their identity. However, several, like Lug, Nuada, and Segomo, are safely identified in Gaul, Britain, and Ireland.¹ Taranis, the thunder-god, was worshipped as Terun (or Etherun) at Tara,² another hazel-ridge. Segomo, the war-god, had devotees, perhaps reputed descendants or kindred, in Co. Waterford, and among the Dal Cais of North Munster.³ Brigid, or Brigend, or Berecynthia, a war-goddess, was revered in Gaul, Spain, Britain, and Ireland, as the names Brigantia, Brigantes, Bregond, and Ptolemy's Brigantes (the last two in Munster) attest.

But the Irish gods were eventually degraded. Nuada Argetlamh ("the great god Nodens," or Ludens, in Britain), gradually fell to be a dead hero, and, worse, a mean, "ill-conditioned fellow," a wizard, and pestilent magician. Lug,⁴ the glorious sun-god, the patron of the towns called "Lugdunum," on the Continent, became a dead king.

Other religious features are common to Gaul and Ireland. To take a single example, the holy grove, or *nemeton*, was the *fidh nemeth* of the Irish:⁵ but, with us, the yew and the hazel, perhaps, ranked above the oak, although many of the great *hols*, or sacred trees, like the Eo Mughna and Eo Rossa,

¹ For the general subject of the Irish gods see Rhys (Hibbert Lectures, vol. iv); D'Arbois de Jubainville, "Irish Mythological Cycle," and article on Celtic gods (McCulloch), "Early History of Religion and Ethics," vol. iii, especially pp. 284 sqq., and vol. vii, pp. 258-60.

² "Etherun, idol of the Britons" (Dindsenchas of Temar).

³ All names in the Tíamonn legends, found also on British and Gaulish monuments, see *Irish Art*, Adams, Brigus, Camul, Cass, Cunan, Conic; the prefix Cuno, Cathall, Dara, Garmanus, Ingus, Lugodis, Mor, Nodien, Nem, Nemet, Segomo, and Vlatu. (See *Rev. Celt.*, vol. i, pp. 293-8.)

⁴ Nuada, so described in Agallamh, p. 152. The ostentatious, doubtless, his "silver hand" (most vivid picture of a disarmed river-mouth), as Brand's "silver fore-arm," is the Boyne River. The epithet was probably invented in Britain, where the great river-mouths impressed the Gauls. We see "Blood-red Nuada silver hand" in a poem of St. Columba (*Ossianic Society*, vol. v, p. 255).

⁵ "Lugh, like the sun in splendour, men were not able to look on his face" (*Atlantis*, vol. iv, p. 161).

⁶ "Segomor . . . made Bilsamun (the crafts goddess) this *nemeton*" (Rhys, Hibbert Lectures, vol. iv, p. 40). See *Ann. Irish Laws*, v. l. 1, p. 165, for "Fidh nemeth" and "Dolth." Also burning of *Fidh nemeth*, Armagh, c. 996. Drunemeton was a chief sanctuary in Gaul. The *nemeta* were scenes of human sacrifice (Lucan, *Pharsalia*, book iii). Taranis, Teutates, and Hesus were the Gaulish triad to whom human beings were offered. Perhaps the Irish equivalents of the first two, Etherun and Segomo, at Tara and in South Munster, were thus honoured. Cenn Cruach was perhaps a "hill-god" ("head of the mountain"); he received human offerings; and the summit of the Cruach of Cloughpatrick, in Co. Mayo, 2 ft by a great dry-stone rampart, appears as the scene of a spiritual struggle of St. Patrick with the demons and with "Crom Dubh."

were of the latter species. The grove of 'Aine was clearly of the second "tree."

But who was 'Aine? The occurrence of the name of Aife at Gleneefy, and the lost "Cenn Aife," not far from 'Aine's hill, suggests that the two ladies may be the fairy goddesses 'Aine and Aife,¹ who, with Clidna and Aibinn,² figure so largely in Munster folk-lore. The first two are closely connected with Manannán mac Lir,³ the sea-god. The "Duanaire Finn" tells how the lady Aife was transformed into a crane in his house, and how he killed Fer Fidhail,⁴ son of Eogabál, of Síd Cliath, who was his pupil, and bore a forked javelin (? trident). Another tale in the "Agallamh"⁵ tells how 'Aine, daughter of Eogabál, married him (Manannán) on condition that he gave his wife to her brother Aillen.⁶ Aife was wife of Cáin, of Cenn Febrát slebe Cáin, evidently one of the group of mountain-gods in Clíu.⁶ Others said the ladies were daughters of the sea-god, and 'Aine at least was a goddess of fishers at Dunainey, on the coast.⁷ This does not make the Aillen tale impossible in the known laxity of pagan ideas,⁸ for what was abysmal sin in the law of Sinai and Galilee was sacrosanct among the kings of Persia, Peru, and Egypt. In a late tale the sea-god's son, Etar, died of love for 'Aine, and was buried (a late mark) on the peak of Edar⁹ or Howth—the "Edros" of Ptolemy. In the "Sleep Song of Gráinne,"¹⁰ over Diarmait, we hear of "the

¹ O'Rahilly's Poems (Ir. Texts Soc., p. 203) place Aife's *sidh* in Sliab Eibhlinn. "Aife's cows" were rocks on a hillside (see Rev. Celt., vol. xiii, p. 378; and Metr. Dind., vol. x, pp. 115, 231, and 499). Her name meant "hillside." For Aoife, wife of Lir, who turned his children to swans, and was turned to an air-demon, see "Fate of Children of Lir" (Atlantis, vol. iv, p. 119). Her father was reared in the god Bodb Derg's síd-mound.

² Aibinn, or Aibhill. See Folk-Lore, vol. xxi, pp. 186-7. Aibinn's name, like that of "Crom Dubh," or "the Daghdá," is concealed under an epithet, the "pleasant" or "lovely."

³ The Dindshenchas says that Clidna, Aife, and Edain were daughters of his *Ollamh* (under "Clidhna" and "Tuag Inbir"). There were probably Milesian attempts to affiliate 'Aine to the Gaulish pantheon. The Eogabál legends may be the non-Milesian element. 'Aine's foster-sister, Becuma, was seduced by Manannán's son (Eriu, vol. iii, pp. 151, 163). She sought refuge in Eogabál's *sidh*.

⁴ Rev. Celt., vol. xvi, p. 152; for the crane, see Duanaire Finn, p. 118.

⁵ Pp. 225, 196. St. Patrick calls it "a complicated bit of romance"!

⁶ Metr. Dinds., vol. x, p. 115. Deda was a lake-god at Killarney (Eriu, vol. i, p. 184). His brother, Febra, also honoured at Cenn Febrát, is probably divine, like him, Aine and Aife.

⁷ Roy. Soc. Antt. Ir., vol. ii, p. 36.

⁸ For attempts to bowdlerize such tales see those of Clothra, Nes, Cairbre Musc, and Duben (Silva Gad., vol. ii, p. 535; Roy. Soc. Antt. Ir., vol. xl, p. 184); Clothra in Keating's Hist., vol. ii, p. 233; Nes, Rev. Celt., vol. xvi, p. 149.

⁹ Dindsenchas, Rev. Celt., vol. xv, p. 331.

¹⁰ Duanaire Finn, p. 197.

sleep in the west of 'Aine, daughter of *Gailian*, what time she fared with Dubthach," which recalls "the wife of Dubthach," revered in the cemetery-sanctuary of the *Ernai*, on *Cenn Febrat*, not far from 'Aine's Hill. This suggests that various legends differed as to 'Aine's father,¹ calling him *Eogabál*, *Durgabál*, *Gailian*, and *Manannán*.

Of the other divine occupants of the sanctuary hill and mounds of *Knockainey*, we find several sons of *Eogabál*—*Ferí*,² *Ferfí*, *Fere*, *Fernait* or *Fer Fídal* (still remembered there, like 'Aine), *Aillen*, *Lu*, and *Fainle*. Another supernatural lady, *Bacht* (the *Cacht*, wife of *Eogabál*, of the poem), came from *Síd Cliath* to *Drom Fingín* (*Killfinan*) to confer with *Fingín mac Luchta*, King of *Munster*,³ and we hear of *Émer*, wife of *Uainide*, and *Eter*, wife of *Ferí*: perhaps the lady *Étar*, connected with *Ben Edar*, in other poems. In the North of Ireland 'Aine is the *Cailleach Bheara*, who, at *Knockainey*, is reputed to have made the curious *casán*, or causeway, over the *Cammogue*. *Donn*, under many epithets,⁴ is revered in many places, as in the sand-hills of the *inchee*, at *Lehinch*, Co. *Clare*, and at the fairy-cairn of "Strickeen" on the summit of *Knockfirina* (under the name of *Donn Fírinne*) visible from the cairn of 'Aine.

THE GODS' FORTS.

Many Celtic gods were patrons or makers of forts.* The god *Lug* gave his name to three places called *Lugdunum* or *Longdounon*. *Lyons* and *Leyden* show a shadow of his name, and his August festival, the Irish *Lugnasadh* was observed at one of them.[†] *Camulós* gave his name to *Camulodunum*; his equivalent, "Segomg," bore the epithet "dunates" (of the *dee*, from earthworks). *Nuada*, *Nolens*, or "Ludens," held the British fort *Dinn Llud* and probably *Ludgate* in *London*. In *Ireland* the difficulty is to select analogies, not to find them. The *Dagda*, with his huge

* Variant parentage was common in Irish allusions to gods and heroes: cf. the war-goddess (*Rev. Celt.*, vol. i, pp. 330-331); *Finn's* divergent genealogies, and *Macha*. Also see *Rev. Celt.*, vol. xvi, p. 46. *Nuada's* father varies in many sources.

¹ *Ferí* (*Told. Lect. Ser.*, vol. xv, p. 3); *Fernause* (*Agall.*, p. 248); *Fer Fídal* (*Rev. Celt.*, vol. xvi, p. 152).

² *R. Ir. Acad.*, Irish Texts Ser., vol. i, p. 9, from *Book of Fermoy*.

³ *Celt. Finnegian* (ed. Meyer), pp. 1, 13-15; *Agallanb.*, p. 225. For his connexion with *Knockanna* see *Lewis*, "Topog. Dict.," p. 114; *Introd.*, *Féis tighé chonain*, p. 93; and *N. Munster Arch. Soc.*, vol. i, p. 108.

⁴ See *Rélys*, *Harriet Lect.*, vol. iv, for *Lug*, *Nuada*, and *Camulós*; also "Irish Mythological Cycle" (*De Jubainville*).

[†] On *August 1st*, rededicated to the Emperor *Augustus*, "All Gaul met at *Lugdunum*."

[‡] The term "Dunates" or "Dunns" (*Rev. Celt.*, vol. xxxiii, p. 463) probably refers to the *Puy de Dôme*.

fork, cut the double trench of *Lorg an dagdae*. He also fortified Ráith Breise, and built the Grianán of Ailech, which latter was also sacred to the war-god Neit—"Ailech Neit, on account of Neit's splendour."¹ Oengus, son of the Dagda, made a *dún* and *dindgna*, with a lofty *sonnach* or palisade.² Manannán dwelt in Dún Inbir; his father, Lir, in Síd Fiondachaid dún;³ Lug, in a rath; and the war-goddess in Lis na Morrighna, or Maiste, the great fort of Mullaghmast.⁴ Nuada left his strong fort of Almha to his son Tadgh.⁵ Balor, the demon-god, had his fortified promontory of Dún Balor, on Torry Island,⁶ as the four-headed Suantowit had his entrenched temple on Arcona headland. (Borlase recalls "Ardchonain" on Torry.) Imlech, descendant of the god Nuada Argetlamh, "built" forts in Imlech-Fir Aendarta (called after him), now Emlygrennan, at the foot of Sliabhriach.⁷ The Tuatha Dé dug Rath coraind,⁸ and the horned, bull-headed god, Buar Ainech, like the Daghada, was rath-builder to Bress.⁹ Little doubt that in the three rings of Dunainey, on the Knockainey Hill, the triad of gods, Eogabál, Feri, and 'Aine, were supposed to dwell; and they had also their cairns, of which 'Aine's one was evidently called Síd clíath, the sacred mound of Clíu. It and Uainide's cairn are extant.

SÍD MOUNDS.

The perpetual difficulty of Irish archæology is the vagueness of its nomenclature.¹⁰ As the ring-forts of earth and stone and the promontory and square forts are called dun, liss, rath, dangan, port, and cathair, so the word *síd* connotes no type. Tumulus, or feudal mote, disc barrow, or house-ring cannot be distinguished by external features alone;¹¹ even excavation often

¹ Battle of Moytura, p. 187; and Agallamh, p. 131.

² Agallamh, p. 11.

³ Mr. H. T. Knox describes the curious Cashelmanannan at Rathcroghan (Roy. Soc. Antt. Ir., vol. xlv, p. 26). For Lir see "Childrea of Tuireann" and "Children of Lir" (Atlantis, vol. ii, pp. 115, 125; vol. iii, p. 386; vol. iv, pp. 115, 145).

⁴ Agallamh, p. 217; *Irische Texte*, iv, 1, 4812, 4818.

⁵ Tadgh, see (Harleian MSS. 502, p. 148 b; Book of Leinster, f. 320 d; Book of Lecan, f. 407). See also for Tadgh's fort Harleian MSS. 5280; Atlantis, vol. ii, p. 120.

⁶ Identified with the mythic High King Tigernmais in early sources. Ulster Journal of Archæology (old series), vol. i, and O'Donovan's note on Balor, Ann. Four MM., vol. i: cf. Borlase, Dolmens of Ireland, vol. iii, pp. 1087, 1164.

⁷ *Supra*, vol. xxxiii, p. 470.

⁸ "First Battle of Moytura," Eriu, vol. viii, p. 31.

⁹ Book of Leinster, f. 50, col. 1.

¹⁰ "Sidh and Dun" (Echtra Nerai, Rev. Celt., vol. x, p. 221), "a dinn, a dun, an admirable (i.e. ceremonial) hill" (Book of Ballymote, p. 490), "Rath and Sidh Cruachan" (Rev. Celt., vol. xvi, p. 463), "Hunting mound, residence, outlook, and burial-place" of Duma Selga (*ibid.*, p. 471).

¹¹ To assert that it can be done is very injurious to sound archæology, and encourages people unacquainted with Irish records and remains (and even some Irish writers) to indulge in baseless theories.

proves that the same structure was a house and a tomb. Doubtless, the temple and tomb were often identical, and the mighty dead became a god for ages, and reverted again to be a dead man. *Síd* was used for haunted knolls of rock, like Crag an Aibhíll, above Killaloe, "Campul na Muckagh," and the *Sídhéan* on Inisatürk,¹ Cnoc Dabilla, or Rockabill, off the coast of Leinster, and the Bull Rock, "Bui," off that of Munster.² The rocky hill of Almha was a *síd*, and that of Cashel was called *síd druim*.

The mote-like high mound was also *síd*: like the most famous one at Raith Cruachan, in Connacht; Magh Adair, Co. Clare, and Clogher, in Tyrone, are most probably congeners. The great *síd bhraig* of the god Oengus was Newgrange tumulus, and those of Knowth and Dowth, near it, were dedicated to Boodan and the shepherd of Emain, the god who once owned Newgrange. Emain had a *síd* (presumably the flat-topped mound levelled in Victoria's reign), and Tara had one to the north of the well Neammach and the stream Nith.³ Ring forts, "unroofed green raths," could be *síd*, like *Síd Findachaid*.⁴ Like Knockainey, Carbury Hill, or *Síd Nechtain*, had a mound and two rings, evidently of the triad of Nuada, Nechtan, and his wife Boand, the Boyne.⁵ Most probably the conjoined rings of the Clogher group were the *sídh* of Nechtan and his wife Cúil.

The diminutive term *sídhéan* was equally vague. The "sheeuan" on Inisatürk and *Craicín na t-áibhí*, in Co. Clare, were fortified rock knolls. Lissatooman (*Liosán tsíbhán*), not very far from the last, is a shaped natural hillock; so is Barrinagh in Co. Roscommon.⁶

The *síd bhraig* had sometimes a well, pillar, and *feithche* or green near it.⁷ Magh Adair mound has an enclosure and one (perhaps two) pillars. Lissatooman, near Brinné,⁸ has a small pillar on its summit, and Newgrange had another.

As to the conjoined rings, the very complex ones seem peculiar to Co. Limerick. Ouloughtragh, on Slieveragh, Dunainey, on Knockainey, and

¹ Proc. R. I. Acad., vol. xxxi (Clare Island Survey, Part II), pp. 50, 51.

² But see L. na RÚidhíre and R. Soc. Antt. Ir., vol. xi, pp. 184-5; Cnoc Dabilla in Dindshenchas.

³ "Síd bhraig Emain Macha," perhaps a holy place of the war goddess Macha (the mountain G. sídhéan). Rev. Celt., vol. xv, p. 463, vol. xvi, p. 46. "Emain, the Truth De. came to it from the west" (O'Grady's Catalogue of Irish mss. in British Mus., Egerton iii, p. 404).

⁴ Dindshenchas, Revue Celt., vol. xvi, &c.

⁵ "Children of Lar" (Sídha God., vol. ii, pp. 379, 382); "Atlantis," vol. iv, p. 145.

⁶ "Boyne and Blackwater," p. 29.

⁷ For these see Proc. R. I. Acad., vol. xxxi, Part II, p. 51; R. Soc. Antt. Ir., vol. xxiv, p. 345; vol. xlv, p. 48; vol. xlv, p. 307.

⁸ Irish Texts, vol. iv, pp. 229, 255, 258; "Féis t-úche Cheman" (Introd.), p. 88.

⁹ *Supra*, vol. xxxiii, p. 490.

Doonakemna, on Barna Hill, have respectively four (or five), three (or four), and three rings, three always in line.¹ Killulla, Co. Clare, has two conjoined and a third joined to them by a straight earthen mound. The conjoined two rings are more common. They occur at Tara, Uisnech, and several presumed 'Oenach sites, Clogher, Monasteranenagh, and Cahermee.² A good example is found in Controversy, Co. Tipperary; three, with a circle and a shield-shaped annexe, are near Quin, Co. Clare.³ As to the disc barrow, such as Cooloughtragh and Dunainey seem to be, it seems fairly certain that the demolished *Treduma Nesi* at Tara consisted of three conjoined mounds, not concentric rings. Near it was an evident disc barrow, a flat ring with a little central mound (cnocán), called "The shield of Cú Chulaind."⁴ He (as we know) was son of "the goddess Dechtire" (some said by the sun god Lug), and nephew of the "earth god Conchobar," son of Ness, who was revered at other rings, near his "Shield" and "Head and Neck" mounds.⁵ The connexion of other rings and mounds with the cultus of the *bile* trees⁶ lies outside the present subject, though there was probably a sacred hazel grove at Knockainey.

MODERN REVERENCE OF 'AINE.

Condensing from my own notes⁷ and the full and valuable ones of David FitzGerald in 1879,⁸ I must give a short account of the folk-lore and observances of Knockainey, leaving others to complete them. 'Aine was a

¹ A similar triple earthwork is shown on the old map (O. S. Carlow 16) near Bagenalstown in Kilcarrig. It only appears as double on new map.

² One mound near Cahermee fair green contained a cist; so did Knockaun Liss, near Mallow racecourse. The fair and race probably each represented an early oenach, as do the fairs of Cush, Aine, and Knocklong.

³ Proc. R.I. Acad., vol. xxvii, p. 231, p. 379, and Plate xxxii.

⁴ Rev. Celt., vol. xv, p. 287.

⁵ See Dind. S., Rev. Celt., vol. xv, p. 288. The cairns lay north and south, like the Cush and 'Aine rings. The king was forbidden to go round Tara *deisiol* (Bruden Da Derga, ed. Stokes, p. 19). The inauguration ceremonies at Tara were very archaic (Eriu, vol. vi, p. 134). For the "goddess Dechtire and the earth god Conchobar," see Book of Leinster, f. 135 b, Rhys, Hibbert Lectures, vol. iv, p. 143. Cuchulaind was revered at Tara and perhaps at Síd Setanta in Muirthemne (Irische Texte, i, p. 215).

⁶ For the *bile* trees, see Ann. Four MM., 982, 1051, 1099, 1111, 1143. The Bile Buada (Atlantis, vol. ii, p. 102). Bile ratha ("King and Hermit," Meyer, 456-7). Also see Imram Bran, "The Voyage of Bran," p. 57; Ancient Laws, vol. iv, p. 143; Tain bo Flidhais (Celtic Review, vol. iv, p. 23), and Dindsenchas (Rev. Celt., vol. xvi, p. 277).

⁷ I heard of 'Aine and the red bull, the meadowsweet, and the Garrett Earla legends at my old home, Attyflin, farther north, about 1870, from the peasantry.

⁸ Rev. Celt., vol. iv, pp. 185-191. See also vol. xiii, p. 435. Nicholas O'Kearney in R. Soc. Antt. Ir., vol. ii, p. 32, and Introd. to "Feis tighé Chonain," pp. 93 and 169, says Miluachra, 'Aine's sister, is "The Cailleach Bheara." His theories are unreliable in some cases.

water spirit, and has been seen, half raised out of the water, combing her hair. She was a beautiful and gracious spirit. "the best-natured of women,"¹ and is crowned with the meadowsweet (*spiræa*), to which she gave its sweet smell. She is a powerful tutelary spirit, and (aided by Cleenagh and Aibhell) attacked and repelled the grim Atropus from a sick man.² She was connected with the moon, for her hill, "Carron Hill" (*recte cairn*), was "sickle"-shaped and meant "sickle hill," and men, before performing the ceremonies, used to look for the moon (whether it had risen or not), lest they should be unable to return. They used to go in procession on St. John's Eve, carrying lighted wisps (*cliar*, whence "Aine Cliar," *recte cliach*), encircling the hill, and visiting "the little moat called *Mullach cruachain laimhre leab' an triuir*," the mound of three persons³ (perhaps the local triad), visiting the tillage and meadows to bring luck to the crops and cattle.⁴ Some girls, who lingered behind one time, saw 'Aine, who asked them to go, and showed them, through a ring, that the hill was crowded with fairies. Once the procession was not made, out of respect to a dead neighbour, but the fairies were seen marching round the hill-top. 'Aine was violated by the Earl of Desmond (a recollection of the legend of Oilioll Aulom). She had a son, Geroid Iarla, "the magician Earl of Desmond," who is still seen riding over (or glittering under) the ripples of Loch Gur till his horse's golden shoes are worn out.⁵ She owned a red bull, with which she entered the "green hill." "She, or the Cailleach Bheura," laid the great blocks of the *casán* over the river. Indeed the *Sliocht 'Aine*, several local families,⁶ descend from her in the female line. As to the procession round a mound or cairn, the King of Tara was forbidden to go *deisiol* round that sanctuary, though other persons performed the rite there between two cairns. The Agallamh has "around the *bragh* let him walk *deisiol*." A poem, A.D. 555,

¹ This trait appears in old literature, as where she befriends Becuma ("Adventures of Art," *Book of Fermoy*, p. 139, *Eriu*, vol. iii, p. 163).

² See poem of 1737 in *Introd.* "Féis tighé Chonán," pp. 93-169. Cf. Cuchulaind's fight with Hercules, and the defeat of the Tuatha Dé by the Philistines. In later days absurd pseudo-classic "ornament" is common.

³ So Tara is "Tulach an Tur," from the "three fairy youths" of Eman (*Battle of Magh Leana*, p. 92). It was forbidden to disturb a meeting-tulach, or quarrel in a fort (*Anc. Laws*, vol. i, p. 175).

⁴ Compare the cultus of the *Matres* in Gaul, deities "of growth and fertility," "worshipped at large central gatherings during the great festivals" (*MacCulloch, loc. cit.*, p. 279).

⁵ *Rev. Celt.*, vol. iv, p. 191. Or, as more usually said, "when the silver shoes of his horse" are worn out.

⁶ She was called the "Lady Awney," of "Orange," in 1870. In some legends "Orange" is Norway. I have heard of "King Liangowl of Orange" landing in Waterford to fight King Shamus, and the Danes came from Orange.

⁷ O'Briens, FitzGerald, Dillanes, Creeds, Laffans, and O'Deas.

mentions "the hosts that go round the cairns"; and long before the days of Medb, Poseidonius tells how the Gauls made a turn to the right. The reverence for the monuments is well shown by the *tabu* in the Book of Rights not "to sit on the tomb of the wife of Maine"; and another, in the *Agallamh*, "not to walk on the *sidh* of Femen (in Co. Tipperary, the residence of the god Bodb Derg), by the new-kindled blaze of a red fire," like the *cliar* at 'Aine. In the same work we are told that men feared to sit on the three *tulachs* on Cean Febrat (till St. Patrick did it), for fear of the Tuatha Dé Danann. I may add the oft-cited case at Croaghateeaun, where we were told "to cross ourselves against the Dannans."¹ It should be remembered that the god of the Galtees, the harper Clíu, came himself from Baine's *sidh* mound.²

THE REMAINS.

The long, low hill (as the "Mesca Ulad" notes) has a noble outlook in all directions. The view from such a place should be studied, and it is noteworthy how many prominent points in legend and fairy lore are in sight—the dolmen-topped Cromwell Hill and Duntrileague, the cairn-capped Knockfirina, and the Loch Gur hills, the castled ridges of Knocklong and Rathcannon, the fairy hill of Síd Asail, the flank of the cemetery of Clann Deda on the edge of Cenn Febrat, and the boundary ranges named by the Mesca Ulad. It is boldly curved, and the marshy fields and pools at its southwest foot mark an ancient lake,³ full when the woods of Coill Mór and Coill Cruaidh condensed the mists of the mountain tops, and poured them into the now shrunken Lubach, Saimer, and Cammoge. It was also once fenced by deep marsh to the east. The *Grossi Fines*, Roll No. 14, names the Lake of Any as existing in 1322.

THE CAIRNS.—That of 'Aine, the Síd Cliach, occupies (as Cormac's Glossary⁴ says), the highest ground, standing on the eastern brow 537 feet above the sea. Though so famous in legend and lore, it is a defaced, insignificant heap of earth and stones wrecked by treasure-seekers,⁵ daring, I

¹ Rev. Celt., vol. x, p. 287; Ann. Four MM., 555; Book of Rights, p. 5; *Agallamh*, p. 125. Poseidonius, quoted by Athenaeus, Lib. iv, p. 152. Forts were used for magic. See "Rath of the Incantations" and the "Duma nandruad" in *Irische Texte*, vol. iv, 1, and *Eriu*, vol. viii, p. 49.

² *Dindsenchas*, Rev. Celt., vol. xv, p. 441, Crotta Cliach. He died of fright when Baine, in the form of a dragon, burst out of the mound at his magic harping.

³ Like Loch Lungae (*Trip. Life*, p. 209), Loch bo (*Agall*, p. 123), Loch Cenn, and other lake sites. Much of Loch Gur and Monaincha Lake and Coolasluasta Lake have been drained away in modern times.

⁴ *Sanas Chormaic*, p. 9.

⁵ No new outrage; not only the Norse but the Irish ravaged such monuments. See many interesting accounts in *Agallamh*.

presume, from a reliance on 'Aine's proverbial kindness. Much, too, was taken for the long wall beside it. It measures 48 to 55 feet across, and is 11 feet high to the west, 6 feet to the south, and 8 to 9 feet elsewhere. No large stones remain. It is beside an apparently artificial hollow, dug along one of the great rock-ribs so characteristic of the hill. A faintly marked enclosure and an even fainter circular hollow adjoin the cairn.

THE ECHLASA PILLARS.—No trace remains; they may have been used for material for the castles and other buildings in the village below the hill.¹

THE CONJOINED RINGS.—This is called Dunaincy and the "Mullach an triuir": three fosses, with rounded mounds of the Rathnarrow type, one in each ring. A modern fence crosses them, like that through the Coolough-tragh rings at Cush. They were probably disc barrows, and sepulchral; perhaps, like several of those excavated, they were women's graves.² But for its poor preservation, the whole would be comparable with the Cush monument. No trace remains of an enclosing mound round the whole; if it existed, it was possibly 6 feet wide, as the fosse rings are 12 feet apart. They lie north and south; the northern a little to the east of the central axis of the others. The whole measures (if we include the northern cairn and ring 27 feet away) about 250 feet north and south. The fosses and interspaces are 12 feet wide. The rings are 33 feet, 36 feet, and 36 feet, taking them from north to south, and about 63 feet to 54 feet over all, east and west.

The cairn to the north of them lies in a ring 6 feet thick, and 63 feet over all; it is a heap of small stones 18 feet through and 4 feet high, the centre opened.³ The rings were deliberately dug on a slope, the edge of the southern touching the edge of the plateau on which 'Aine's cairn stands, 99 feet away.

O'Donovan did not notice the northern rings: he took no interest in the earthworks, and contemptuously notes the "defaced cairn," the fort, and "two small mounds evidently sepulchral," apparently the southern rings. He adds that "'Aine was still (1840) supposed to haunt the hill in the shape of a banshee."⁴

¹ For "a district marked by a stone of worship" see *Ancient Laws*, vol. iv, p. 143; the largest circle of Lough Gur has been removed since 1850.

² "Ancient British Barrows" (Thurnham in *Archæologia*, vol. xliii, pp. 285, 348); "Ancient Hist. of South Wiltshire" (Hoare, 1812), p. 21; "Tumuli Wiltunenses" (same, 1821), pp. 19, 159.

³ Keating cites from *Book of Lecan*, f. 258, in "Three Bitter Shafts of Death," the passage, "a small rath was raised round the corpse, with a leacht, or cairn." This accurately describes this monument.

⁴ O. S. Letters, vol. i, p. 229.

THE RING FORTS.—The western, perhaps the *dun* of Conall Eachluath, repaired by King Brian 1002–1012, lies on the western brow, above the wooded demesne of Kilballyowen and the O'Grady's residence. It may be the earthwork attributed to Eogabál "on the west." It is crossed by a fence, and much injured by cattle, being of red, friable earth. There is some trace of a fosse, especially to the north, where it is 12 feet wide below, and has a spring in a rock-cut tank filled with water-plants. It is high and steep to the north, and is 125 feet across, north and south, and 108 feet east and west. The ring is 12 feet thick, 10 feet high to the south, and 12 feet to the north, its base 12 to 18 feet thick. The platform is 5 feet above the field, and the whole about 177 feet over the fosse.

The southern fort seems to have been largely of stone; slight trace remains beside a cottage on the south slope, near the ancient track, up the middle of the ridge, where it joins the by-road called Bohernaskagh, "the way of the thorn bushes," leading westward from the ancient fair green.

There is also a curious well half way down the slope, south from 'Aine's Cairn, cut in the rock, but with only a small flow, even in wet weather. The rectangular cleavage of the rocks makes it very regular; it is partly fenced with large rocks torn out of the crag.

The *casán* or causeway is of large slabs, bridged over by ones of considerable size. Mr. H. S. Crawford has illustrated and described it for the *Journal of the Royal Society of Antiquaries of Ireland*, vol. xlvii, p. 82.

'OENACH CULI, CLOGHER (O. S. Map, No. 42).

When I first noticed the unusual group of remains in the townlands of Clogherbeg and Raheenamaddra, I saw that the place had been of ancient note, and the name suggested 'Oenach Clochair. This, however, had been located as near Monasteranenagh, and the number of "dogmatic equations" published about Co. Limerick throw unusual difficulties in the way of topographers. The whole question had to be reconsidered, and it was only after I had got the evidence methodized that I ventured to assert a new identification. I overlooked till later the fact that Mr. P. J. Lynch had already suggested the same;¹ but as he gives no reason for it, I will here give the evidence, at some length, which led me to the same conclusion.

'Oenach Clochair, or 'Oenach Cúli, was one of the chief assembly places of the Munster men, and the cemetery of the Dergthene,² as Cenn Febrat appears to have been of the Ernai. Our predecessors followed O'Donovan in regarding

¹ *Journal North Munster Arch. Soc.*, vol. ii, p. 10.

² "Tract on the Cemeteries" given by Petrie in "Round Towers."

it as 'Oenachbeg, somewhere near Monasteranenagh Abbey. Two early documents, however, should have taught them better. The *Mesca Ulad*¹ represents the invaders coming southward, towards Cenn Febrat, from Knockainy, to "Oenach sen Clochair,"² where they camped, though "the rough winter weather was not the time of the 'Oenach." The *Agallamh*,³ so rich and accurate in its topography, tells how St. Patrick left Cuillend ua Cuanach (Cullen, in Co. Tipperary, on the border of Co. Limerick) and, on his way to Ardpatrick, skirted "the ónach of Nechtan's wife, Cúil, now called the heifer-carrying 'fair' green of old Clochar (óenach sen Clochair)." Now Monasteranenagh lies far to the north-east of 'Aine, quite off the route of the raiders, and, similarly, the saint was not likely to have been supposed to make a huge circuit, for no recorded object, when he wished to reach Ardpatrick. Take a line from Cullen to Ardpatrick on the map, and it touches Clogher. There can be little doubt from the Irish sources that the latter, and not "Oinach orbecc" or "Oenach beg," is intended. "Finn and the Phantoms" does nothing to fix 'Oenach Clochair, but is valuable as showing that horse-races took place there. "Munster men from the plain gathered at it; they ran three clear races at the *faithche mhic Mairéda*." The black horse of Dil, son of Dachrech, ran "to the rock over Loch Gur," and King Fiacha Muillethan asked his maternal grandfather for the steed.

The Norman records seem equally clear; Prince John's charter⁴ to De Magio Abbey, or Monasteranenagh, in 1186, confirms to it "Enachculi in Corbally," and mentions Clochar and Loc Geir (Gur). Corbally townland adjoins Rahenamaddra, in which the remains occur, and is less than a mile distant from the mounds. Corbali, in Grene, Kilfrush, and Dunmoon, all in the Clogherbeg district, were held by the Hospitallers.⁵ Enachculy is also named in a lawsuit at Limerick of Maurice de Londres⁶ against Monasteranenagh in 1234.

The god Nechtan, it will be remembered, was revered with his wife Boud and "the great god Nuada," at the source of the Boyne.⁷ He also sent Eogabal and his family to Knockainey; so Cúil, his other wife, was

¹ Ed. Hennessy, p. 19.

² The "sen" shows that even when the *Mesca Ulad* was written the antiquity of the place was realized.

³ P. 118.

⁴ Rev. Celt. vol. vii, p. 29. *Duanaire Finn* (ed. Ir. Texts Soc.), p. 127. There was also a "*faithche mhic Mairéda*" on Magh Eala.

⁵ Cal. D. Ireland, No. 136; see also 96, 2138, and p. 288.

⁶ From these "Londoners" Ballylanders, near Clogher, is named.

⁷ Sir W. Wilde's "Boyne and Blackwater" (2nd ed.), p. 29; *Metz. Dinds.*, vol. x, pp. 27, 29, 31.

probably a local goddess, revered with ceremonies and races at 'Oenach Cúli, or 'Oenach Clochair, by the Dergthene, who revered Nuada. Of course "fair" is a most inadequate translation of the ancient "'Oenach."

The remains suggest a place of ancient worship, and resemble other pagan cemeteries. At "Brugh" we have three great tumuli, several small ones (like the Clogher mounds), ring works, and pillars, also wells and streams. Mounds were there, one called "the Dagda's Head" (like "Cuchulaind's Head" at Tara); others as "the Comb" and "the Casket of the Dagda's wife," and the Duma Trese; rings like the *Fert* of the Dagda's son Aedh; twin mounds like the "Two breasts of the Morigu." So at Tara we find great conjoined works like the Teach Cormaic and the Forraidh, large disc barrows like the "Shield of Cuchulaind," conjoined mounds like Treduma Nesi, mounds like the Duma na ngiall, and lesser ones like Dal and Dorcha; ring-forts and pillars, wells and streams, and tracks. 'Oenach Carmain had seven mounds where the dead were bewailed, twenty-one raths, a cemetery, and three markets. A large track leads southward from Ushnach, which has its cemetery, conjoined rings, and its holy rock and springs. Cush, the Cenn Febrat cemetery, has ring-forts, conjoined rings, large and small tumuli, tracks, springs and streams, and pillar-stones. The Clogher group is closely similar.

THE REMAINS.

The site has three (or four) rising grounds, hardly hills; the northern called Clogherbeg, the north-eastern Clogher Hill, the south-western Knockaunatariff, or "bull's hillock,"¹ the south-eastern nameless. Clogherbeg has on its summit a small perfect mound, a bowl barrow, with no fosse, 7 to 11 feet high, and about 99 feet across the base. Near the road to Knocklong village is Raheenamaddra, the dog's little fort, a flat-topped mote, or barrow, 10 to 14 feet high. An old raised causeway, farther on, leading from the north-east to Knocklong Hill, is also noteworthy.

Turning southward, past the "Cross of the Tree"² and over a brook, we enter the fields to the west. Crossing a very regular depression, probably natural, and very likely the limit of the *óenach* eastward, we find, on the eastern rise, traces of enclosures. One is a platform, certainly ancient; it is oblong, 93 feet east and west, by 61 feet; raised 2 to 4 feet over the field,

¹ It may be a casual name, but bull feasts were a feature of Irish pagan assemblies. For the name *Donnotaurus* and its connexion with the "Donn Bull" and "Tarvus trigaranus," see MacCulloch, *Dict. Relig. and Ethics*, vol. iii, p. 296, cf. p. 294; and men masquerading in bull hides, *ibid.*, vol. v, p. 838.

² The "Tree" was enclosed by Mr. Ryan, of Scarteen, 1862.

with a slight fosse and rounded corners to the east, and a hollow track along its south side. From the latter side two parallel tracks, also 6 to 8 feet wide, run towards the south-east to the hollows or dry pools 84 feet away. Between these ponds is a mound 4 feet high, of doubtful age. From the double track another one leads at right angles towards the west. Crossing the stream and valley, and going up Knockaunatarriff, through a marsh thick with yellow iris, or "flagger," we get a noble view of Sliabh riach and the Galtees; the rise has a slight terrace, probably natural.

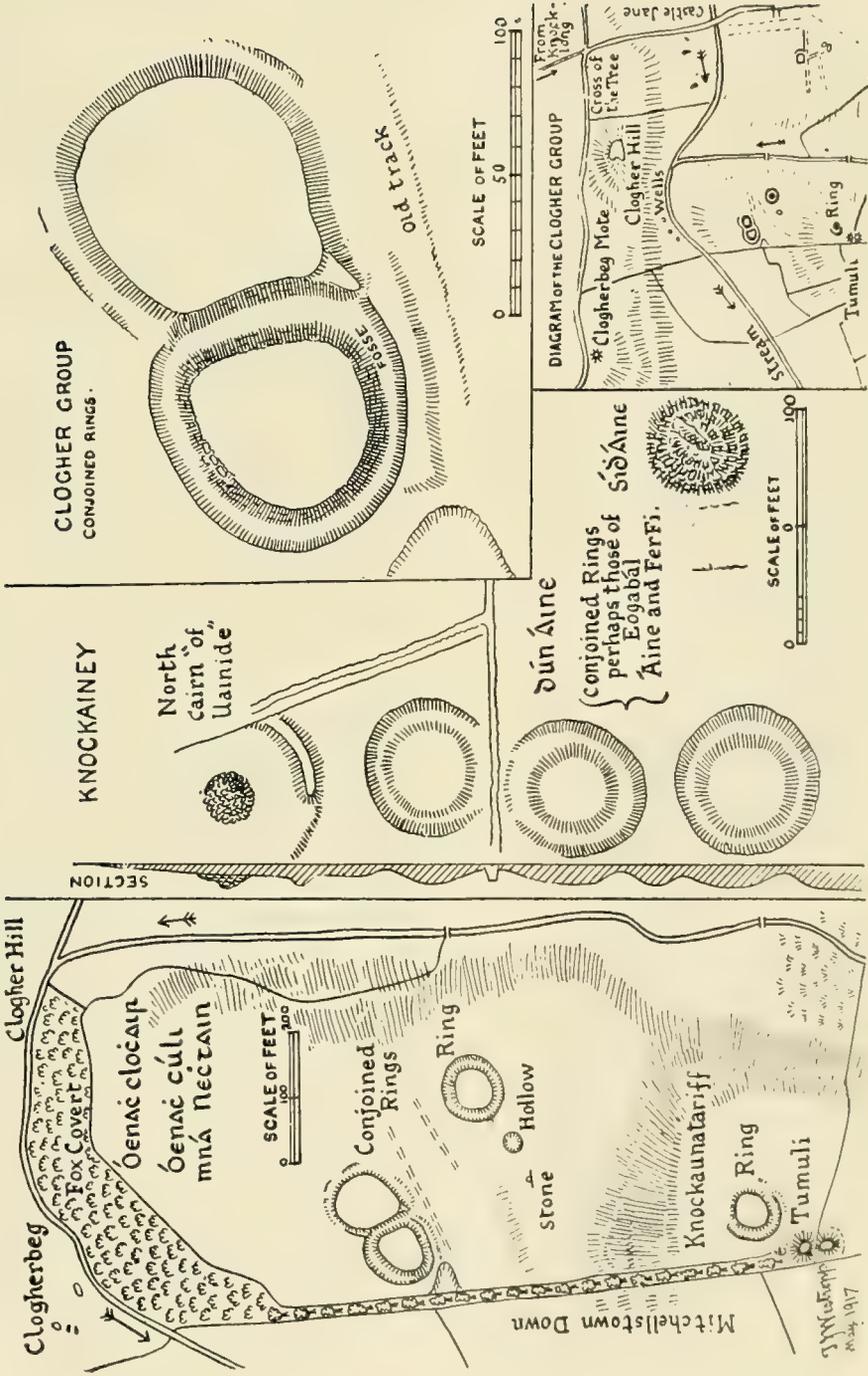
TWIN MOUNDS.—At the end of a long "screen" (plantation), and on the summit, we find conjoined twin tumuli: they are cut by the mearing of the townland, and that of Mitchellstown Down,¹ and recall the "Two Breasts" at the Brugh. Each has been opened; the cross fence has been made between them, and the boundary fence cuts their west flanks. They are on a steep slope, so the southern is 13 feet high, in three slightly marked stages, to the east, and 5 feet to the west, and the northern 10 to 12 feet, and 5 feet high. The first is 13 feet across the top, and 45 feet below; and 15 feet from it, beyond the fence, is the northern mound. It is 15 feet on top, and over 30 feet below.

RING-MOUND.—In the field, lower, but still on the summit, is a ring-platform, 60 to 61 feet across, and 5 feet high; a fosse 12 feet wide and barely 2 feet deep remains to the south, west, and north; there is a trace of the outer ring to the south-east.

CONJOINED RINGS.—Going northwards down a gentle slope we reach a flagger patch and an old track about 100 yards from the upper ring, and at 33 yards farther the most remarkable of the remains. This consists of two platforms conjoined² within one fosse 12 feet wide. Each is D-shaped in plan, and 4 to 5 feet high, and the western is 60 feet across east and west, and 54 feet north and south. The dividing fosse is straight, 9 feet wide below, and 24 feet from platform to platform. The eastern section is 81 feet across, north and south, 78 feet east and west. The main fosse is obliterated to the north-east of it. The western ring has signs of large stone facing; one block is over 3 feet long and high, and 2 feet 6 inches thick. From its position any ceremony on the platforms must have been visible to many

¹ Ballenvistallane-Down, in 1587. Fiant 5179.

² I have noted such remains in the following counties: there are possibly many others:—Clare 3, Kerry 1, Limerick 13, Tipperary 14, Cork 2, Waterford 1, Louth 1, Meath 5, Westmeath 1, Carlow 1, Roscommon 4, Mayo 1. The preponderance in Limerick and Tipperary is very marked.



WESTROPP.—ANCIENT SANCTUARIES OF KNOCKAINEY AND CLOGHER, CO. LIMERICK.

hundreds of spectators on the slope.¹ South of the main fosse is another, perhaps part of an old hollow way leading to it; the section leads down to a hollow or pond not far to the south-west of the mounds, and has trace of an outer ring between the fosses 9 feet thick and 2 feet high.

EASTERN RING.—There is an oval ring platform to the south-east about 150 feet away. It measures 66 feet north and south to 81 feet east and west, rarely 4 feet high; the fosse is 10 feet wide and 2 feet 6 inches deep. An old track, 45 feet from it towards the conjoined rings, runs between the "forts." To the south-west, 14 yards away, is a shallow, oval basin, 18 to 23 feet across, and about 4 feet deep. Beyond it, 120 yards from the fort, is a large stone over 4 feet long, 3 feet high, and 3 feet 6 inches thick. Another, possibly as large, but partly buried, lies to the north-east above the slope to the stream, which joins a second stream, and has several pools and springs beside it. The tracks may be ditches of old fences, but have no traces of mounds, and in most cases lead direct to the earthworks. They are fairly uniform hollows, rarely over a foot deep, and 6 to 8 feet wide. They are, I think, old tracks, like those on Slievemore, Achill, and those leading to the Black Castle causeway at Loch Gur and the promontory forts of Doonaunroe, Dundoillroe, and George's Head, Co. Clare, and Clashmelchon and Pierce's Island, Co. Kerry. I saw no other remains in the ancient chief cemetery of the Dergthene, but many must have been destroyed by cultivation in the tilled lands of Mitchellstown Down, on the same ridge. Between farming and fox coverts it is wonderful that any remains escaped to our days.

I trust that this paper, despite its limitations, may prove of use to those studying the obscure and neglected subject of our early sanctuaries, and lead others to devote themselves to the identification of other sites of pagan worship in our island.

¹ The Ancient Laws of Ireland, vol. v, p. 475, "erecting stands and platforms at an 'Oenach.'" Vol. iv, p. 220, "the *cladh* of a fair green." Vol. i, p. 233, disturbing a fair green; p. 129, cleansing it for sports.

IV.

ON SOME INTERMENTS AT MOORETOWN, CO. MEATH.

BY R. A. S. MACALISTER, LITT. D., AND J. R. D. HOLTBY, M.B.

PLATE II.

Read FEBRUARY 12. Published AUGUST 27, 1917.

MR. JOSEPH DOLAN, Ardee, wrote to me three or four months ago to the effect that a find of human bones had been made in the course of quarrying operations at a site near his town. Mr. Holtby and I took an early opportunity of visiting the place under his guidance.

The site is in the middle of a field on the townland of Mooretown, just over the boundary of Co. Meath. Mr. Moore, the proprietor, made us welcome, and gave us every help in his power.

We found that in digging down to the rock for quarrying purposes the workmen had cut through a series of shallow graves, each containing at least one skeleton; but the bones had much decayed, and were in a very rotten state, and a good deal of damage had been done by treasure-seekers in the interval between their discovery and our arrival. The osteological material recovered was therefore not so much as it might have been.

The graves were shallow trenches, about 2 feet 6 inches below the ground level, lined on each side for their lowest 10 or 12 inches with slabs on edge, supporting horizontal cover-slabs. The length of a perfect grave exposed was 8 feet 3 inches, and its breadth 1 foot 6 inches.

There were eleven graves exposed when we came to the ground. Most of them had been broken and were empty. They lay approximately east and west, the heads to the west; but they showed a tendency to radiate; the last four of the series pointed more towards the north.

Nothing whatever was deposited with the bodies to give a clue to their age.

Of the eleven graves exposed, the first three (counting from the south) were empty, the fourth contained an astragalus, the fifth and sixth were empty, the seventh contained the remains of a man's skeleton, the eighth the fragment of a skull, the ninth part of the bones of two women, the tenth and eleventh were empty. A twelfth grave, we were informed, had existed south of No. 11, but had been destroyed by the quarrymen. We tried with a

crowbar and at last found another grave, west of No. 4; it had, however, been imperfectly lined—there were stones round the lower part of the tibiae only—and the rest of the skeleton, unprotected from the rich, damp soil, had absolutely decayed to nothing.

R. A. S. M.

As regards the human remains, portions of two skulls, a femur, and two tibiae were recovered, together with a talus from a young subject. The skulls, which we will distinguish as A and B, were unfortunately so damaged as to render impracticable the estimation of many measurements which would have thrown a fuller light on their characteristics. Both skulls were from male subjects, and were dolichocephalic, though not to a marked degree.

The chief measurements are appended. It will be noted that the index of cephalic length is 71 and 70 respectively; figures below 75 are considered to indicate a long-headed condition. The altitudinal index in these cases was estimated by a method which I have recently described, actual measurement of the height being impossible owing to absence of the cranial base. In skull A the difference between the cephalic and altitudinal indices was rather more marked than is usual. It is, however, possible that, owing to the imperfect condition of the specimen, the cephalic index should be a little higher than the figure given. The left occipital fossa of this skull showed a very well-marked elevation, indicating a definitely operculated and defined sulcus lunatus (*Affenspalte*)—a condition generally seen in, though not confined to, primitive races.

The teeth showed the well-worn condition of the crowns so common in ancient specimens.

The petrosquamous suture was more obvious than is usual.

MEASUREMENTS AND INDICES OF SKULLS.

SKULL A:—

Maximum length (glabella to occipital point),	18 cm.
Maximum breadth,	12·8 cm.
Cephalic index,	71·1
Opisthobregmatic height,	15 cm.
Altitudinal index,	75

SKULL B:—

Maximum length,	17·5 cm.
Maximum breadth,	12 cm.
Cephalic index,	70
Opisthobregmatic height,	13·7 cm.
Altitudinal index,	70·5

LIMB BONES.

Femur.—This showed distinct anteroposterior flattening at its upper end, as indicated by a platymeric index of 67·6.

The *linea aspera* was raised and prominent, giving a pilastric index of 107·1.

The upper and lower extremities of the bone were missing.

Tibia.—Portions of two were recovered. Each showed flattening from side to side or platynemia (the so-called razor-like tibia), the indices being 63·1 and 65·7 respectively. Each also showed a distinct facet at the fibular margin of the front of the lower extremity.

Talus.—One was recovered. It had belonged to a young subject. It showed a marked extension of the articular surface on to the medial side of the neck of the bone. This, like the facet described on the lower end of the tibia, is due to pressure between tibia and talus.

NOTE ON LIMB BONES.

The normal index of platymeria in modern British femora is 81·8 (Hepburn). This anteroposterior flattening of the upper portion of the femoral shaft is commonly associated with side to side compression of the tibia and is due to unequal repressive development of the various components of the quadriceps extensor muscle of the thigh, resulting from functional activity, such as might be necessary in the habitual assumption of the posture of squatting.

It is often found also in conjunction with a markedly raised condition of the *linea aspera* on the back of the femoral shaft. The amount of pilastering here found (107·1) might, however, be found to-day, though insufficient figures are as yet available as to its incidence in modern bones. The pilastric index has, however, some significance on account of the other associated conditions.

Platynemia is quite uncommon in modern tibiae, the breadth index of these ranging between 80 and 100 [Manouvrier gives 88·2 as the average for modern French specimens]. It is usually ascribed to influence of strongly developed calf muscles, and is found frequently in races of squatting habits. It is very marked in these bones.

SUMMARY.

Modern skulls tend in the aggregate, so far as this country is concerned, to be mesaticephalic, with an index between 75 and 80; and it would be quite unusual in taking a series to find any two, chosen at random, with indices such as the two in this series possess.

The specimens from Cork Hill, which could be dated as about 900–1000 A.D., had indices well over 75, and I think that we are justified in assuming that these were probably earlier. The occurrence of the impression for the *Affenspalte* strengthens this view.

It should, however, be noted that as Ireland was subject to invasions by various races, such a migration might have a pronounced effect on the skulls of a particular locality. I do not know if there is such a factor to be considered in the case of the site from which these remains were recovered.

The evidence afforded by the limb bones is in favour of an early date; and, so far as the remains are concerned, Dr. Macalister's view that the burial-place was pre- or early Christian seems reasonable.

J. R. D. H.



FIG. 1.



FIG. 2.

V.

THE DISCREPANCIES BETWEEN THE DATES OF GIFT AND
HALL-MARK DATES FOUND ON PIECES OF PLATE
BELONGING TO TRINITY COLLEGE, DUBLIN.

BY M. S. DUDLEY WESTROPP.

[Read NOVEMBER 30, 1917. Published JANUARY 2, 1918.]

AT the request of the authorities of Trinity College, Dublin, I made, in June, 1916, a catalogue of the plate belonging to the College. As I proceeded with the work, I was surprised to find that the date of gift inscribed on a large number of pieces was much earlier than that indicated by the hall-marks.

This, at the time, I tried to account for in two ways. First.—In former days plate received comparatively rough usage and in time appeared unsightly, so that it became a common practice to have a disfigured piece remade, either in the form of the original, or in that of the period in which it was remade. Second.—The donors may have given money at a certain date for a piece of plate which may not have been purchased till a later period.

On April 24th, 1917, Dr. J. P. Mahaffy, Provost of Trinity College, Dublin, read a paper on the subject before the Academy, in which he rejected these two theories as being unsatisfactory, and also he tried to prove that the inscribed dates on the plate were the ones to be relied on for date of manufacture, and that the hall-marks were of secondary importance.

In his paper the Provost quotes from a register of Oriel College, Oxford, that it was the frequent practice to sell or exchange pieces of plate worn out or no longer in fashion, but that the inscriptions were in most cases carefully transferred. The Provost also admits that numerous pieces of the College plate, such as cups and tankards, were in the eighteenth century melted down, and made into more useful articles, but that the names of the original donors were inscribed on the new pieces. An entry of the year 1766, in the Bursar's books of Trinity College, Dublin, records a payment to a Dublin silversmith for the exchange of old plate. These records appear to substantiate in some way my first theory.

I will now endeavour to show that the date indicated by the hall-marks

is the one to be relied on for date of manufacture. From long experience I have found that inscribed dates on plate are most untrustworthy for ascertaining the date of manufacture. I have seen comparatively few pieces on which the inscribed date of gift and the hall-marks synchronize. This usually occurs only on exceptional pieces, such as maces or such other objects as would have been made specially for the occasion. In the case of cups, salvers, &c., which formed the usual stock of a silversmith, any piece could have been selected and inscribed with a date according to the wishes of the purchaser, irrespective of hall-marks.

In Ireland the hall-marking proper of plate begins in the year 1638, although a mark for standard silver is mentioned in 1605. In 1637 the Goldsmiths' Guild of Dublin received a Royal charter, which empowered them, among other things, to strike a punch of a crowned harp on all standard plate. Hall-marking was begun early in 1638, and at the same time an alphabetical letter, generally changed annually, was adopted and struck on plate.

The alphabetical letter was struck to denote the year in which a piece of plate was made, so that in case of any irregularity the master and wardens of that year could be held responsible. The harp crowned, date letter, and maker's mark were the only marks struck on Dublin plate from 1638 to 1730.

In the year 1729 an Act of the Irish Parliament (3 Geo. II, c. 3) laid down that from and after the 25th day of March, 1730, a duty of 6*d.* per oz. was to be imposed upon all gold or silver plate wrought or manufactured which shall be imported and brought into the kingdom of Ireland, and that upon all gold and silver plate which shall be made or wrought in Ireland at any time or times from and after the 25th day of March, 1730, during the term of twenty-one years, a duty of 6*d.* for every ounce Troy was to be paid by the makers or workers thereof respectively. Also that no goldsmith or silversmith or other person working or trading in wrought or manufactured gold or silver shall sell, expose to sale, barter, or exchange any gold or silver vessel, unless it be silver wire, or such things not exceeding 4 dwt., until such time as such plate, vessel, or manufacture of gold or silver shall be assayed, touched, and marked, upon pain of forfeiting the value thereof; and that after the same shall be touched and marked, the duty of 6*d.* per oz., imposed by the Act, shall be paid by the person bringing such plate to be assayed and touched, to the assay-master, who is hereby empowered and required upon receipt of said duty to stamp or mark without fee or reward the said plate with such stamp or mark as the Commissioners of His Majesty's Revenue for the time being, or any three or more of them, shall from time to time appoint. To denote the

payment of the duty imposed by this Act the figure of Hibernia in an oval punch was struck on Dublin plate.

An entry, dated April 21st, 1730, in an assay book belonging to the Dublin Guild of Goldsmiths, states that "duty came on this day."

From this Act it is apparent that no duty stamp was struck on imported plate, but only on plate made in Ireland.

Although the mark of Hibernia was struck on Dublin plate from 1730, being first found in conjunction with the date-letter L of that year, it was not legally authorized until the year 1776. In the latter year one Michael Keating, a Dublin silversmith, was convicted of counterfeiting the duty mark on plate: but on looking into the matter, it was found that the Commissioners of the Revenue had never appointed any mark to be used by the assay-master. Michael Keating was accordingly acquitted on this charge. The Commissioners of Revenue afterwards received a full certificate of Mr. Thomas Nuttall being appointed assay-master, and they made the proper order therein, and appointed a particular mark to be used by him in the future, and to be struck on all sterling plate pursuant to the Act of Parliament.

The Hibernia mark was probably selected by the Dublin Guild of Goldsmiths, though no reference to the matter occurs in their proceedings, nor is there any difference in the detail of the mark from the year 1776. Acts of Parliament were passed from time to time reimposing the duty on plate, which was finally abolished in 1890.

The requirements of the Act of 1729 as to the marking of plate do not appear to have been always fulfilled, as frequently pieces of Irish plate are found, made both before and after 1730, which bear no hall-marks, but only the maker's mark.

To remedy this another Act of Parliament was passed in 1751 (25 Geo. II, c. 19), which laid down that, "Whereas silver plate is often sold without being assayed, touched, and marked, to avoid the payment of the duties, for remedy whereof it is enacted that from and after the first day of May, 1752, no person shall buy take, and receive in the way of purchase, barter, or exchange any wrought or manufactured gold or silver plate of or from any goldsmith or silversmith or any person working or trading in gold or silver, unless it be silver wire or such things, not exceeding 4 dwt. not being assayed, touched, and marked by the assay-master at the time such gold or silver shall be delivered to the buyer, upon pain of forfeiting the value thereof."

From this latter Act the Provost draws the conclusion that all unmarked plate made previous to the first of May, 1752, was to be called in, assayed,

and marked. The Act, however, does not state this, and makes no mention about the clause being retrospective.

There are pieces of plate belonging to Trinity College, made in the second half of the seventeenth century, and not hall-marked yet. The Act of 1729 sets forth clearly that all plate made on and after the 25th March, 1730, was to be liable to the duty of 6*d.* per oz. Plate made before this date was not liable to duty, and, therefore, did not bear the figure of Hibernia. If a piece of plate made, say, in the year 1720 was found not hall-marked, and was brought to the hall to be assayed and stamped, say, in 1752, it would not be liable to duty, not having been made after 25th March, 1730, and, therefore, could not have the duty-mark of Hibernia struck on it.

The Provost in his paper suggests that pieces of plate sold unmarked were years afterwards assayed and stamped with the hall-marks of the period in which they were assayed. This conclusion he draws from the fact that several pieces of the College plate have the assay scraping mark still visible.

All plate to be assayed must have a small portion scraped off in order to ascertain the fineness of the metal. In most objects this scraping mark is rubbed down and cleaned off in the final polishing; but in many cases, where the scraping would not show, it has been left just as the piece came from the assay office. In some instances an assay may have been made at a date much later than that of manufacture, as the owner may have been uncertain as to the quality of the silver.

If a person wished to purchase or sell a piece of silver, and was in doubt as to its being of standard quality, he could ascertain this by taking it to the assay office and getting it assayed. There would be no necessity to have it stamped if it was only to be turned into money.

In former times silversmiths were notorious for trying to get hall-marked silver which was below standard. Numerous cases of fines having been imposed on them for this offence occur in the records of the Dublin Goldsmiths' Guild.

In a very large number of cases pieces of Dublin plate of the eighteenth century bear no date letter. This the Provost accounts for by the post-assaying process. For example, a piece of plate made early in the eighteenth century, and not assayed and stamped until, say, 1760, could not have a date-letter struck on it, as the exact year in which it was made was not known; therefore no letter at all was struck. There are, however, examples among the College plate, of supposed post-assayed pieces, which have the date-letter, including a soup tureen, with inscribed date 1722, and hall-marks, with date-letter for 1781, and three cups inscribed, respectively,

1699, 1745, and 1751, and bearing date-letters for 1814, 1769, and 1817 respectively.

I am of opinion that the absence of the date-letter is due simply to carelessness. As long as the crowned harp, Hibernia, and maker's mark were struck, the assay-master, or official who actually struck the marks, thought that the date-letter did not matter.

During the seventeenth and eighteenth centuries each punch was struck separately, but in the nineteenth century what are called press-punches were introduced. The press-punch contained in one piece all the hall-marks to be struck. Instances of careless marking often occur on plate. For instance, on old Cork plate the proper mark was the ship between two castles, generally in three separate punches; but pieces are often found with the maker's mark struck instead of the ship, to save the trouble of taking up the ship punch.

I have come across hundreds of pieces of Dublin plate, and also many of English plate, of the eighteenth century, which have no date-letter, but the hall-marks are contemporary with the date of manufacture, as indicated by the form and decoration.

In former times, in plate, one style of an object generally lasted for a certain period, until another fashion arose, though, of course, there was a little overlapping in the styles. Now, however, you can find in a silver-smith's shop, and made at the present day, pieces of plate in all styles, from Roman times to A.D. 1917. In old silver the style and decoration of the object generally tell you approximately the period in which it was made; but the collector of the distant future will not be able to rely on this evidence.

The Provost states that he cannot detect any variation in the form of the crowned harp punch at different periods. To the casual observer the small crowned harps, such as are found on Dublin silver, may seem all alike, but on examining them closely a great difference will be apparent. From having examined immense quantities of old plate I could generally tell the approximate date of a piece of Dublin silver from the crowned harp alone, without the aid of a date-letter. There were, naturally, several die-sinkers employed, who from time to time cut the punches, and each had his own way of cutting them. The number of strings to the harp and the dots on the crown vary considerably, to say nothing of the general outline of the whole stamp.

There is another and very serious flaw in the Provost's theory of post-assay, and that is, that dates of gift are inscribed on pieces of plate which were never made or thought of at the period denoted by the inscribed

date. For example, you may find a teapot or coffee-pot with inscribed date, say, of 1560, and hall-marks of, say, 1750, or a match-box inscribed, 1750, and hall-marked 1900, and say that these articles were made at the dates inscribed on them. The only drawback to this assumption is that these particular objects were unheard of at the earlier dates.

There are almost equally ridiculous instances among the plate of Trinity College, Dublin, if we rely on inscribed dates.

There is an item in the College accounts I would like to draw attention to, and that is the quantity of plate purchased by the College from private owners and silversmiths during the eighteenth century. From 1758 to 1781 there was over £1800 worth of plate bought, including £175 paid to Robert Hopkins, a Dublin silversmith, in 1758; £659 to Lord Mornington in 1759; £350 to Mrs. Stone in 1765; and £474 to James Warren, a Dublin silversmith, in 1775.

Taking seven shillings an ounce as a fair average of the price of silver in the eighteenth century, this would amount to roughly 5200 oz. Of this plate, that bought from private owners would possibly have had a family crest or coat-of-arms engraved on it, and that bought from a silversmith would probably have been uncrested. Now almost all the pieces of plate belonging to Trinity College, Dublin, with the exception of some spoons and forks, and a set of dishes and plates totalling roughly about 2000 oz., have an inscription setting forth the donor's name and date, together with his arms. There is no entry, so far as I can trace, in the College books of any sale of plate by the College during the eighteenth century.

My theory, which is of course open to correction, is that this silver was obtained, and in many cases inscribed with donors' names and dates, in place of pieces which had become broken and unsightly, or pieces for which money had been given, but not actually purchased.

If this theory is not correct, then what has become of about 3000 oz. of plate bought by the College?

I am not including in this 3000 oz. uninscribed knives, forks, and spoons, as almost all of these, amounting to about fifty-five dozen, are of nineteenth-century make.

I shall now mention a few of the more important pieces belonging to the College, and try to show why the inscribed dates are not to be relied on for dating the period of manufacture. To begin with two-handed cups. There are three of these of exactly similar pattern, one inscribed with date of gift 1690, one 1699, and the third 1791 (this latter the Provost says should be 1701). Now these three cups are all struck with the punch of the same Dublin silversmith, Joseph Jackson, and bear the Dublin hall-marks for

about 1780-90. (The College paid £84 16s. 8½*d.* to a silversmith in 1781 for plate and engraving.) Although similar in some ways to cups of the earlier periods, the work of these three cups does not appear to be of those periods, and there is no sign of the handles having been replaced, as the Provost suggests. The handles are typical of the period of the hall-marks.

It seems curious that three cups, given at different periods and by different donors, should all bear the same maker's mark and hall-marks of a much later period. I am inclined to think that these three cups were made about 1780 or 1790 to replace the pieces given at much earlier dates, and which had become battered. Another cup, inscribed with date of gift 1751, bears the Dublin hall-marks and *date-letter* for 1817, and maker's mark of James Lebas. The cup itself is in the style of about 1750-1760, a plain-belted cup, but the hall-marks clearly show that it must have been made in 1817. If the piece was made in 1751, how could the date-letter for 1817 be put on, as the Provost contends, or how could the King's-head punch, which did not come on until 1807, be struck? This also appears to be a piece made at a later period in the style of the date of gift. The silversmith could easily have procured a cup of the period as a model.

A cup, inscribed with date of gift, 1699, bears the Dublin hall-marks and date-letter for 1814, and maker's mark of James Lebas. This cup is of a style in fashion neither in 1699 nor in 1814, but belongs to about the middle of the eighteenth century. Made by the same silversmith as the last, he probably copied a mid-eighteenth-century model in both cases. If the cup was made in 1699, how could it have the duty-mark not struck until 1730, the King's head not struck until 1807, and the date-letter for 1814? In any case a cup of this form was unknown in 1699.

As the date-letter punches and generally the other punches were defaced annually, there could be no possibility of obtaining an old punch to mark plate with.

Turning to salvers, there are several anomalous examples. A salver with inscribed date of gift 1714, bears the Dublin hall-marks for about 1750-60, but no date-letter, and maker's mark of Robert Hopkins. Robert Hopkins, according to the College accounts, was paid £148 in 1758 for plate for the College. This style of salver was not in fashion in 1714, the usual salver of that period being a plain circular one on a central foot, while this one has a shaped border and rests on four scroll feet. Salvers of the early part of the eighteenth century are found on four feet which are usually perpendicular in form: but the shape of the salver is not circular, but more or less rectangular, with rounded or set back corners. This salver could not have been made in 1714, and it is curious that the hall-marks (including Hibernia, which could

not have been put on in 1714) agree with the date at which Robert Hopkins supplied plate to the College.

A salver with inscription and date 1692 bears the Dublin hall-marks for about 1760. The salver is circular, with shell and gadroon border, and rests on four ball-and-claw feet. Such a pattern was never heard of in 1692, the shell and gadroon edge not appearing for about fifty years later.

The same remarks apply to a salver with inscribed date 1693, and bearing the Dublin hall-marks for about 1760.

There are six other circular salvers, each on three feet, with inscribed dates varying from 1693 to 1702, and bearing hall-marks of about 1760 and 1730.

There are four oblong sauce-boats and covers, with gadroon edges, each on four scroll feet, inscribed with dates of gift (different donors) of 1699 and 1710, and all bear the same Dublin hall-marks of about 1770 and the maker's mark, probably of John Locker. This form of sauce-boat was unknown at the dates indicated by the inscriptions. Sauce-boats are found dating from about the second decade of the eighteenth century, the earliest ones being somewhat boat-shaped, with a lip at either end, and two handles, one on each side.

Two saltcellars, inscribed with date of gift 1707, bear the Dublin hall-marks for about 1760 and maker's mark of probably James Warren. These saltcellars are circular, each on three lion head feet—a fashion which did not come in until about 1720-30. The saltcellars of 1707 would have been the ordinary trencher-salt pattern, which lasted down till about 1725 or even later.

Pieces of plate such as wine-coolers, boxes, &c., having four claw or scroll feet, are found dating from the second half of the seventeenth century; and standing salts, tankards, &c., with three ball feet are found of the latter part of the sixteenth century; but the three feet with lion or human masks or shell bosses, found on cream-ewers, sauce-boats, saltcellars, &c., were not introduced until between 1720 and 1730. It is a curious coincidence that a number of pieces of the plate belonging to Trinity College, Dublin, bear the maker's mark IW, probably that of James Warren, a Dublin silversmith, working from about 1750 to 1790, and that in 1775 James Warren, silversmith, was paid the sum of £474, presumably for plate supplied to the College.

There are also belonging to the College forty-four pistol-handle knives and forty-eight pistol-handle forks, with inscribed dates varying from 1708 to 1730, and all bearing the same Dublin hall-marks for about 1730-40. It seems curious that these pieces given at such different dates and by different donors should all bear identically the same hall-mark of a later period.

The same remark applies to eight baluster-stem candlesticks, given at different dates from 1694 to 1722, and by different donors, but which all bear the same Dublin hall-marks for about 1745.

The College possesses several pieces of plate with inscribed dates, given late in the nineteenth century and early in the twentieth, but with hall-marks of some fifty or sixty years earlier. If hall-marks are not to be relied on, then why not say with analogous reasoning that these pieces were made at the date set forth in the inscription? These examples are, I think, sufficient, although there are others among the College plate, to show that the inscribed dates cannot be relied on for proving the date of manufacture. As I have pointed out, many of the pieces could not have been made at the earlier dates, as the form of the particular object was unknown at the period. None of the pieces shows the slightest trace of any earlier hall- or makers'- marks. With all due deference to the Provost, I fail to see that his theory shows that the inscribed dates on the College plate, or on any other plate, prove the date of manufacture.

VI.

ASSOCIATED FINDS OF IRISH NEOLITHIC CELTS.

By E. C. R. ARMSTRONG, M.R.I.A., F.S.A.

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No apology is needed for placing before the Academy the following short account of some finds of Neolithic celts. Finds of associated implements and weapons belonging to the Irish Bronze Age have often been published; but those of the Neolithic Period have met with less consideration. It is, however, only by the publication and examination of associated finds that it will become possible to arrange Neolithic antiquities in a progressive series. The Neolithic finds of other countries have been described from time to time.¹ An interesting recent contribution to the subject is that of Dr. Karl Schumacher,² who has published an illustrated account of the finds of associated implements of the Neolithic Period discovered in West Germany.

The information about the finds included in the present paper has been obtained partly by searching the Museum Registers and Wilde's *Catalogue*; partly from information supplied by private collectors; and partly from accounts that have appeared in archaeological publications.

Some remarks of a speculative character are added to the latter portion of the paper regarding the classification of the two principal forms of Neolithic polished axes, *i.e.* the type in which the outline is triangular and the butt pointed, and the type in which the outline assumes a more rectangular shape, while the butt is rounded or roughly squared. Should such a classification be established by further researches, it will materially assist the arrangement of antiquities of the later portion of the Stone Age.

The Collection of the Royal Irish Academy, preserved in the National Museum, Dublin, contains a large number of stone celts and chisels of various types. Unfortunately, in the early days of the collection, the records as to

¹ See Déchelette, *Manuel d'archéologie*, i, p. 516, note; *Congrès International d'Anthropol. et Archéol. Préhistoriques*, Genève, 1912, ii, pp. 46, 47; *Præhistorische Zeitschrift*, ii, pp. 57-60; iii, p. 170; iv, pp. 231, 232; v, p. 262; and *Mannus*, v, 300.

² *Præhistorische Zeitschrift*, vi, p. 29, sqq.

the finding and associations of objects were frequently not preserved, so that these details are unknown about many of the specimens in the Museum. But so far as the records are available, they show that few celts have been found associated with burials: the greater number have been accidentally discovered in agricultural operations, in draining or excavating the beds of rivers or the neighbourhood of lakes, or in cutting turf bogs for fuel.

It is often difficult to determine whether associated finds of stone celts not obtained from interments, should be considered either as implement-makers' hoards, or as votive offerings, or as household goods hidden by their possessors in the ground when hurriedly compelled to leave their dwellings owing to some unfriendly raid or other cause: in the latter case the recovery of the implements may have been prevented by the death of the owners or their flight to a remote locality.

To ascertain the material of which a polished celt is composed is not easy. Geologists are shy about giving an opinion without examining a section of the implement under a microscope. Private collectors and curators of Museums sometimes have difficulty in getting their implements properly examined: thus statements as to the composition of celts are often inaccurate; and in many cases it has not been possible to give the composition of the celts mentioned in the course of the present paper.

The finds are described in the alphabetical order of the counties in which they have occurred:—

Co. Antrim.—Mr. W. J. Knowles, M.R.I.A., of Ballymena, Co. Antrim, whose collection of Irish Stone-Age antiquities is known to all students of the subject, possesses an interesting find of six polished stone celts. They were discovered together close to a sandstone grinding slab, four feet from the surface in the brick-clay of Cullbane. Mr. Knowles¹ has suggested that the person who ground the implements had intended to return the next day and grind others, but that in the meantime a flood had occurred in the Bann River, which either took a long time in subsiding, or else covered the axes and slab with a deposit of mud so that the place could not again be found. The objects comprised in this find have been lent to the Academy for exhibition in the National Museum. The grinding slab has been illustrated by Mr. Knowles²; it is made of sandstone, and measures 13 inches in length and 8 inches in breadth; it has been ground on both its flat faces. The butts

¹ This also appears to be the case in Scotland; see Anderson, *Scotland in Pagan Times (Bronze and Stone Ages)*, pp. 305, 306.

² *Proc. Royal Irish Academy*, xxx, Sec. C, p. 219.

³ *Ibid.*, Plate XIX, 126.

of all the celts are sharply pointed, except that of the smallest, which either has not been ground to so fine a point as the others or has been subsequently damaged. They do not vary much in size: the longest measures $5\frac{1}{4}$ inches in length, and the smallest $3\frac{1}{16}$ inches.

Mr. Knowles also has in his collection two chipped celts which were found together at Rasharkin, Co. Antrim. One of these is made from flint. These two celts have also been lent to the Academy, and their owner has allowed them to be illustrated. (Fig. 1, 11 and 12.)

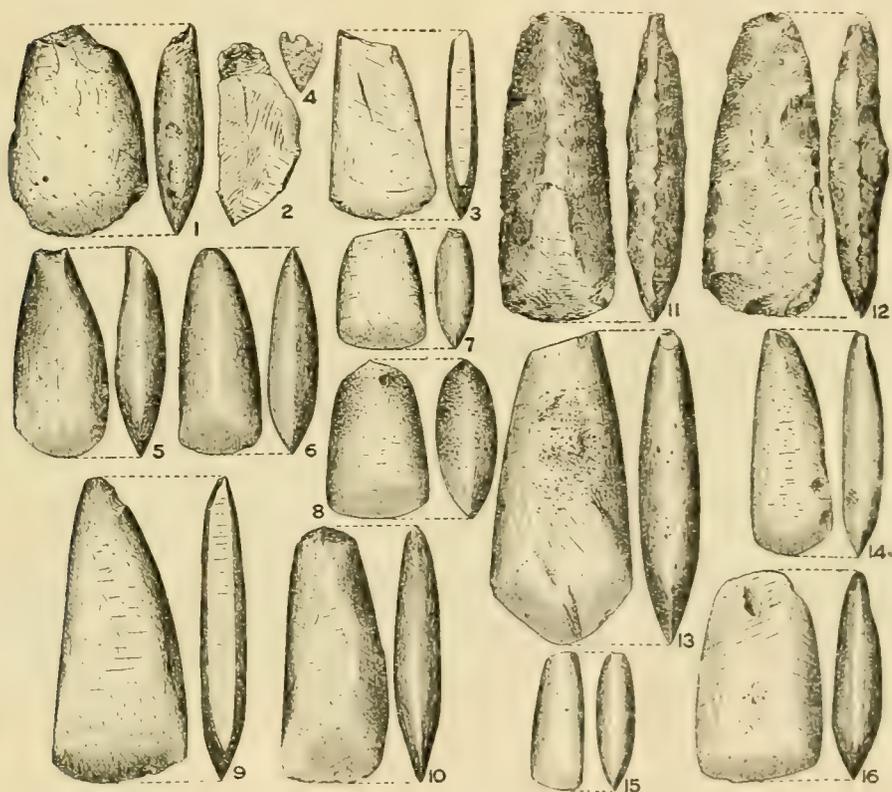


FIG. 1.

Associated finds of stone celts from various localities. (One-fourth.)

In his paper on the Cushendall finds, Mr. Knowles¹ figured five chipped stone celts. Two are roughly blocked out; the others, which are finished, are of the same type: they were found together at Glenariff. He also has in his collection a large unground celt, fourteen inches in length, which was

¹ *Journal Royal Anthropological Institute*, xxxiii, p. 364, and Pl. XXXIII.

found, with a slightly smaller specimen. "sticking with their edges in the ground," in the townland of Knockans, near Cushendall.¹

To Mr. H. C. Lawlor, M.R.I.A., I am indebted for an account of an interesting find of stone celts, discovered, about 1872, at Danesfort, Malone Road, Belfast, when making a small plantation. The find included nineteen stone axes, which are at present in Mr. Lawlor's custody. Three urns, described as of food-vessel type, were discovered, about fifty yards away from the celts, when making a drain. Figure 2, made from a photograph taken by Mr. W. A. Green, of Belfast, shows the celts reduced to about a ninth of their actual size. A twelve-inch scale is placed next to the largest celt:

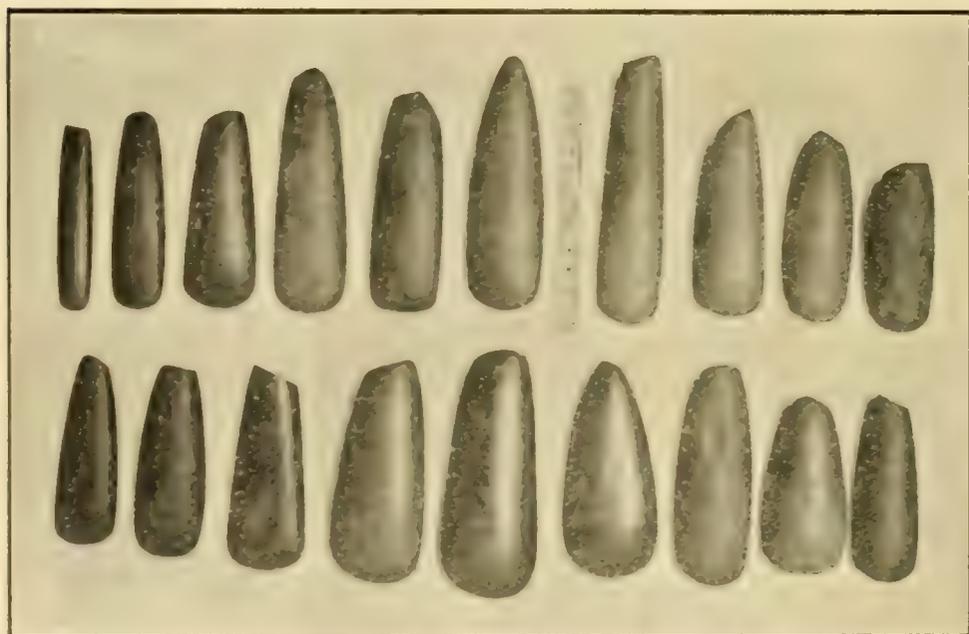


FIG. 2.

Stone celts found together at Danesfort, Malone Road, Belfast.

From a photograph by Mr. W. A. Green.

as can be seen from the illustration, they vary considerably in size and shape: some have pointed, others rounded, butts; one is chisel-shaped. Their exact lithological character has not been determined; but they are made from some hard rock, which is possibly the type of basalt found in parts of Co. Antrim.

A partly ground flint celt and a flint scraper were found, presumably together, at Dunboy, near Ballymoney, Co. Antrim. They were obtained by the Academy from the late Mr. S. F. Milligan, M.R.I.A.

Co. Cavan.—A polished stone celt, with a square-shaped butt, two urns, only one of which has been preserved (a food-vessel of advanced form), a flint knife, a flint fabricator, and an object of bone, were discovered together in a cist in a tumulus at Killicarney, Co. Cavan. The objects were presented to the Academy in 1879 by the Earl of Enniskillen, through Mr. Loftus Tottenham, M.P. The urn, celt, and other objects have been figured and described by the late Mr. W. F. Wakeman.¹

Co. Fermanagh.—A polished stone celt, with a rounded butt, made of amygdaloidal porphyrite, was found with burnt bones and charcoal in the south side of the cairn, on Topped Mountain, near Enniskillen, Co. Fermanagh.²

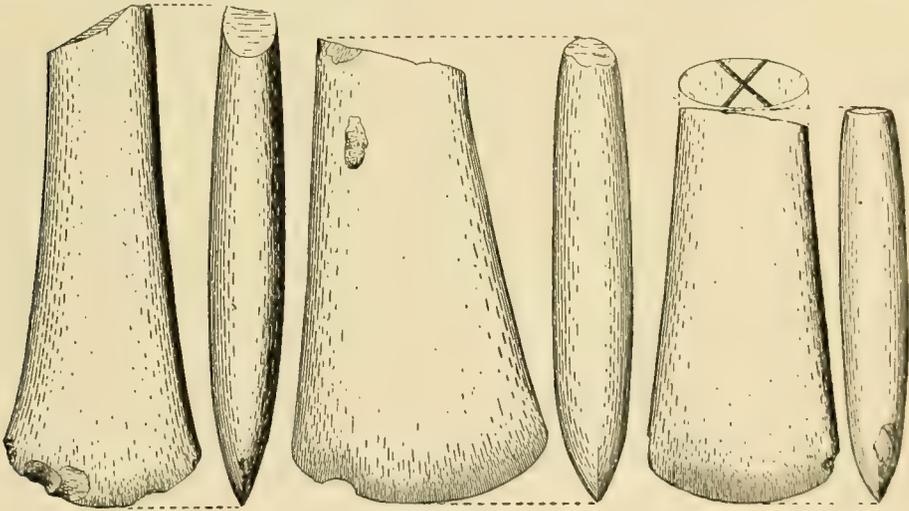


FIG. 3.

Stone celts found at Canrower, Oughterard, Co. Galway. (One-fourth.)

Co. Galway.—Three stone celts were discovered under the root of a large deal tree, in the shallow bog of the townland of Canrower, near Oughterard, Co. Galway. They were found by a man named Naughton, (who), "Having dug round the root, he put his hand under it to raise it, and brought out these stone hatchets."³ The three celts (Fig. 3) are stated to be made of siliceous,

¹ *Journal Royal Society of Antiquaries of Ireland*, xv, pp. 189-194.

² Plunkett and Coffey, *Proc. Royal Irish Academy*, xx, pp. 656, 657.

³ Wilde, *Catalogue of the Antiquities of Stone in the Museum of the Royal Irish Academy*, 1857, pp. 58, 59.

greenish-grey felstone. They are highly polished. Their butt-ends appear to have been broken off; but the butt of one has been smoothed and polished, and a saltire has been cut upon it. These celts are interesting specimens: the cutting edges of two are slightly expanded, as if they were late in date, and had been reacted on by a metal form. It hardly appears likely that they were used to fell the tree, were broken in the attempt, and then thrown aside. Possibly they were deposited at the root of the tree as a votive offering. The worship of trees was so widespread in prehistoric times¹ that such an offering need cause no surprise: while the axe was frequently regarded as a sacred symbol by peoples of antiquity; so that its votive use is easy to understand. Another celt, formerly in the collection of Dr. Petrie, has its butt-end, which seems to have been broken, polished and ornamented—this specimen, and the celt above described, appear to be the only two in the Academy's collection which show this curious feature.

Two roughly made celts, now in the possession of Professor Lucas White King, M.R.I.A., are stated to have been found together at Menlough, Co. Galway. The butt of one is pointed; it has a flattened side. The butt of the other is oval. Professor White King has allowed these celts to be illustrated. (Fig. 1, 9 and 10.)

A small stone celt, $4\frac{1}{2}$ inches in length, and $1\frac{1}{4}$ inch in breadth, and portions of what were probably two others, are in the Academy's collection. All are stated to have been found together, close to the castle of Aughmanure, near Oughterard, Co. Galway. The perfect celt has a butt-end closely approaching a point. It is not possible to determine exactly the shape of the broken specimens.

Co. Kilkenny.—Two large polished stone celts, formerly in the Dawson collection, of similar shape, with roughly squared butts, are stated by Wilde² to have been found at Raysrath, Co. Kilkenny. The two celts are so alike in form as to lead to the supposition that they were fashioned by the same hand. There can be little doubt they were found in association. (Fig. 4.)

Co. Limerick.—There are a number of stone celts in the Academy's collection which are described as having been procured from Lough Gur, Co. Limerick. Lough Gur is a lake situated some three miles north of Bruff. Many antiquities of stone, bronze, and iron have been obtained either from the lake or near it, but as a rule particulars as to the exact spot where they were obtained are wanting. The lake appears to have been a place of

¹ See Frazer, *The Golden Bough*, 3rd edition, ii, Part 1, p. 7, sqq. ² *Op. cit.*, p. 51.

importance and sanctity in prehistoric times; objects being deposited in or near it probably as votive offerings to the water spirits.¹

Two celts from Lough Gur are definitely stated to have been found together; they were purchased on 11 May, 1892, from J. J. Keane. One is a well-formed specimen with a narrow butt; the butt of the other is broken. (Fig. 1, 5 and 6.) It is unfortunate that the exact spot where these two celts were found was not recorded: they are registered as having been found together in the lake.

Five stone celts found at Lough Gur were purchased from W. Hinchy on 22 May, 1865. Two are flat and wedge-shaped, belonging to the type distinguished by Sir John Evans as having flat sides.² Another is a good

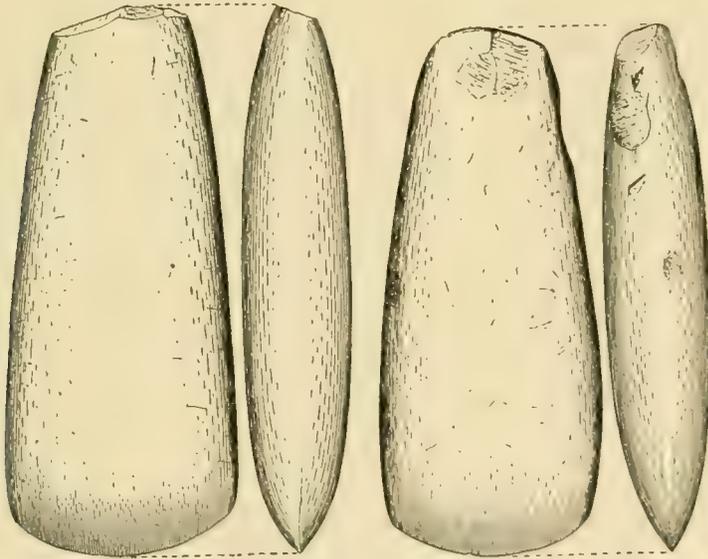


FIG. 4.

Stone celts found at Baysrath, Co. Kilkenny. (One-fourth.)

specimen with a rounded butt; the butt of the fourth is pointed; the fifth is a small, flat celt with a rounded butt. It is possible that these celts may have been in association when found; but the only information available is, as stated above, that they were purchased on the same date from the same person; they may have been discovered at different times.

Three celts found at Lough Gur were purchased on 9 July, 1891, from the same person. One of these has a butt of intermediate type; in another

¹ For instances of similar customs see Déchelette, *Manuel d'archéologie*, ii, pp. 451-453.

² *Stone Implements*, 2nd edition, 1897, p. 98.

the butt is unground; the third is irregular in shape, it is flat on one side and at the butt: that these celts were found in association is uncertain.

Wilde¹ describes six stone celts as having been procured from Lough Gur, but he does not state whether they were found together.

The remaining celts that came from this locality were procured for the collection at different times.

Two stone celts were discovered, presumably together, when ploughing a field at Ballinacarriga, Co. Limerick; they were presented to the Academy by Colonel Gloster. Both are rectangular in shape; the butt of one is square, that of the other is irregular. (Fig. 1, 7 and 8.)

Co. Longford.—Two stone celts, a flint flake, and a tanged and barbed arrow-head, all purchased from Mr. Patrick Trapp, of Longford, are stated to have been found together in a field in the townland of Soran, parish of Clonbroney, Co. Longford, by Mr. John Sexton. The larger celt shows traces of use at the cutting edge; its butt appears to have been broken off. The cutting edge of the other celt also shows traces of use, its sides are ground, and it has the general appearance of being copied from a metal celt. The flake may have been used as a knife; both its edges appear to have been worked: the arrow-head is of the ordinary tanged and barbed type. (Fig. 1, 1, 2, 3, and 4.)

Co. Meath.—Two polished stone celts were found at Knockmooney, Faganstown, near Navan, Co. Meath, in 1843; they were presented to the Academy by Mr. J. R. Taaffe. One is oblong in shape, with a round butt; the other is rectangular; its butt has been broken.

Co. Monaghan.—Two polished green-stone celts were discovered with two vessels of baked clay on the property of Captain Stopford, at Lislea, near Clones, Co. Monaghan. The two celts, and one of the vessels, were given, in 1866, by Captain Stopford to the late Mr. Robert Day, of Cork. The vessel, a typically Neolithic urn with a round base, has unfortunately got separated from the celts; it was purchased by the Academy after the sale of the Day collection in 1915. The two celts, as figured and described with the urn in 1904 by the late Mr. George Coffey, M.R.I.A.,² were similar in appearance, and measured some 8½ inches in length; their butts approach the pointed, more closely than the squared, type. It is desirable that their present habitat should be ascertained.

¹ *Op. cit.*, p. 65.

² *Journal Royal Society of Antiquaries of Ireland*, xxxiv, pp. 271-273.

The Academy's collection contains another Neolithic vessel ornamented with incised stripes, and having a rounded base; it was found in a subterranean cavern approached by a narrow passage, beside the moat of Dunagore, Co. Antrim. A stone celt and a number of flint arrow-heads are stated to have been found with the vessel, but they have not been preserved.¹

A stone celt with a pointed butt, and a hammer stone, were found, presumably together, in the townland of Carn, Latnamara, Newbliss, Co. Monaghan: they were purchased by the Academy from Mr. Michael Croarkin.

Co. Sligo.—The Academy's collection contains a food-vessel of advanced type, catalogued by Wilde² as "found at Rathbarn, five miles west of Collooney, county of Sligo, in the summit of an ancient rath, 'in a square coffer of flag-stones, placed on edge, and contained burned bones and the small mica slate disc,' which stands in front of it on the shelf." Col. W. G. Wood-Martin, M.R.I.A., in a memoir on *The Rude Stone Monuments of Ireland*,³ published some thirty years later than Wilde's *Catalogue*, figured this urn, the disc, and also a small celt of shale with a pointed butt, which he described as having been found with the urn and disc. Wilde⁴ has catalogued this disc (W. 512) as "found near Rathbarn, Co. Sligo." It seems doubtful if the celt was discovered in actual association with the urn and disc, for Wilde was usually careful to mention objects that had been found together; and the fact of his having done this in the case of the disc, but neglected the celt, leaves the association of the objects open to question: therefore it appears better not to use this find as evidence.

Co. Westmeath.—Two stone celts were found together when ploughing a field at Clonrelick, Mount Temple, Co. Westmeath. They were purchased by the Academy in 1912. The butt of the larger celt has been broken off, and the end ground; that of the smaller has been slightly flattened. (Fig. 1, 13 and 14.) It is probable, from the name of the locality, Clonrelick, *i.e.* the meadow of the cemetery, that these celts formed portion of the furniture of a grave, in which case the bones had possibly either perished or were not noticed by the person who found the celts.

¹ Wilde, *op. cit.*, p. 184.

² *Ibid.*, p. 189.

³ *Journal Royal Society of Antiquaries of Ireland*, xviii, pp. 271, 272. Abercromby (*Bronze Age Pottery*, i, pp. 126 and 143) follows Wood-Martin in describing the objects as found together.

⁴ *Op. cit.* p. 71.

Two stone celts were found, in 1867, by Andrew Corrigan of Coolaleena in a bog on the property of Mr. Edward Stanley, in the townland of Muckanagh, Noughaval, Kilkenny West, Co. Westmeath. One of these is flat, with straight sides and a broad butt; the other is chisel-shaped. (Fig. 1, 15 and 16.)

Co. Wexford.—A find which, if genuine, is of interest as indicating the continued use of stone axes during the Bronze Age, is stated to have been discovered in 1892 by William Barrett, who found a stone celt associated with a bronze socketed celt at a depth of six feet in a bog at Ballyday, Co. Wexford. These objects were acquired for the Academy's collection in 1914 from John Troy: the stone celt, which has a roughly squared butt, is made of slaty stone; it measures $3\frac{5}{8}$ inches in length and $2\frac{3}{8}$ inches across above the cutting edge.

Some mention must be made of the best-known sites where celts or implements were manufactured, and where consequently they have been found in more or less close association.

The geology and archaeology of Larne, in Co. Antrim, the most important of these, have been studied and described by Mr. R. Lloyd Praeger in conjunction with the late Mr. George Coffey.¹ The typical whitish and much-rolled Larne flakes are too well known to require further description. The so-called "Larne Celt" is of importance: a number of these implements are figured by Coffey and Praeger.² Coffey, who placed the industry in the earlier stages of the Neolithic Period, considered the Larne celt to be a roughed-out stage in the manufacture of Kitchen-midden axes. But the extreme similarity between the Larne celt and the Campigny pick cannot be ignored; it is possible that the Larne celt is a finished implement, the whole culture being of the same period as that of Campigny. If this be so, the question of date presents a difficulty, for it is uncertain whether the culture of Campigny is to be regarded as a distinct chronological division of the Stone Age or merely as a local manifestation. On this point it is desirable to bear in mind the cautious view taken about this industry by the late M. Déchelette.³

Several sites are known in Co. Antrim where stone implements were made, the most important being near Cushendall, where Mr. W. J. Knowles, M.R.I.A., who discovered the site, obtained 1,812 unground celts, 273 broken specimens, and 240 ground and polished celts, making in all over

¹ Coffey and Praeger, *Proc. Royal Irish Academy*, xxv, pp. 143-200.

² *Ibid.*, p. 183.

³ *Op. cit.*, i, pp. 326-329.

2,000 axes from Glen Ballyemon and Tievebulliagh. In addition to these, others were obtained by collectors who acquired flakes and celts after the sites became known. Mr. Knowles, who presented a series of implements from this important find to the National Collection, has described the site, and illustrated the various types of implements he collected.¹ The celts, &c., are made of black rock, probably an altered diorite, and are chipped, not polished. As well as the celts, picks, discs, chopper-like implements, rounded hammer-stones of black rock, and larger ones made of quartzite boulders, were discovered, together with thousands of flakes. Mr. Knowles considers the celts to have been roughed out on this site, and then carried away to other places to be ground and polished. The age of the implements is not clear; but Mr. Knowles² wrote: "The rude axes from Tievebulliagh and Ballyemon being found below the peat, and even mixed with the clay on which it rests, is, I think, satisfactory proof that they are of the earliest date and belong to a very early stage in the neolithic period."

Mr. R. A. Smith, F.S.A., who has devoted considerable study to Stone-Age antiquities, refers in his paper *On the Date of Grime's Graves and Cissbury Flint-mines*,³ to the Cushendall implements, certain of which he compares to those from Cissbury, while in others he recognizes the hand-axe of the Drift; the side-scraper of le Moustier; the edge-trimming of Aurignac; and the culture of Campigny. Mr. Smith considers that the culture represented by the remains at Grime's Graves and Cissbury is contemporary with the Palæolithic Cave-period. If this be so, it would seem that the Cushendall implements are also to be referred to the earlier Stone Age, and thus do not come within the scope of the present discussion.

A large number of stone celts have been found in the Shannon Fords. Wilde⁴ wrote in 1857 that "The Academy is indebted to a Commission appointed for deepening and improving the navigation of the river Shannon, for the acquisition of more than one-half of the stone celts in the Collection." The celts mentioned by Wilde were presented to the Academy on behalf of the Shannon Commissioners on 9 January, 1843,⁵ by Mr. Griffith, who stated that the celts were found at the fords of Keelogue and Meelick on the Shannon. These are the first points on the river passable except by boat

¹ *Journal of the Royal Anthropological Institute*, xxxiii, pp. 360-366; and *Journal Royal Society of Antiquaries of Ireland*, xxxvi, pp. 383-394.

² *Journal Royal Anthropological Institute*, xxxiii, p. 366.

³ *Archæologia*, lxiii, p. 141.

⁴ *Op. cit.*, p. 48.

⁵ *Proc. Royal Irish Academy*, ii, pp. 312-316.

above the falls at Killaloe, and are the main passes between the counties of Galway and King's, and those of Clare and Tipperary. To improve the river for navigation it was necessary to deepen its bed at Keelogue ford by excavating to a depth of six feet below the bottom. A portion of the river was dammed off, one hundred feet in width and seven hundred feet in length. The material excavated consisted of two feet of gravel, loose stones, and sand at the top; and of four feet of a mass composed of indurated clay and rolled limestone at the bottom. The loose material at the first two feet yielded a number of bronze swords, spears, &c., while the stone celts were found towards the lower part of the upper two feet. The greater number of the celts were stated to be made from a siliceous rock known as Lydian stone which occurs in thin beds stratified between the impure limestone called Calp, and is abundant in the neighbourhood of Keelogue and Banagher, but others were said to be made from a subcrystalline and apparently igneous porphyritic rock, none of which occurs in the neighbourhood.

Formerly it was thought that the discovery of such a large number of weapons at the river-passes indicated battles which had occurred between the men of Leinster and Connaught when disputing possession of the fords. But, as many of the celts are of the adze type, it is probable that they are to be regarded as implements rather than weapons: possibly they were used in making dug-out canoes. The few celts which are made of harder stone, and are more perfect in shape, may have been weapons. It is, however, to be remembered that only the shallow portions of the river were examined; the contents of the deeper parts are unknown.

More than three hundred celts of all types from the Shannon fords are in the Academy's collection. Eighty-seven of these were not acquired by the Museum until 1911 when they were presented by Mr. T. P. S. Crosthwaite, who described them as found in the Shannon River at Killaloe when the bed of the river was being deepened some three or four feet by excavation and dredging. Most of them were found above the bridge; but some were obtained below it while two were obtained under it, at almost the third arch from the Co. Clare side.

The shapes of the celts from the Shannon vary considerably; but it is not possible to draw any conclusions from this as it is uncertain whether they were deposited together.

The kinds of celts having been described, the theoretical portion of the paper may now be discussed, *i.e.*, whether the celt with a triangular outline and pointed butt is an earlier form than that in which the shape is more rectangular and the butt either rounded or roughly squared.

The Neolithic culture of Scandinavia has been divided into four periods, the first three having a characteristic type of stone celt.¹ In the earliest period the celts are made of flint, and are pointed-oval in section. Some are polished. In the second period the celts have squared sides and a thin butt; while in the third and fourth periods the sides of the celt are squared and the butt is broad.

Some attempts have been made in other countries to determine the comparative age of the different types; and describing, in 1912, five triangular stone celts, with pointed butts, found together at Bussleben, Thuringen, II. Mötelfindt² wrote that the question of the attribution of individual forms of stone celts to certain divisions of the Neolithic Period claims our interest in increasing measure.

The solution of the matter seems to centre upon the position occupied by the triangular-shaped celt with a pointed butt.

Schuchhardt³ considers that in France the celt with a pointed butt was evolved from the form in use in the last stage of the Palæolithic Period, as shown by the chipped, unpolished implements of the culture of La Madeleine and that of Campigny. Schumacher⁴ agrees with this view. He considers such celts to have originated in Western Europe, especially in France. Although Déchelette⁵ distinguished three French types of celts, which he described as triangular, rectangular, and cylindrical, he did not place them in a progressive series, but appeared to consider that the varieties of form and shape were due either to the use for which the celts were designed, or to the natural form of the original stone from which the object was fashioned.

It must be borne in mind, as Schumacher⁶ pointed out, that there is a connexion between the various shapes of the butts of stone celts and the manner in which they were hafted. The method of doing this varied in different countries; in Switzerland, the basin of the Saône, the basin of the Rhône, and the south of France, the most usual method was to fix the butt of the celt into either a kneed shaft, or a tenon of deer's horn fixed into the wooden shaft; occasionally the head of the tenon was pierced and the wooden shaft passed through it. In a few cases at Robenhausen the stone celt was fixed directly into a club-shaped shaft. In England, north-west France, and

¹ *British Museum Stone Age Guide*, 1911, p. 99; also Déchelette, *op. cit.*, i, p. 334; and Hoernes, *Natur und Urgeschichte des Menschen*, ii, pp. 183-185.

² *Præhistorische Zeitschrift*, iv, p. 231.

³ *Sitzungsberichte der Königlich Preussischen Akademie der Wissenschaften*, 1913 (2nd half year), p. 746.

⁴ *Præhistorische Zeitschrift*, vi, p. 43.

⁵ *Op. cit.*, i, pp. 513, 515.

⁶ *Op. cit.*, pp. 44-46.

Belgium the celts, which are often long and pointed, were generally hafted directly into a wooden handle through an oval hole. That this was also the case in Ireland is indicated by the small stone celt with a pointed butt inserted directly into a wooden haft, which was found at Maguire's Bridge, Co. Fermanagh, and is now preserved in the Academy's collection in the National Museum, Dublin. A wooden handle for a celt, found at Coal bog, Boho, Co. Fermanagh, also in the same collection, has an oval hole in the head of the haft for the insertion of the celt.

Sir John Evans' arranged polished celts in four classes, *i.e.* :—

- (1) Those sharp or but slightly rounded at the sides, and presenting a pointed oval or *vesica piscis* in section.
- (2) Those with flat sides.
- (3) Those with an oval section.
- (4) Those presenting abnormal peculiarities.

These divisions were adopted in order to describe celts more conveniently; it was not suggested that they denoted any difference in the date of the implements.

Without going into a more minute classification, it is sufficient for the present to deal with two broad types of Irish Neolithic celts, *i.e.*, those which are more or less triangular in outline and have a pointed butt; and those in which the outline assumes a rectangular form, and the butt is either considerably rounded or roughly squared.

Something, no doubt, would depend upon the form from which the polished Neolithic celt was derived: its origin has often been sought in the Danish kitchen-midden axe, and the late Mr. George Coffey wrote that "The kitchen-midden axe, or chisel, is typologically the beginning of the celt series."¹ The kitchen-midden axe is a wedge-shaped implement, the cutting edge of which is formed by striking off a single large flake on each side. But Mr. R. A. Smith has recently published a paper on *The Origin of the Neolithic Celt?* in which he traces the evolution of one form of celt back through a large series to the "point" of Le Moustier. The "point" of Le Moustier is roughly triangular in outline; so if Mr. Smith's contention is correct, its shape may have exercised some influence on that of the Continental, and English, Neolithic celt with a pointed butt, which in turn may have influenced the Irish examples.

¹ *Op. cit.*, p. 98.

² *Proc. Royal Irish Academy*, xxv, Sec. C, p. 187.

³ *Archæologia*, lxvii, pp. 27-48.

The Academy's collection contains about fourteen hundred polished stone celts and chisels, not including those found in the Shannon fords. Less than a quarter of these have pointed butts; they are not confined to any particular locality, so they cannot be considered as a local manifestation; the remaining celts have rounded butts, or belong to intermediate types. A small number are flat in section and have their cutting edges expanded into a typical metal form; these are considered to have been made under the influence of metal celts, and to belong to the transitional period when metal implements were gradually replacing those of stone. Such celts can probably be considered on typological grounds as the latest form assumed by the stone celt.

The evidence of the associated finds does not definitely settle the question as to the priority of the type with the pointed butt over that with the rounded butt. In some cases celts belonging to the two different types were found in association; against this, however, must be placed the evidence of the larger number of finds which only included celts of similar type.

The two celts found at Lislea have butts of the pointed type, and from their association with a Neolithic form of urn may be placed early in the series. On the other hand, the stone celt found with a food vessel of advanced form at Killicarney, Co. Cavan;¹ that said to have been found with a bronze socketed celt at Ballyday, Co. Wexford, and the celt found with burnt bones in the cairn on Topped Mountain, have rounded butts. In these cases the associations point to a late date for the celts, so that the evidence, such as it is, is on the whole in favour of what might have been expected on the analogy of other countries, *i.e.*, that the celt with a rounded butt is a later form than that with the pointed butt.

It might, therefore, be tentatively suggested that Irish celts belonging to the latter portion of the Neolithic Period could be arranged in three classes—those with a pointed butt and a triangular outline being regarded as the earliest; those which are of a rectangular shape and have a much-rounded or square-shaped butt being looked upon as a later type; while celts which are flat in section, and have slightly expanding cutting edges, would be considered as having been made under the influence of metallic forms and be placed latest in the series.

¹ But see *ante*, p. 89. If the celt with the pointed butt was really found in association with the urn at Rathbarn (Rathbarron), it would negative the above piece of evidence.

VII.

THE DOMNACH AIRGID.

By E. C. R. ARMSTRONG, F.S.A., M.R.I.A.,

AND

THE REV. PROFESSOR H. J. LAWLOR, D.D., LITT.D.

PLATES III-V.

Read DECEMBER 10, 1917. Published MARCH 12, 1918.

I. DESCRIPTION. By E. C. R. ARMSTRONG.

THE *Domnach Airgid* was obtained by the Academy in 1847; it had been previously described by Dr. G. Petrie, in the Academy's *Transactions*, vol. xviii, 1835-38; the Rev. Dr. J. H. Bernard¹ (now Archbishop of Dublin, and President of the Academy) also referred to the *Domnach* in his paper on the MS. found inside it; and a short account of the shrine extracted from Petrie's paper was included in the Academy's *Celtic Christian Guide*.²

Carleton's *Travels and Stories of the Irish Peasantry*, ninth edition, 1869, vol. i contains pp. 492-5 two letters about the *Domnach*: the first of these, dated 15 August, 1822, was written by Dr. A. O'Beirne, who mentioned a drawing of the shrine (apparently sent to Mr. Carleton, and added "In the closing fac[es] you will see they [the inscriptions] are referred to their *supposed* places." The second letter, from Sir William Betham, is dated October, 1812; he wrote, "I have seen the Dona, which was exhibited at the last meeting of the Royal Irish Academy. It has been put together at a guess, but different from the drawing." This drawing is probably the one referred to by Dr. O'Beirne. In the same letter Sir William Betham also wrote: "There are three inscriptions, on the Dona: one on a scroll from the hand of the figure of the Baptist, of EOE A-XOS DEI. The two others are on plates of silver, but their exact position on the box is not marked in the drawing, but may be guessed by certain places which the plates exactly fit."

Another description of the *Domnach* might be considered unnecessary; but Petrie's paper, upon which all subsequent accounts have been based, was nearly devoted to proving that the reliquary was the identical one given by

¹ P. 14, *seq.*² *Transactions Royal Irish Academy*, xxx, p. 303, *seq.*³ Pp. 45, 46, 94, 95.

St. Patrick to St. Mae Cairthinn : it was published nearly eighty years ago ; and in view of the fresh evidence discovered by Dr. Lawlor, it has been considered desirable to re-describe and re-examine the shrine.

Petrie¹ stated that recently someone had been employed to repair the case, and that certain of the ornamental plates had been replaced in an order different from their original one. The illustrations which accompanied his paper included views of the front, top, sides, and back, of the shrine ; they were made from drawings by Mr. George Du Noyer, and show the mediæval plates on the front and base differently arranged from their present position. Petrie² stated that the figures were “restored to their proper places in the accompanying plates, on the authority of Sir W. Betham’s drawings.” From the letters printed by Carleton it would seem that these included the drawing referred to by Dr. O’Beirne ; whether they represented the *Domnach* as it originally was, or are merely based upon the artist’s suppositions, is impossible to determine.

The panel drawn by Du Noyer as occupying the first quarter of the front of the shrine is now in the fourth ; his second panel is in its present position ; his third is now in the first quarter ; while his fourth panel is the third of the present reconstruction. The small reversed inscription on the top edge of his fourth panel is omitted, while the large one on the upper rim is shown detached from the shrine. The drawing of the top of the shrine shows a crystal in the sinister setting, which is now empty : the sides are ornamented with the plates at present fastened to the base, St. Katherine being on the sinister, and the two others on the dexter side ; the rim is also differently arranged. The drawing of the back omits the ornamentation on the upper limb of the cross and the inscription on the cross-piece.

A small sketch of the *Domnach*, stated to have been drawn by Petrie, is appended to Carleton’s notes about the shrine ; in this, the panel with St. Michael and the dragon is placed in the fourth quarter, and that with the bishop handing the case to an ecclesiastic in the third.

In the short account of the shrine, printed in the Academy’s *Celtic Christian Guide*, the front and top were illustrated from photographs : it is proposed to include these two views in the present paper, and to illustrate the other parts of the case from photographs taken by Mr. A. McGoogan, and made use of by the permission of the Acting-Director of the National Museum, Dr. R. F. Scharff, M.R.I.A.

To avoid confusion, the heraldic terms “dexter” and “sinister” are used throughout the following description :—the dexter is the right side of the

¹ *Op. cit.*, p. 15.

² *Op. cit.*, p. 16.

shrine, which will be to the observer's left; while to his right will be the sinister or left side.

The shrine is badly preserved; this is easy to understand if Dr. O'Beirne's¹ account of its adventures is true. Unfortunately, the repairs and restorations of more recent years have been roughly carried out; lumps of solder have been left exposed in prominent places, while the riveting on of the outer plates has been crudely executed.

The *Domnach Aicgid* is a box of yew wood, which was covered in the first instance with bronze panels coated over with a white metal. Petrie² stated that these panels were plated with silver; but I was doubtful if any process of silver-plating was in use in Ireland at such an early date, and so asked Dr. A. G. G. Leonard, of the Royal College of Science for Ireland, to determine the metal. This he did by means of a spectroscopic analysis. The first examination showed some faint lines of silver, which Dr. Leonard thought were due to impurities in the bronze; he therefore made a second examination of the deposit, and has reported as follows:—

"The result of the spectroscopic examination of the *Domnach Aicgid* shows the deposit to be composed mainly of tin. The silver lines were not appreciably strengthened when the deposit was sparked on to the lines of the bronze, whereas the tin and some copper lines were much intensified." It appears, therefore, that the bronze plates were coated with tin, not plated with silver. From the colour of this tin coating the shrine received its name of *Domnach Aicgid*, i.e. the silver *Domnach*. In the fourteenth century a further covering of silver-gilt plates, ornamented with figures of saints in relief, &c., was added, a rim of ornamental panels, one having an inscription, being placed round the case to cover the edges: it will be shown that there is reason to believe that the present back, and the embossed plate on the top of the shrine, were still later additions.

The *Domnach* is now made up of the following parts:—

(1) The front, ornamented with the fourteenth-century crucifix and panels, which are directly attached to the inner framework, all traces of any earlier metal plate having apparently disappeared. Including the rim, it measures 230 mm. by 167 mm.

¹ Carleton, *op. cit.*, p. 402.

² *Op. cit.*, p. 15.

³ The practice of covering objects with white metal goes back to early times. Several Irish bronzes, probably of seventh-century date in the Academy's collection, are so coated in their backs. The Lough Erne shrine, which has been assigned to the ninth century, is made of a yew-wood box covered with bronze panels which are "apparently tinned." Several objects of Scandinavian origin found in Ireland are coated in the same way. See Coffey, *R. I. A. Celtic Christian Guide*, 1910, pp. 23, 24, and 42-44.

(2) The top, now covered by an embossed silver plate, it measures, including the rim, 226 mm. by 101 mm.

(3) The sides. These are bronze panels coated with tin, and form part of the earliest metal covering of the shrine. Including the rim, they measure respectively 173 mm. by 92 mm.; and 173 mm. by 96 mm.

(4) The base, now covered by three silver-gilt fourteenth-century panels, which are apparently riveted directly to the inner framework. Including the rim, it measures 228 mm. by 99 mm.

(5) The back: a plate of bronze or latten nailed to the inner wooden case; attached to it by rivets is an ornamented and inscribed cross of copper, gilt. Including the rim, the back measures 222 mm. by 167 mm.

(6) The rim: portions of this have disappeared; the vacant spaces have been filled with pieces of brass.

(7) An inner box of yew wood, which is described *post*, p. 105.

The front of the case (Plate III) is thus ornamented: the centre is treated as a cross dividing the remaining space into four panels, each contained in a frame of niello work; the dexter lower panel has on its upper side an inscription, reversed, in raised Lombardic characters, which reads:—

JOHANNES : O BARRDAN : FABRICAVIT

Each panel measures, including the frame, roughly 89 mm. by 70 mm. A figure of our Lord, of silver, gilt, is attached to the cross; over His head is a bird, presumably a dove, in a setting of blue champlevé enamel; above this is a small square silver setting, composed of a beaded base supporting a band of dots arranged in groups of five, with fleurs-de-lis claws, containing a crystal. Petrie¹ wrote that this setting probably contained "a supposed piece of the true cross." Examination has shown this conjecture to have been correct; see *post*, p. 104. Adjoining this setting, in a rectangular frame of blue enamel, is a heater-shaped shield bearing emblems of the Passion, the crown of thorns, three nails, and two hands holding scourges; remains of red champlevé enamel can be seen on the shield.

The first of the silver-gilt panels is divided into two niches: the dexter contains a figure of St. Michael and the dragon; the saint, who carries a shield emblazoned with a cross, stands upon the reptile and thrusts a cross-headed spear into its mouth; the sinister niche contains an effigy of the Virgin, crowned and enthroned, giving her breast to the child; she holds some small object in her left hand. The second panel is divided by niches into three compartments. In the first is a figure, wearing a round hat, dressed in a long robe; he holds in each hand a long-handled rod with a foliated top.

¹ *Cp. cit.*, p. 15.

Sir William Betham in his letter, previously referred to, described this figure as a "bishop pierced with two arrows."¹ Petrie² names it St. James. If so, possibly he is holding fuller's teazles; in the second compartment is an effigy of St. Peter with the two keys in his right hand, and in his left a book; the third niche contains a figure of St. Paul, holding in his right hand a sword, and a book in his left. The third panel has two compartments; the dexter contains, under a double arch, an effigy of a seated bishop, wearing a mitre, amice, cope, and albe, handing a box to an ecclesiastic. Petrie³ suggested that this scene represented St. Patrick handing the *Domnach Airgid* to St. Mac Cairthinn. A female figure, wearing a hood and flowing robe, stands in the second niche. The fourth panel is divided into three niches; the first contains an effigy, perhaps of St. Columba, dressed in a long robe, with his right hand on his breast, and clasping a book in his left; the figure of an abbess, holding in her right hand a floral-headed crozier and in her left a book, occupies the second niche; she is probably meant for St. Brigid; in the third niche is depicted an archbishop, possibly St. Patrick, wearing a mitre, amice, appurtenant albe, dalmatic, chasuble, and pall; his right hand is raised in benediction; in his left is an archbishop's cross.

The top (Plate III) is covered by a silver plate, originally gilt, now broken into three parts. Its removal has shown that beneath it is a bronze panel, coated with tin, and decorated with interlaced knot-work of a character similar to that on the sides, but not bordered with fret-patterns; the interlaced knots at the ends are more elaborately decorated than those in the centre (Plate V). The upper plate is ornamented with three round bosses. Each rises from a beaded rim, and measures some 65 mm. in diameter. The decoration of the dexter and sinister was similar. It consisted of an oblong crystal, contained in a fleurs-de-lis claw-setting, which formed the centre of a star with six rays, originally covered with blue champlevé enamel. Between the rays are alternate griffins and lions, looking backwards. The crystal on the sinister side is missing. The central boss contains a large oblong crystal in an elaborate setting of a beaded rim, from which rises a band, ornamented with dots grouped in fives, surmounted with fleurs-de-lis. The body of the boss is ornamented with a ribbon of beaded and linear work arranged in a chevron pattern. The upper of the triangular spaces made by the ribbon are filled with wire-work, each of the lower with two birds perching at a cross-headed staff. Between the central and outer bosses are four galloping horsemen. They wear helmet-shaped hats, with wide brims, have large rattles round their necks, and are clothed in a long

¹ Carleton, *op. cit.*, p. 404.² *Op. cit.*, p. 15.³ *Ibid.*, p. 18.

pleated garment, belted at the waist. According to Irish custom they do not use stirrups. At two of the corners of the plate are small circular settings of beaded work, with fleurs-de-lis claws: the dexter is now empty; the sinister contains a pearl: possibly these settings were originally attached to the corners of the rim. Petrie¹ stated that the crystals set into the bosses covered relics. Examination has failed to disclose these.

The sides (Plate IV) are bronze panels, coated with tin, attached to the wooden box. They are engraved with interlaced work, bordered with a fret-pattern at the side edges.

The base (Plate V) has, according to Petrie,² lost its original ornaments, their place having been supplied by the "recent repairer" with panels taken from the sides; now it is covered by three silver-gilt panels, each roughly square, measuring about 70 mm. by 70 mm., ornamented with effigies in relief, contained in a beaded and linear framework. The dexter panel contains an effigy of St. John the Baptist, who wears a camel's-hair robe, and holds a black enamelled disc, on which is the *Agnus Dei*, in his left hand; in his right is a scroll bearing an inscription in Lombardic characters AGNUS DEI . To the saint's left, engraved on the field of the panel, is Salome, with the Baptist's head on a charger. An effigy of St. Katherine crowned occupies the centre panel: she holds a wheel in her right hand, and in her left a book. On her right is engraved a priest adoring her; and on her left is a server, swinging censers. In the sinister panel is a male effigy, enthroned, wearing a cope, fastened by a jewel, and an albe; his right hand is raised in benediction; he holds a small cross in his left: engraved at each side of him is a figure, swinging a censer.

The back of the shrine (Plate IV) is a bronze or latten plate, attached by rivets to the wooden box, engraved with a plain ornament of straight lines round the edge, and with quarter-circles at the corners, and also round the centre of the copper-gilt cross which is riveted to the plate: the upright shaft of the cross is ornamented with a floral decoration; on its cross-piece is engraved an inscription in black letter. Petrie³ wrote that he was unable wholly to decipher this inscription on account of its injured state, but that it ended with the word **cloachbar**, the name of the see to which the reliquary had originally belonged.⁴ After examining the inscription carefully I saw

¹ *Op. cit.*, p. 16.

² *Ibid.*

³ *Op. cit.*, p. 17.

⁴ In the extract about the shrine printed in the *Academy's Celtic Christian Guide*, pp. 94, 95, Petrie's reading of this inscription is repeated. In the preface to that work it is stated that Mr. R. I. Best, of the School of Irish Learning, had re-examined the inscriptions on the various shrines. Mr. Best is not, however, responsible for the repetition of this error: he only examined the Irish inscriptions on the different shrines.

that what Petrie had read as a **c** was part of the symbol **ibc** which is placed on a small compartment of the inscription; on my pointing this out to Dr. Lawlor, he at once concurred. Professor R. A. S. Macalister subsequently examined the lettering with me, and, after working at it for a short time, we were able to decipher the names of the Magi, or Three Kings, the inscription reading:—

jappar **ibc** melchicar ba **ibc** ldarar

The traditional names of the Magi, commonly known as the Three Kings of Cologne, are frequently found on mediaeval ornaments. As a magical formula they were supposed to be of especial efficacy against the falling sickness; they were also used as a charm against fever.¹

The rim (Plates III, IV, V) was composed of silver-gilt plates, apparently bent at right angles, so as to cover the edges of the case. The plates were joined lengthways by hinges, the longest centre-piece measuring 141 mm. in length. The corners were covered by three plates placed together at right-angles, their juncture being marked by a triangular-shaped ornament decorated with a trefoil. To the angles of this ornament were attached either three human, or three zoomorphic, heads, and to these were fastened small circular settings, with beaded bases, and fleurs-de-lis claws, now empty, with the exception of one on the dexter side, which contains the remains of a pearl. Much of the early rim has perished, and its place has been supplied with pieces of brass. The upper rim on the front (Plate III) is reversed. Its centre-piece contains, in niello work, an inscription, in Lombardic characters, which reads:—

JOHNS : O KARBRI : COMORBARUS : S : TIGRACH : PMSIT

From this inscription the date of certain parts of the shrine can be ascertained, for the death of John Ua Cambri, successor of St. Tigernach in Cluain-Eóis, is recorded in the *Annals of Ulster*,² at the year 1353. There can be no doubt that this is the ecclesiastic who is commemorated on the *Dunmuck Aural*. To the dexter side of the inscription is hinged a small silver panel in a hooped frame, containing a hare at speed. A zoomorphic head divides this from a similar panel, containing a running hound, with a jewelled eye. On the sinister a panel of the same type, but containing a wyvern, with a floriated tail and jewelled eye, is hinged to the inscribed panel: it is divided by a human head from a similar panel, forming part of

¹ King, *Archæological Journal*, xxiv, pp. 233, 234; also see *Archæologia*, xxx, p. 400; and Dalton, *British Museum Catalogue of Mediaeval Finger Rings*, p. 140.

² ii, p. 497, and note.

the rim at the side. The long panel at the top of the shrine contains two birds, with long floriated tails, placed on each side of a small, square setting, with a beadwork base and fleurs-de-lis claws, which contains a crystal: hinged to this, on the dexter, is a panel containing a hound, a zoomorphic head divides this from another, containing a hare, which is joined to a small panel¹ containing a six-leaved flower. On the sinister side a panel containing a hare joins the long one, and a human head separates it from a hound and a small flower panel. On the base of the front of the shrine the long panel contains two birds, placed at either side of the Saviour's feet, similar to those in the long panel at the top of the shrine: hinged to this, on the dexter, are two wyvern panels, divided at the corner by a human head; and, on the sinister, are two panels, one with a hare, and the other with a hound, separated at the corner by a zoomorphic head. The under side of the long panel, which is on the base of the case (Plate V), is plain: at each side of it are hinged hare, hound, and floral panels, parted on the dexter by a human, and on the sinister by a zoomorphic head. The rim on the upper dexter side of the case (Plate IV) consists of two panels of interlaced work, divided by a zoomorphic head, and one flower panel. At the base of this side are two wyvern panels, which a human head separates, and a flower panel. The rim on the upper end of the sinister side (Plate IV) consists of two wyvern panels, parted by a human head, and a flower panel; and on the lower, of two interlaced panels, separated by a zoomorphic head; and a flower panel. At the back of the shrine (Plate IV) the corners are composed of bronze or latten panels, placed together like those on the front; these panels are plain, with slightly ornamented borders, their junction is marked by what seem to have been zoomorphic heads; but these are now so much worn that it is impossible to be certain on the point. The remaining undescribed portions of the rim are made of brass, and appear to be modern additions.

The interior of the shrine and the contents of the settings may now be described. Permission having been given by the Council of the Academy, with the assistance of Dr. Lawlor, I opened the shrine on Wednesday, 7 November, 1917. Mr. A. C. Forbes, F.H.A.S., Forestry Inspector to the Department of Agriculture, kindly attended for the purpose of determining the species of wood of which the inside box was made; Mr. J. J. Buckley, M.R.I.A., Keeper of the Art and Industrial Collections in the National Museum, was also present. I first raised the claws and removed the crystal from the small square setting on the front of the case which Petrie¹ stated "probably contains

¹ *Op. cit.*, p. 15.

a supposed piece of the true cross": its under surface was flat; it rested upon another crystal with four facets and a flattened point, fastened down by some kind of plaster, in which were two small fragments of wood, one measuring about five millimetres in length, the other being about the size of a pin's head, and some dust. The smaller fragment crumbled into dust. Dr. G. H. Pethybridge, M.B.A., Professor H. H. Dixon, Sc.D., F.R.S., Professor H. J. Seymour, Esq., and Mr. A. C. Forbes, F.H.S., kindly examined the larger piece under a microscope: its small size rendered any determination as to its character doubtful, so Dr. Pethybridge undertook a further more searching examination, and has kindly sent me the following note (with which Professor Dixon concurred), giving the result:—

"The piece of wood, said to be a portion of the true Cross, is of light colour, about five millimetres long three-quarters of a millimetre wide, and one-fifth of a millimetre thick. It is most improbable that this piece of wood can have been a portion of a piece of timber as ordinarily understood. On the other hand, microscopic examination of it both in cross-section and longitudinally goes to show almost with certainty that it must have been derived from a young twig or branch of a tree or shrub. Portion of the medullary sheath of the twig is present with primary wood (protoxylem), and with some half-dimen rows or so of elements of secondary wood. The secondary wood present appears to consist of tracheids only, having simple pits; but it is quite possible that had the specimen been larger, portions of the secondary wood, including vessels, might have been present. In one part of the fragment a structure resembling a small bordered pit was seen. From the small amount of tissue necessarily present in such a mere fragment of wood the identification of the tree or shrub from which it was taken would be a matter of great difficulty, and one involving probably an inordinate amount of time."

It is probable that the fragment represents the piece of the true Cross which is mentioned in the *Life of St. Mac Carthinn*¹ as one of the relics contained in the shrine. It is recorded in the *Annals of Tigernach*² (Howl. B. 488) at the year A.D. 1123, that a piece of Christ's Cross was brought to Ireland and that some of it was given to King Tondelbach Hua Chulchubair, who enshrined it at Roscommon: so a relic of the true Cross was brought to Ireland in the early part of the twelfth century.

The small crystal in the square setting on the rim was next removed; beneath it was some dust.

¹ See the passage quoted by Dr. Lawlor in part II of this paper, *post*, p. 110.

² *Revue Celtique*, xviii, p. 43, *seq.*

The added silver plate on the top was then lifted off; below it was one of the original metal plates of the case, ornamented with interlaced work. Beneath the central boss of the added plate was a mixture of dust and small fragments of wood; there was nothing beneath the crystal. No remains were found beneath the dexter and sinister bosses, and there was nothing under the crystal remaining on the dexter side.

Mr. J. N. Halbert, M.R.I.A., Assistant in the Natural History Section of the National Museum, Dublin, kindly examined the material found beneath the various settings, and has reported as follows:—

“Most of the material handed to me for examination was obtained from under the central boss on the top of the shrine; a much smaller quantity was found under the square setting on the rim, and in the setting which contained the part of the true cross. A minute examination of this material shows that it is mainly composed of dust grains, numerous wool-fibres, fine bristles, small pieces of a soft white wood, fragments of insects and spiders, the whole mass being held loosely together by the fine strands of spider webs. A few small fragments superficially resembling human hair are present, but these proved to be nothing more than dyed sheep's wool similar to that used in homespun cloths. At one time there may have been a layer of cloth¹ between the boss and the top of the shrine. If not too tightly fitted, this layer would supply a suitable habitat for the caterpillars of small house moths, and indeed the cocoons of such moths, as well as the remains of the insects, are present in the debris. The material found under the other ‘settings’ resembles that of the central boss.”

The removal of the front disclosed the interior of the case: it was empty (Plate V). The wooden box is hand-cut; it has every indication of age. Its dimensions are:—interior length, 193 mm.; breadth, 140 mm.; depth, 74 mm.; the average thickness of the wood is about 11 mm. A piece measuring about 119 mm. by 25 mm. has been broken away from the upper portion of the base; it has been partially repaired by a thin slip of wood. The outside measurements of the box are 218 mm. in length and 164 mm. in breadth.

The lid, which is in a bad state of repair, and has been covered at the back by a brass plate measuring 192 mm. by 143 mm., measures 218 mm. in length and 143 mm. in breadth.

Mr. A. C. Forbes, F.H.A.S., and Dr. G. H. Pethybridge, M.R.I.A., kindly examined small samples from the front and one side of the box, also a specimen of the thin piece let into the base, in order to determine the species of

¹ See on this point Appendix I of Dr. Lawlor's memoir on the *Cathach* (*Proc. Royal Irish Academy*, xxxiii, sec. C, p. 394), where instances are given of pieces of cloth being inserted as relics in Irish shrines.

wood. They inform me it is yew; the small piece of wood, inset apparently in modern times, to repair the box, is oak.

The box (Plate V) has the appearance of having been made with a sliding lid: the two sides show a rebate: one end is slightly lower than the other and levelled to the rebate: but though the present breadth of the lid would allow it to rest on the rebated sides, it is the full length of the box, and if slid in and placed against the higher end it would leave a portion protruding from the case.

The date, or rather dates, of the various parts of the shrine can now be considered. The three remaining plates of the first metal covering available for examination, *i.e.*, the lower plate on the top and the two sides, are un-inscribed, so that their dating must rest upon artistic grounds: they are decorated with interlaced work: the sides have a border of fret patterns. These interlaced patterns closely resemble those of the Book of Durrow. The evidence collected by Dr. Lawlor and published in his Memoir on the *Cathach*, points to the seventh century as the probable date for the Book of Durrow. Professor W. M. Lindsay,¹ in his palaeographical notes appended to Dr. Lawlor's Memoir, says that the ms. cannot be much older than 700 A.D., but seems inclined to put it little later. Professor R. A. S. Macalister² has, however, sought to prove that the middle of the ninth century is a more probable period for the writing of the ms. in question. Now the interlaced style was not in general use in Ireland before the seventh century,³ and as the ornament of the panels of the *Dessau's Arzoid* shows no trace of La Tène survivals, it cannot, I think, be earlier than the seventh century, while it is probably as late as the eighth. It is impossible to date with certainty the wooden box to which the metal sides were attached: if its lid was originally a sliding one the protruding end would have hindered the fastening on of one of the metal ends, but the metal plates presumably always had a framework to which they were fastened, so it is probable that the wooden box is at least as old as they are.

The inscriptions on the front of the shrine show that it was redecorated not later than the middle of the fourteenth century, and to this period may be assigned the silver panels with figures of saints in relief and the earlier portions of the rim.

The silver plate now covering the top is more difficult to date. Petrie⁴ considered it to be contemporary with the added panels on the front and

¹ *Proc. Royal Irish Academy*, **xxiii**, sec. C, pp. 317-322.

² Appendix A of the same paper, p. 400; see also the Rev. S. F. H. Robinson, *Celtic Illuminative Art*, 1908, p. xx.

³ *Essays and Studies presented to William Ridgeway*, 1913, p. 301.

⁴ See Coffey, *Royal Irish Academy's Celtic Christian Guide*, 1910, p. 8.

⁵ *Op. cit.*, p. 16.

base, and described one of the four horsemen represented upon it as exhibiting "with minute accuracy the costume of the nobility in Ireland during the 14th century." But the most noticeable feature about the horsemen's costume is the ruffles round their necks, and on this account I am not inclined to believe the panel to be older than the sixteenth century—an opinion, I may add, that is strengthened by the inferior craftsmanship of the plate, which, though based upon, lacks the strength and vigour of, early mediæval work.

The Rev. J. E. McKenna, M.R.I.A.,¹ has suggested that the horsemen were placed on the *Domnach* as a compliment to the Maguines, as a section of that family had adopted at an early period a mounted knight, sword in hand, for their "insignia or arms."² This seems a reasonable way of accounting for the presence of such warlike figures on a sacred object: if correct, it would strengthen my view as to the late date of the top, for heraldic devices do not appear to have been adopted by the Irish chiefs until late Tudor times.³

Petrie stated that the inscription on the cross which is attached to the back of the shrine was later in date than those on the front; this is evident. On the front Lombardic characters are used, while the inscription on the back is in black letter. The examination of a number of ecclesiastical seals⁴ has shown that good Lombardic characters were used from the early part of the thirteenth to the middle of the fourteenth century, when they were replaced by black letter, which, at first bold, afterwards fine and close, remained in use until about 1500 A.D. The metal back of the shrine may, therefore, be as late as the fifteenth century; it is certainly not older than the latter portion of the fourteenth.

Thus the *Domnach Airgid* appears to have been first constructed as a simple wooden box of uncertain age, having as early as the seventh or eighth century a metal casing of bronze plates, coated with tin, engraved with interlaced patterns. Before 1353 the crucifix, silver-gilt panels, and rim were added. The fifteenth century probably saw the addition of the back and cross inscribed with the names of the Three Kings; while in the sixteenth century the embossed plate was attached to the top. The pieces of brass-work to be seen on the rim and on the cross on the front of the shrine were possibly added by the person Petrie⁵ alludes to as the "recent repairer."

¹ *Ulster Journal of Archaeology*, vii, 1901, p. 121.

² Such a device doubtless originated from a common type of equestrian seal bearing the effigy of the chief. Sir Bryan Maguire, created a peer in 1627, bore arms of Vert, a man in armour on horseback with a sword in his right hand. See Burke, *Dormant and Extinct Peerage*, 1883, p. 349.

³ Armstrong, *Journal Royal Society of Antiquaries of Ireland*, xliiii, p. 66, *seq.*

⁴ See Sir W. St. John Hope, *Proc. Society of Antiquaries of London*, 2nd S., xi, p. 305.

⁵ *Op. cit.*, p. 16.

II. HISTORY. By H. J. LAWLOR.

A tradition was current in the upper part of the county Fermanagh a century ago that the shrine then known among the peasantry of that district as "the Donnach" was presented by the Pope to one Donagh O'Hanlon, who had made a pilgrimage to Rome about 600 years earlier. This story of course cannot be true; and it is vain to speculate as to the element of fact which may lie behind it. Its value is not enhanced by the assertion of the person who told it to Dr. O'Beirne of Portora in 1832, that it rested on the authority of Sir James Ware.¹ It is nevertheless not without interest, as we shall see. But Dr. O'Beirne's informant went on to relate the wanderings of the Donnach in the seventeenth century, with no appeal to authority: and here, I conceive, we may accept his statements as at least not far from the truth. Dr. O'Beirne, it is true, describes them as "vague detail"; but I am rather inclined to note the absence of vagueness and the minuteness of detail as a guarantee of the general accuracy of the tradition. This is what he said: O'Hanlon deposited the shrine in the monastery of Aghalurcher;² but when this monastery was destroyed in Cromwell's time, it was hidden at Lough Eye, between Tempo and Lisbellaw, and after the restoration of peace it was placed in a neighbouring chapel. In 1689 it was again concealed at Largy, "an old castle at Sir H. Brooke's deer-park," from which it was dug up after the Boyne by a priest named Anthony Maguire. All the places mentioned are in Maguire's country in the county of Fermanagh, and not far apart. After Anthony Maguire's death it was carried by his niece to Florence Court; but the Maguires insisted that it should be brought back, and this was done. Here the story ends, and we hear no more of the shrine till the beginning of the nineteenth century, when it was in the possession of an old woman at Brookborough, close to Largy, and in the Parish of Aghavea, which adjoins Aghalurcher. She was a Maguire and lived in Maguire's country; and she declared that the shrine, which was supposed to contain some of the Blessed Virgin's hair had belonged to "the lord of Emmiskillen" - the chieftain of the Maguires who was executed for complicity in the rebellion of 1641.³ From

I do not know any passage in Ware's published writings which refers to the Donnach.

¹ The Rev. J. E. McKenna believes that there was no religious establishment in Aghalurcher, other than a parish church, in later centuries. But in Fermanagh traditions old parochial churches are often called monasteries. The church of Aghalurcher was in ruins in 1622. The introduction of Cromwell at this point of the story is therefore unhistorical.

² A very small townland, named Largy, adjoins Deerpark in the parish of Aghavea.

³ J. Groves in W. Shaw Mason's *Parochial Survey*, 1819, vol. iii, p. 163; W. Carleton, *Tracts and Stories of the Irish Peasantry*, ser. 2, Dublin, 1833, vol. iii, pp. 441-443.

her it was purchased by Mr. George Smith, the well-known Dublin bookseller. When it was opened it was found to contain a mutilated copy of the Gospels. It was apparently in Mr. Smith's hands when it was exhibited to the Academy in 1832;¹ and a few years later it was sold by him to the Hon. Henry Robert Westmore, afterwards third Baron Rossmore, for £300. Ultimately it was purchased by public subscription, and became the property of the Academy in 1847.²

When the Domnach came to Dublin it was naturally assumed that it had originally belonged to St. Tigernach's monastery at Clones, for nothing was then known of its early history except what might be inferred from the inscription which states that its outer case was constructed by permission of a comarb of Tigernach. That was the view expressed by Sir William Betham a day or two after he saw it for the first time. He wrote that the manuscript which it contained was "probably the property of St. Tigernach himself." He seems to have found confirmation of this opinion in the representation on the cover of the shrine of one ecclesiastic handing a book to another. This, he held, was St. Tigernach passing on the Domnach to his successor Sinellus.³ I mention the fact because it is an illustration of the fatal ease with which evidence for any theory can be found in such sources.

But Betham's guess was put out of court by the discovery made by Dr. Petrie, that in two early documents—in one of which it was actually called the Domnach Airgid, or Silver Shrine—the Domnach was stated to have been presented by St. Patrick to St. Mac Cairthinn, the founder of Clogher.

I quote the passages, as I shall have occasion to mention them in the sequel. The first is from the Tripartite Life of St. Patrick (ed. Stokes, p. 175f.):

"Once as Patrick was coming to Clochar from the north, his champion, to wit, Bishop Macc Cairthinn, lifted him over a difficult place. This is what he said after lifting Patrick: 'Oh, oh!' 'My God's doom!' saith Patrick, 'it was not usual for thee to utter that word.' 'I am [now] an old man and I

¹ It is stated in the *Transactions* that Dr. Petrie read the paper, which will be referred to immediately, on 22 October, 1832, and 9 January, 1837. If so, it must have been largely altered in the interval between those dates. In the ms. minutes, under 22 October, 1832, there is no mention of a paper: it is merely recorded that Petrie exhibited the shrine. But under 9 January, 1837, we read, "Dr. Petrie exhibited a ms. of the Four Gospels of which he had given an account in a paper some time since before the Academy."

² *Proceedings*, iii, 237, 413; iv, 115.

³ Carleton, *l.c.*, p. 439 f. That Sinellus was the successor of Tigernach, or had anything to do with the establishment at Clones, is unsupported by evidence. See my *Fragments of the Register of Clogher* in the *Louth Archaeological Journal*, vol. iv, no. 3, Extract ii. Sinellus was the possessor of a noted shrine, but it was called Deargann.

am infirm,' saith Bishop Macc Cairthinn, 'and thou hast left my comrades in churches, and I am still on the road.' 'I will leave thee, then, in a church,' saith Patrick, 'that shall not be very near, lest there be familiarity (?), and shall not be very far, so that mutual visiting between us be continued.' And Patrick then left Bishop Macc Cairthinn in Clochar, and with him the *Domnach Airgit* which had been sent to Patrick from heaven when he was at sea coming towards Ireland."

The second passage is from a Life of St. Macc Cairthinn, a portion of which is preserved in the *Codex Salmanticensis* (ed. C. de Smedt and J. de Backer, col. 799):

"Denique cum ipse in universali praeedicaret semen uitae per Hiberniam serendo iuuenilis annos actatis suae transegisset, die quodam sanctum magistrum trans flumen quoddam ut solebat portauit, cumque sacrum deponeret onus signa debilitatis suspirando ostendit. Cum a pio patre pulsaretur ut causam suae diocret debilitatis, ait, Jam inquit pater, accedente senio uires michi deficiunt et assiduum iter me multum grauat. Fac ergo me pater in aliquo loco Deo et illi seruire. Quod pater annuens ait, Uade in pace fili et monasterium filii constane in platea ante regalem sedem Ergallensium resurrexeris in gloriam inde. Sedes enim illorum qui terrena sapiunt desolabitur, tua uero deo in idem arguentabitur, atque de eius sacro cinitherio plurimi ad beatam resurgent uitam. Et addidit, Accipe, inquit, baculum stitens nec quo ego mouer et meo sustento et serinium in quo de sanctorum apostolorum reliquiis et de sancte Marie capillis et sancta cruce domini et sepulchro eius et aliis sanctis reliquiis continentur. Quibus dictis dimisit cum cum usulo pacis, paternis illius benedictione. Itaque illuc perueniens Clochorensis fundauit monasterium."

Whatever else these passages may prove, they certainly show that when the documents from which they are taken were written the *Domnach* was not at Clones but at Clogher, and that it was believed by the writers to have been there from the foundation of the see. And the evidence of the Tripartite Life carries us back to a date long prior to the inscription to which reference has been made. The presumption therefore is that the shrine originally belonged to Clogher.

¹The opening words of this extract are not in the Salamanca fragment, which begins at *transiit*. They are taken from the Clogher Register. See below, p. 121. I print here part of the corresponding passage of Jocelin's *Vita S. Patricii*, c. 143. It is no doubt derived from the Tripartite Life, and has no independent value. 'Expletis aliquantis diebus praefatus mon [Macc Cairthinn] Clochorensi ecclesiae quam ipse S. Patricus tunc regibus et comitibus construxerat cum in episcopum, contulit illi chrismatarium quod uentum sui destinatum susceperat.' Here *chrismatarium* is probably a mere conjectural rendering of *Domnach Airgit*.

Assuming for the moment that it remained there till the sixteenth century, I may indicate what seems to have been its later history. It was probably removed from Clogher in the interval between the death of Cornelius MacArdghail, who was alive and administering the see in 1592,¹ and the arrival of the first bishop appointed by the Crown, the Scotsman George Montgomery. He succeeded MacArdghail, after a long vacancy, in 1605. From that time, except during its sojourn at Florence Court, till its purchase by Smith—a period of 130 or 140 years—it was in the territory of the Maguires, and in the custody of various members of the sept.

Dr. Petrie's discovery was apparently made shortly before he wrote, or finally revised, the paper in which for nearly sixty years he was generally held to have said the last word on the Domnach Airgid.² It was published in the Transactions of the Academy in 1838.³ In that paper he found some difficulty in escaping from the thrall of the earlier theory. 'Thus he writes that the shrine was purchased "in the neighbourhood of Clones, in the county of Monaghan, *its original locality.*"⁴ And further on he says that it "belonged to the monastery of Clones, or see of Clogher"; adding, in explanation of that obscure, if not unmeaning, phrase, that on "the death of St. MacCairthinn in the year 506, [St. Tigernach] removed the see of Clogher" to Clones⁵—a statement which is unhistorical.

In this essay Dr. Petrie's main purpose is to prove that the manuscript which was found in the Domnach Airgid belonged to St. Patrick, and that it was brought to Ireland by him.⁶ His argument rests on the three following propositions:—1. The Domnach itself was the property of St. Patrick; 2. It was originally intended to be a book-shrine, not, as has been commonly supposed, a reliquary; 3. The book for the preservation of which it was designed was the manuscript of the Gospels which was found in it in 1832.

¹ *Journal of Kilkenny Archaeological Society*, N.S., vol. i (1856-7), p. 81. This conjecture, which was suggested by the historical facts, is confirmed by Mr. Armstrong's opinion that the latest part of the outer case of the shrine dates from Elizabethan times, and that the figures with which it is adorned resemble the Maguire arms. There is no improbability in the hypothesis that the case was made after 1592, when the shrine was in the hands of the Maguire clan.

² The evidence which connected the Domnach with St. Mac Cairthinn was unknown to Betham after the exhibition of the shrine in 1832, at which he was present. See Carleton, *l.c.*, p. 440.

³ *Transactions of R.I.A.*, vol. xviii, Antiquities, pp. 14-24.

⁴ P. 14. On p. 17 Clogher is said to be the see to which it "originally appertained." The words "in the neighbourhood of Clones" are misleading, for Brookeborough is almost equidistant from Clones and Clogher—about twelve miles from each, as the crow flies. The important point is that neither Clones nor Clogher is in the Maguire Country.

⁵ P. 18. I may again refer to my Fragments of the Clogher Register, *l.c.*

⁶ P. 20.

If all these assumptions are sound, Dr. Petrie's thesis is established; if any one of them is false, it falls to the ground. All three were challenged in a valuable paper contributed to our Transactions in 1893 by Dr. J. H. Bernard, now President of the Academy and Archbishop of Dublin.¹

Let us examine them one by one.

1. The first proposition is founded on the passages already quoted from the Tripartite Life of St. Patrick and the Life of St. MacCairthinn in the *Codex Salmaticensis*. And the statement which they agree in making, that St. Patrick gave the Domnach to St. MacCairthinn, must be admitted to be an early tradition. Nevertheless it cannot be true. Petrie himself tells us that the ornamentation of the inner metal case of the shrine—the Domnach Aingal proper—“indicates a period between the sixth and twelfth centuries”;² and Mr. Armstrong now expresses the opinion, based on surer ground, that the seventh or even the eighth century is its earliest possible date. A shrine which was constructed in the sixth or any later century cannot have been in the hands of St. Patrick.

But Petrie provides himself with a way of escape out of this difficulty. He gives us to understand that the wooden box within the Domnach is earlier than its most ancient parts, and he says plainly that it “may probably be coeval with the manuscript which,” according to him, “it was intended to preserve.”³ Now it is obvious that the box was not designed for the purpose which it has actually fulfilled—to be the case of a metal shrine. For that end its sliding lid would have been useless; once the box was encased it could not be drawn off. Moreover, if it lay on the rebate provided for it, its projecting end would have made it impossible to attach plates of metal to the side over the edge of which it protruded. These difficulties have not been satisfactorily surmounted by fixing the lid to the front of the shrine; for of necessity both it and one of the ends of the box fall to extend completely over the plates which they support, and the rebate which was intended for the lid has no function. It seems, therefore, that Petrie's assumption that the box is older than the case which contains it is correct. But for the larger assumption, that it was already made in the fifth century, these facts give us no ground. Indeed, the hypothesis that this rude box, which appears never to have had a lid securely fastened to it, continued for three centuries, or even one century, to preserve a book or relics, or anything else that belonged to St. Patrick, and was only after so long a period provided with a protecting cover, is in the highest degree improbable. But assume its possibility, what becomes of the testimony of the Tripartite Life and the Life of St. MacCairthinn? One of

¹ *Transactions*, vol. xxx, pp. 303–312.

² P. 15.

³ *Ibid.*

them speaks of a shrine, the other of a silver shrine; and neither can be identified with a simple box of yew. If we try to re-habilitate the tradition by assuming that originally it applied to the box, and was later on transferred to the shrine in which the box was ultimately encased, we resort to conjecture. And mere conjecture, however plausible, cannot serve as an argument for Petrie's purpose.

The fact is, as I venture to think, that we have no warrant for the belief that St. Patrick ever saw any part of what we call the Domnach Airgid. But we have by no means done with a tradition when we have decided that it cannot be accepted at its face value. Every tradition of respectable antiquity will carry us some way towards the ascertainment of historic fact, if we subject it to a sufficiently searching analysis. At this point, therefore, we may attempt to ascertain whether the story on which Dr. Petrie laid somewhat undue stress throws light on the early history of the Domnach.

Its main value, as I conceive, is that it fixes a later limit for the date of the construction of the shrine. The tradition of the donation of the Domnach is undoubtedly early. The *Tripartite Life*, in which it first appears, is a work of the eleventh century, and "many if not all" of the documents on which it was based "were composed before A.D. 1000."¹ Thus the story, in the form in which the *Tripartite Life* presents it, had found its way into a written document by the tenth century. But the narrative in the *Life of St. Mac Cairthinn*, though agreeing in the main with that of the *Tripartite Life*, so far differs from it in detail as to suggest that the one was not derived from the other. The two accounts seem rather to be bifurcations of a tradition older than either of them.² Thus the *Codex Salmanticensis* makes mention of certain relics which were in the shrine, about which the *Tripartite Life* is absolutely silent. Doubtless one or more of the items in the list are insertions;³ but we have no reason to suppose that the general statement that the Domnach contained relics is relatively late. Again, the *Life of St. Mac Cairthinn* records that

¹ For the date see Stokes, *Tripartite Life*, Int., p. lxii ff. Apparently the latest historical event referred to does not bring us further down than 936. This points to the early years of the eleventh century.

² It may be pointed out that the argument is independent of the question whether the story of the donation is an intrusion in the *Codex Salmanticensis*. It is merely regarded as a recension of the story which differs from that of the *Tripartite Life*, quite apart from its date and context. But if it be a genuine portion of the text, what is here said of it may be applied to the whole narrative. The *Tripartite Life* implies that the Church of Clogher had already been founded by St. Patrick; the *Codex Salmanticensis* states that it was founded by St. Mac Cairthinn.

³ This must be the case if Petrie's remark (p. 20) is correct, that "some, at least, of the relics . . . were not introduced into Ireland before the twelfth century." He was no doubt thinking of the fragment of the Cross. Compare Mr. Armstrong's remarks, above, p. 104.

St. Patrick's staff was given to Mac Cairthinn along with the shrine, while the Tripartite Life makes no allusion to the staff in this connexion. On the other hand, the Tripartite Life adds the statement that the Donnach "had been sent to Patrick from heaven when he was at sea coming towards Ireland."¹ This of itself raises the suspicion that the staff had originally a place in the story; for the words are an accurate summary of what we are told elsewhere in the same work about the Bachel Isu. When Patrick had parted from Germannus, and was voyaging to Ireland, at Mount Hermon, in the neighbourhood of an island on which he had stayed for three days, "the Lord appeared to him, and told him to go and preach to the Gael, and gave him the staff of Jesus."² Now at least as early as the twelfth century the staff of Jesus was one of the principal treasures of the Church of Armagh.³ It was therefore to be expected that a biographer of St. Patrick a couple of centuries earlier would suppress the statement that it was given to another see. Thus the origin of the story may be pushed back a considerable distance before the document used in the Tripartite Life—let us say to the middle of the tenth century.

But again such a story, even if it were deliberately invented, could not gain currency within a few years of the making of the shrine. It cannot be supposed to have originated until the circumstances of the construction of the shrine and the name of its maker had passed into oblivion. The shrine can hardly be less than a century earlier than the tradition which made it coeval with St. Patrick and St. Mac Cairthinn. Hence we may conclude, with some confidence, that the latest date which can possibly be assigned to it is the latter half of the ninth century.

But we may go further. A tradition such as we are considering cannot have come into being by spontaneous generation in a vacuum. Before it arose there must have been certain facts or beliefs which were the seed out of which it sprang. Before men could have come to believe that the Donnach was given to St. Mac Cairthinn they must have assumed that it once belonged to St. Mac Cairthinn, and that again implies the belief that it was then, and had been from time immemorial, at St. Mac Cairthinn's church of Clogher. Thus it appears that the shrine had been at Clogher for a long period before the tradition took shape in its simplest and earliest guise. The interval required for the evolution of the story of the donation out of the belief that the Donnach had belonged to St. Mac Cairthinn cannot, of course, be determined. We shall regard it as longer or shorter according as we suppose the tradition to have developed in the natural course, or the later story to have been a deliberate fabrication. Our view will also be affected by the opinion which we may hold as to the antiquity of the belief that

¹ Tripartite Life, p. 31.² *Ibid.*, p. 171.³ St. Bernard, *V. S. Malachiae*, 24.

St. Mac Cairthinn was a disciple of St. Patrick. But in any case it cannot have been very brief; and the necessity of allowing for it carries back the date of the construction of the shrine to the confines of the eighth century, which Mr. Armstrong has already indicated as a *terminus a quo*. We seem, therefore, to have firm ground for the assertion that the Domnach was made in that century, and that, if not made at Clogher, it was deposited there shortly after its construction. In the church of Clogher it would seem to have remained from that day up to the eleventh or twelfth century.

2. We come now to Petrie's second proposition, that the Domnach was originally a book-shrine. In favour of this hypothesis he adduces no other evidence than its form. "The form of the cumdach," he says, "indicates that it was intended to receive a book."¹ This is obviously disputable. Dr. Bernard was of the contrary opinion. To him its form suggested, not a book-shrine, but a reliquary.² For myself I can only say that the examples of shrines undoubtedly made for the purpose of holding books do not seem sufficiently numerous to warrant a dogmatic statement on the ground of form alone. On the whole, I am inclined to agree with Dr. Bernard. The argument is at any rate not conclusive.

But when we turn to evidence other than the dimensions of the case, we find that the only witness mentioned by Petrie tells against him. The Life of St. Mac Cairthinn, as we have seen, gives a list of the contents of the shrine: they are all relics; there is no suggestion that there was, or had been, a book within it.

Petrie makes two attempts to get rid of this testimony. In the first place he asserts that the relics were not in the Domnach proper, but in recesses in the outer case. But that explanation of the words of the Life cannot be maintained. The writer tells us that the relics were *in*, not outside, the shrine. Moreover, the Codex Salmanticensis is a fourteenth-century manuscript. It is, therefore, quite possible that no part of the present outer case was in existence when it was written. But let us grant that it was already made. Then it must be noted that the enumeration of the relics is put into the mouth of St. Patrick. Assume everything that is in favour of Dr. Petrie's contention: that the sentence before us was written towards the end of the fourteenth century; that it was not copied from an earlier exemplar—that of the body of the text or any other—but was actually composed by the scribe himself; that the scribe was aware that the case, with its attached reliquaries, had been already constructed: still the sentence cannot be dated much more than half a century after the making of the case, and the writer must have known that it was a

¹ P. 19.

² P. 306.

recent addition. How then could he assign it to the time of St. Patrick? It is clear that he is speaking, not of it, but of the Donnach itself. Finally, only one of the recesses contains, or probably ever contained, relics. That one, it is true, holds a fragment of the Cross. But where were the relics of the Apostles, where was the Virgin's hair (remembered as late as the nineteenth century), where were the fragment of the Holy Sepulchre and the other relics, not definitely described?¹

But Petrie has another defence. "Monkish biographers," it seems, could not have known what the Donnach contained, for no one would have dared to open it. "No superstition was and is more common in connexion with the ancient cumbachs than the dread of their being opened."² That may be. But that this cumbach was actually opened at the beginning of the century in which the Codex Salmanticensis was written is certain. The evidence will be produced lower down.

The fact is that the documentary evidence is too strong for Dr. Petrie's hypothesis. Viewed without prepossession, and in the light of the facts disclosed by Mr. Armstrong's investigation, it will be found, as I believe, to lead to the following conclusion. Prior to the middle of the fourteenth century the Donnach Airgid was used as a receptacle for relics, of which it contained a large store. When the outer case was made the fragment of the Cross was removed from the interior of the shrine to a more fitting position, immediately above the representation of the crucifixion, which was the principal ornament of the new cover. There it was securely fixed in a recess, and covered by a crystal; and there it still remains.

3. The third proposition which is essential for Dr. Petrie's argument is one of which he gives no proof, that the manuscript which was in the shrine a century ago was "the treasure for whose honour and preservation" the Donnach was made.³ Dr. Bernard makes short work of it. "It is demonstrable," he writes, "that the inner case of yew was not made to contain the Gospels in their original form. For the measurements of the inside of this case are 7½ × 5½ × 2¼ inches only; while the ms., now that it has been opened, is seen to have been certainly not less than 9 inches long by 6¼ inches broad."⁴ When I read this more than twenty years ago, it appeared to me conclusive.⁵

¹ Dr. Petrie seems to have thought that the relics mentioned in the Codex Salmanticensis were under the crystals on the outer case. The hypothesis was *a priori* probable. There was a relic under one of the crystals of the shrine of the Cathach of St. Columba (*Foras na Cealla*, xxxia C. p. 394), as Petrie doubtless knew; and below one of the crystals of the Donnach there is a fragment of the Cross. But of the six crystals on the Donnach three are on the plates which are of Elizabethan workmanship: the scribe of the Codex Salmanticensis cannot have alluded to them; and whether there were any crystals in the portion of the shrine which they replaced we are ignorant.

² P. 20.

³ P. 17.

⁴ P. 306 f.

⁵ Cp. Bury, *Life of St. Patrick*, p. 309.

But lately a doubt has insinuated itself into my mind. It is supposable that the manuscript, when a shrine was made for it in the eighth century, had suffered considerable injury, and that its leaves were already frayed and curled up. If so, measurements taken after the leaves were flattened out would not demonstrate that it was not the tenant for whose reception the box of yew was intended. And the very fact that a mutilated and unsightly Gospel book was deemed worthy of an elaborately ornamented eumdach would indicate a tradition that it had belonged, if not to St. Patrick, at least to some renowned saint.

With this suspicion forcing itself upon me I was anxious that fresh evidence should be found. And a happy accident soon brought it into my hands. Last June I undertook to edit for the Louth Archaeological Society the extant fragments of a Register of Clogher which had been inspected by Archbishop Ussher in his early manhood, and about the same time by George Montgomery, Bishop of Clogher, but which has long since disappeared. The Register was compiled as late as 1525; but a study of the extracts from it which still exist convinced me that parts of it were based on—in one instance copied from—a Register of Matthew Mac Cathasaigh, who was Bishop of Clogher for some years before and after 1300. Among the passages derived from this source is one which gives strong corroboration to the conclusions which Dr. Bernard reached in his paper on the Domnach Airgid.¹

¹ For the statements in this paragraph and those that follow about the Clogher Register, see my edition of the fragments in the *Louth Archaeological Journal*, vol. iv, No. 3. The passage summarized in the next paragraph is Fragment iii, and runs thus:—

Memorandum quod Dominus Matheus episcopus Clochorensis, iuit ad ecclesiam beati Constantis de Eoynys ad faciendam translationem beati Constantis praespiteri et etiam beati fergiuminth episcopi de Cutmaine [*l. Culmaine*] successoris beati Aedhami Diaconi et invento corpore beati Constantis divisit reliquias eius in tres partes et relicta tertia parte in ecclesia de Eoynys duas secum duxit ad ecclesiam Clochorensis quarum vnam concessit ecclesiae beati Vumci de *tuirgnech* et fecit illam partem recondi in quodam seriniolo in quo similiter possuit episcopus de reliquiis supradicti fergiuminth episcopi Aliam autem partem de reliquiis Constantis fecit recondi in scrinio magno beati Makartini in quadam cista parua siue pixide lignea. Item reliquias beati fergiuminth possuit in quodam linteo et fecit eas recondi in eodem scrinio. Item beatus Constans secum duxit de Britansea tres viros praelatae fidei ad serviendum sibi et deo in monasterio suo de Eoynys quorum corpora sepulta sunt in inferiori parte Cymiterii de Eoynys et episcopus fecit vnum de ipsis transferri cuius reliquias possuit episcopus in quodam scrinio, quod dicitur Membrana a Membrana dictum quae ibidem continebatur quia cum beatus Tigernacus hospitaretur apud lysdoniam vbi tunc conventus monialium fuerat sanctarum qui conventus vnam habens ovem cuius lana induebantur moniales fecit interfici illam ovem beato Tygernaco pro carnibus et hoc ignorante sancto Tygernaco: vnde beatus Tigernacus rogavit Dominum suum Jesum Christum vt pellis illa afferet lanam ad vsum monialium sicut antea dabat, quando fuit in corpore ovis, Et sic conventus habebat lanam de pelle per plures annos sicut viuenta oue ad supplicationem beati Tygernaci. Postea vero cum pellis illa ad solem fuisset posita causa eam siccandi coruus quidam pellem in rostro recipiens eam

It tells us that Bishop MacCathasaigh went to the island of Eoinis for the purpose of translating thence the relics of St. Constans and St. Ferguinth of Culmaine. The relics of these saints were divided into three parts, one part being brought to Clogher. The bishop at the same time disinterred the relics of a follower of St. Constans, and carried them also to Clogher. The relics of St. Constans were there deposited "in the great shrine of St. Mac Cairthim in a certain little box (*cista*) or *pix* made of wood." The relics of St. Ferguinth were placed in the same shrine wrapped in linen (*in yerdun* *verdun*); while those of the unnamed follower of St. Constans were put into another shrine known as (*quod dicitur*)¹ the *Membra*. We are given our choice of two derivations of that obscure word, one of which is interesting as showing that the shrine was large enough to contain a sheep-skin. According to the other derivation *Membra* is equivalent to *memoriale scrinium*; and this huge shrine was so named "in respect of the greater shrine which is called (*dicitur*) *Domnach Airgid*. In which memorial shrine relics of saints were deposited." Then follows a sentence which may perhaps be rendered, "But that great shrine was intended (*mittibatur*)² for arduous matters, but this for minor matters."³ The writer seems to mean that the *Domnach Airgid* was called great, not because of its size—for it was evidently the smaller of the two—but because of the veneration in which it was held: it was the repository of the more important relics, the *Membra* of the less important. The passage concludes with the statement that the anniversary of the translation, which took place on 6th September, 1308, was ordered by the bishop to be observed as a festival.

This appears to be the only known document, except the Tripartite Life, in which our shrine is called *Domnach Airgid*; and it is the only one which

secum per aera reduxit usque ad sanctum. Badianum† et dimisit pellem ad pedes eius, qui sanctus Badianus cognoscebat pellem esse de qua fecit sanctus Tygernacus miracula remissit eandem pellem ad ecclesiam Clonarchensem. Qui tunc praefuit beatus Tygernacus episcopus et sic scriptum illud factum est ad opus illius pelvis in quo pellis illa recondita fuit. *Volunt enim dicitur Membra* id est memoriale scrineum respectu maioris scrinei, quod dicitur *Domnach Airgid*, in quo scrineo memoriae reliquiae sanctorum fuerunt reconditae. *Verum* illud magnum scrineum ad ardua negotia mittebatur. Hoc vitium et memora negotia. Translato quidem supradicta facta† fuit apud Eoynys octavo Idus septembris Anno Domini 1308 quam diem praecipit episcopus observari pro facto† [*i. festo*] *translacionis plurimorum confessorum*.

¹ Note the present tense. Both shrines would seem to have been in existence and still at Clogher in 1525.

² I am doubtful about this translation. Perhaps *mittibatur* means 'was sent,' i.e. from Clonach to existing places, for the taking of oaths, especially of expurgation. The *Domnach* was used in this way in the last century (Mason, *l.c.*). But the whole context shows that the more important relics were reserved for the *Domnach*, and that would be sufficient reason for "sending" it only on more difficult or remarkable occasions.

gives contemporary witness to an incident in its history prior to the nineteenth century. It is of great interest.

It proves that a few years, at the most forty-five, before the outer case was made the Domnach was not at Clones but at Clogher, and it implies that Clogher was its normal home. We may infer, with little hesitation, that it was there from the time of the writing of the Tripartite Life of St. Patrick and the Life of St. Mac Cairthinn to the year 1308. Moreover in that year it was the principal shrine of the cathedral church. It is most unlikely that the bishops surrendered it to the Abbot of Clones shortly afterwards. Indeed the inference is probable that it was retained in the cathedral as long as the see was held by bishops who set a high value on a shrine so ancient, and on the relics which it contained, that is to the last decade of the sixteenth century. The document itself seems to indicate that it was still in its old home in 1525, when the Clogher Register was compiled. Why the permission of the comarb of Tigernach should have been required for the construction of the new case it is impossible to determine; but the inscription which records this fact can no longer be held to prove that it belonged to Clones.¹

Further, the alternative title of the Domnach was the "great shrine of St. Mac Cairthinn." This makes it fairly probable that the shrine was supposed to be as old as the fifth or early sixth century, and it confirms the opinion already expressed that at the beginning of the fourteenth century it was believed to have been always the property of the church of Clogher. But in view of the inscription just mentioned, the omission of any reference to St. Tigernach is significant. Hardly less significant is the silence about St. Patrick. We may venture to infer from it that the story that the Domnach was a gift from St. Patrick to St. Mac Cairthinn was unknown or disbelieved at Clogher.

Again, the shrine was obviously used as a reliquary. The relics of St. Constans and those of St. Fergiuminith were laid in it, the former enclosed in a "cista parua siue pixis," the latter wrapped in linen. There can be no doubt of the fact if the "cista parua" is the existing box of yew; but this is improbable.² It is certain, however, that neither the small cista nor the linen wrapping can have been attached to the outside of the case. Nor can they have been placed beneath crystals, even if we suppose that the original metal covering had such adornments. Be it remembered that here we have to do

¹ See further below, p. 126.

² For these reasons: (1) it would hardly have been called a "*parua cista*"; (2) the context suggests that the "*cista*" was made for the reception of the relics: the yew box was in the shrine from the first; (3) the relics of St. Fergiuminith were apparently not in the "*cista*"; but they could not have been in the shrine and yet outside its lining.

with the Domnach Airgid proper: the outer case had not yet been made. And the statement of the document is express: 'aliam partem de reliquiis fecit recondi in scrinio.' Further, there is no hint that there was a book in the receptacle into which the relics were put. And there is nothing in the memorandum to suggest that in 1525 the shrine was used for any other purpose than that which it fulfilled in 1308.

Finally, there can be no question, in spite of Petrie's assertion that such an act was impossible, that on this occasion the Domnach was opened, and that the eyes of at least a few favoured ecclesiastics saw what it contained. There is no improbability in the assumption that "monkish writers" shared the knowledge which they obtained.

We may now turn to another part of the Clogher Register, in which we might reasonably have expected to find mention of the Domnach. In the course of this paper I have frequently referred to a fragment of a Life of St. Mae Cairthim in the Codex Salmanticensis. Now in 1528, three years after the main part of the Register had been completed, Patrick O'Cuillean, Bishop of Clogher, added to it an office for the festival of the patron saint of the diocese. There remain of it the hymn and the lesson.¹ The latter is a short Life of St. Mae Cairthim, which has an evident relation to the Salamanca fragment. The differences between them are not such as to forbid the belief that they are two recensions of the same original. Apart from blunders of the scribes they fall under three heads. In the Register there are many slight variations from the Codex Salmanticensis, which may be described as stylistic, alterations of the order of the words, and so forth, which do not alter the sense. Secondly, the Register omits four passages and abridges others, all of which are found in the Salamanca copy: of the omitted pieces one was certainly in the ultimate, if not in the immediate, exemplar of the lesson in the Register. And lastly, the Register adds a paragraph at the end, relating the appearance of the saint in a vision to a woman, and mentioning his death on 24th March. We have sufficient reason to believe that these variants were changes deliberately made by Bishop O'Cuillean in the text of the lesson, for at the end of the Office he wrote the following note:—

"Suprascriptum officium fuit hic per Reverendum virum Patricium Culinn episcopum Clochorensem ad utilitatem publicam ecclesie Clochorensis redactum ex antiquis libris ordinis sancti Augustini studiose transcriptum, et secundum usum Romanum in melius ordinatum atque reformatum superflua reticende ac dinaventa augendo et perfectius emendando, Anno Domini 1528."

Here the bishop avows that he altered the text, and he divides his changes under the three heads of omissions, additions, and emendations, no doubt of style.

¹ Extract xi in my edition.

Now one of his omissions is very remarkable. It is in the passage relating to the foundation of the monastery of Clogher. I print it in full in order that the reader may be able to compare it with the corresponding part of the fragment in the Codex Salmanticensis quoted above, p. 110.

“Denique cum ipse in vniuersali praedicaret sem[en] vitae per hiberniam serendo iuuenilis annos aetatis suae transegit die quadam Patricium patrem more solito transiens per quoddam flumen et portans sacrum onus deponendo suspirauit et percontatus a pio patre vt quid suspiraret inquit pater accedente senio vires meae deficiunt, et assiduum me grauat iter, fac igitur in† si placet in vno loco deo et tibi seruire, sanctus Patricius ait, placet ait vade in bonet† et monasterium construe in platea ante regalem sedem Ergallencium inde resurrecturus in gloria, illa desolabitur, tua vero sedes de die in diem augmentabitur† de cuius sacro Cymiterio plures ad beatam vitam sunt resurrecturi. Deinde vir sanctus ad praefatam plateam perueniens Clochorensis fundauit monasterium.”

In this extract there are many minor departures from the Salamancan text. But far more important is the complete excision of two consecutive sentences, the first of which begins, “Et addidit, Accipe, inquit, baculum.” Bishop O’Cuillean has actually omitted all reference to the gift by St. Patrick to St. Mac Cairthinn of his staff and shrine. How can this be accounted for? Most readily, I think, on the supposition that the bishop rejected the old legend of the donation of the Domnach. If he had believed it to be a true story, he would hardly have omitted it. It could not have been regarded as one of the superfluous things which, as he tells us, he passed over in silence.¹ It will be remembered that we have already had reason to doubt that this tradition was accepted at Clogher in 1308; and the story told 600 years later, that the Domnach was brought from Rome by Donagh O’Hanlon, is proof that it was not accepted in the Maguire country in the nineteenth century. It is worthy of note, in this connexion, that in none of the extant fragments of the Clogher Register is St. Patrick claimed as founder or first bishop of the see, though St. Mac Cairthinn is said to have been his disciple and “fortis athleta.” In the Catalogue of bishops St. Mochta of Louth is the first,² and St. Mac Cairthinn the second, St. Patrick receiving only incidental

¹ It is of course possible that this episode was not omitted by Bishop O’Cuillean, but inserted from another source in the Codex Salmanticensis. If that be the true account of the matter, we still have evidence that the Life of St. Mac Cairthinn used at Clogher knew nothing of the donation.

² Extract ii. The name is latinized “Matheus.” According to Ware the Register described Mac Cairthinn as the first bishop (*De Praes. Hib.*, p. 41), but this is an error. Jocelin ignores St. Mochta, and makes St. Patrick the first bishop. See above, p. 110, note.

mention. This is the more remarkable, inasmuch as St. Patrick's preaching at Clogher is referred to, and the see-lands are regarded as in some sense belonging to him.¹ Thus there is some reason to think that the tradition, ancient as it seems to have been, that the Domnach Airgid belonged to St. Patrick, was never current at Clogher. If so, its value for historical purposes is seriously diminished. It may well have been invented to support the ever-growing pretensions of the see of Armagh.

I conclude by summing up the main results to which this investigation seems to have led us. It appears probable that the Domnach Airgid was preserved at Clogher from the time of its construction to the end of the sixteenth century. There is no evidence that it was a book-shrine. At the end of the thirteenth century it was certainly used as a reliquary. It is unlikely that at that period it held a book. The manuscript which was found in it in 1832 was probably put into it in some later century, just as some leaves of a manuscript which do not belong to it were placed in the cundach of the Book of Mulling.² Lastly, there is the gravest reason to doubt the historicity of the tradition which credits St. Patrick with having given the Domnach to St. Mael-Guthim. That tradition cannot be invoked as a proof of the antiquity of the Gospel-book which it enshrined in later times. The question of its date must be settled, if settlement is possible, by the palaeographers.

NOTE ADDED IN PRESS.

When the foregoing paper was read before the Academy, my friend Professor R. A. Stewart Moodster made some striking remarks upon it, the substance of which he has kindly referred to writing in the following communication:—

I.—The following facts have been brought forward:—

1. There was in medieval times a shrine at Clogher known as *Domnach Airgid*, known to contain certain relics, including a lock of hair of the Blessed Virgin. One tradition, not apparently universally believed, ascribed its origin to St. Patrick.

2. This shrine was opened in the year 1308, and further relics (*not a book*) were *added* to those which it originally contained. The nature of these relics is specified at least in general terms in the Register of Clogher.

3. The shrine in the Academy's collection, identified by Petrie with the Clogher shrine, was traditionally called *Domnach*, not *Domnach Airgid*, *test* Petrie: it contained very sacred relics, nature not specified, *test* the Statistical Survey. O'Brien's letter, appended to *Carlisle's Treatise and Stories*, mentions a lock of hair of the Virgin as among its contents. It is curious that Petrie

¹ Extract iv.

² See my *Chapters on the Book of Mulling*, p. 12 f.

makes no reference to this tradition, which is the strongest argument in favour of his theory of the identification of the two shrines.

4. The inscription on which Petrie relied for the identification of the Academy shrine with the shrine of Clogher is now shown to have been mis-read; and the only historical inscription on the shrine connects it with Clones, not with Clogher.

5. The Academy shrine was found to have contents quite different from those known to have been in the Clogher shrine.

II.—From these facts I draw the following conclusions:—

1. The Clogher shrine is not identical with the Academy shrine. The Clogher shrine, with its relics, is lost; probably it disappeared at the Reformation.

2. The Academy shrine is a Clones shrine, to which no authentic tradition attaches. But the nature of the more important relics in the Clogher shrine was well known: and after the disappearance of the Clogher shrine the popular traditions with regard to them became attached to the Clones shrine and its then unknown contents.

III.—With regard to the contents of the Clones shrine, it is to be noticed—

1. That the book was a crushed, illegible fragment, not a carefully preserved MS. such as we usually find in book-shrines (e.g. the Cathach, or the Stowe Missal). Therefore, either the book was itself preserved, not for study but as a relic; or else was a worthless bit of padding squeezed into the box when its legitimate contents were either lost or abstracted. Of the two theories, the former is by far the more probable. It explains at once what would otherwise be unintelligible—why were these fragments, from a literary point of view useless, deposited in the case?

2. This being assumed, the following further deductions appear probable:

a. That the book belonged, or was supposed to have belonged, to some important saint connected with Clones, and was there preserved as a relic of him. Most likely this would be Tigernach himself, the founder of Clones.

b. That it was for a long time used as a wonder-working relic, and maltreated in various ways as such—cut up for amulets, soaked in water to be subsequently administered for curative purposes, &c. Such treatment would be sufficient to account for its condition.

c. That after it had suffered serious injury from a continuance of this treatment, it was encased in the yew box, perhaps for convenience of transport rather than for preservation. This box could be opened, and the maltreatment of the MS. continued as before.

d. That in time the ecclesiastics of Clones realized that the relic would disappear under this treatment altogether, and therefore they hermetically sealed it up by enclosing the box in bronze plates.

c. That, long afterwards, the silver outer case was added. It was not till this was done that the shrine could be called *Domnach Airgid*; it follows that it cannot be the shrine referred to under that name in the *Vita Tripartita Patricii*, which is a document much older than the outer case of the reliquary.

f. That in time (probably after the Reformation) the true nature of the contents of the Clones shrine became forgotten, and it was then popularly credited with being the receptacle of the far more important and impressive relics which the lost Clogher shrine had contained.

The main point in this very interesting criticism is Professor Macalister's contention that Petrie wrongly identified the shrine found at Brookeborough in 1832 (the Academy shrine) with the *Domnach Airgid* mentioned in the *Tripartite Life* (the Clogher shrine). It gives me the opportunity of supplying a defect in my paper, in which I have adopted Petrie's assumption without argument. The evidence may be stated as follows:—

1. The word "*Domnach*" is very rarely used as synonymous with "shrine." It was applied to the Academy and Clogher shrines, and, so far as I know, to no others.

2. The epithet *airgid*, which was used of the Clogher shrine, suits the inner metal case of the Academy shrine: it was in appearance a silver box. It is of course true that this shrine had in strictness no title to the epithet before the silver-gilt plates had been added. But it must not be assumed that the name *Domnach Airgid* was devised by the maker of the shrine to which it was applied, or by others who knew the details of its structure. It is much more likely to have been a popular designation of later days. That ordinary folk should have supposed that the Academy shrine was made of silver is not surprising. Till Mr. Armstrong told us that its coating was of tin, all investigators held that it was of silver. To be sure, they recognized that it was only a coating: but then they saw the bronze plates which it covered. Before the coating was worn off, and while the inside of the case was not in view, the shrine might quite naturally be dubbed "of silver." But when the gilded covering was made, that description became obsolete. If after that date it had received its name, it might have been called *Domnach óir*. On Petrie's hypothesis it is easy to see why in later centuries the epithet *airgid* was dropped, and it came to be known simply as 'the *Domnach*.'

3. We have little evidence about the material of which shrines were made in early times. Shrines are frequently mentioned in the Annals; but apart from those of St. Conlaed and St. Ronan, "of gold and silver," constructed about 800, and the golden *cumdach* of the Book of Kells, stolen in 1096, on account of which the book "was the principal relic of the western

world,"¹ I can recall no instance in which the material of a shrine is specified. We may infer that these were exceptional shrines, and that the use of the precious metals, or what passed for such, was unusual. This conclusion is not disturbed by the legend that St. Columba desired a church "full of gold and silver to cover relics and shrines withal."² We may believe, therefore, that "silver shrines" were rare, though we have an example, perhaps older than the Clogher shrine, in the Lough Erne shrine, which, like it, is coated with tin. The very name *Domnach Airgid*, clearly in the tenth century a widely current designation of a well-known reliquary, implies as much. It would be remarkable if there were then two "silver shrines" in the neighbouring churches of Clogher and Clones, one of which was called *Domnach Airgid* as a distinctive epithet, while the other was simply known as the *Domnach*.

4. The Clogher and Academy shrines seem to have been of even date. Mr. Armstrong has assigned the latter, and I the former, to the eighth century. Mr. Armstrong's *terminus a quo* is the end of the seventh century; my *terminus ad quem* is the beginning of the ninth.

5. Dr. O'Beirne, in a letter written to Betham before the latter had seen the Academy shrine, reporting information gleaned from "the country people" as to its contents, declared that "the chief treasure it was supposed to contain was a lock of the Virgin's hair."³ Petrie thought it probable that a fragment of the Cross was concealed under the crystal above the representation of the Crucifixion. This is unlikely to have been a pure guess, and it may well have been a tradition reported to him by Mr. Smith, who was associated with Dr. O'Beirne in his investigations into the local traditions. It has now proved correct, and I have suggested that this relic may have been removed from the interior in the fourteenth century. But among the relics in the Clogher shrine were also a fragment of the Cross and some hairs of the Blessed Virgin.

6. On Professor Macalister's theory the Academy shrine was transferred from Clones to the Maguire country; on Petrie's from Clogher to the same district. The latter is the more probable hypothesis; for the Maguires must have had closer relations with their cathedral church than with the monastery of Clones. When the princes of the diocese were called together in 1297 to consider the bull *Clericis laicos*, they assembled in three groups. The first consisted of Donnall O'Neill and the chiefs of Tir Eoghain. The second included Brian MacMahon, King of Oriel, his brother Ralph,

¹ Annals of Ulster s. aa. 799, 800, 1006. The cumdach of the Book of Durrow is not said to have been of 'plated silver,' as Miss M. Stokes asserts (*Early Christian Art in Ireland*, p. 90). It was adorned with a silver cross (Robinson, *Celtic Illuminative Art*, p. xx).

² Stokes, *Lismore Lives*, p. 174. ³ Carleton, *Traits and Stories*, 1853, vol. iii, p. 442.

King of Dartraige (in which is Clones), and other nobles, nearly all from the present county of Monaghan. The third was headed by Donn Maguire, King of Lough Erne.¹ This grouping must represent the natural division of the diocese at the time. The close connexion which subsisted between Clogher and the western part of the diocese is indicated by the names of the principal members of the Cathedral Chapter. Thus, between 1450 and 1550 we know the surnames of five Deans—three Mac Cawells (a Tyrone name) and two Maguires. "Dean McCrenyr" (Shirley's *Monaghan*, p. 321) was apparently a native of Co. Monaghan, but it is not certain that he was Dean of the Cathedral Church. In the same period three Archdeacons are known—two Maguires and an O' Cassidy. O' Cassidy is a Fermanagh name, and in the fifteenth and sixteenth centuries the family was intimately associated with the Maguires (see Mac Carthy, *Annals of Ulster*, index).

These facts seem to me to constitute a strong argument that the Academy and Clogher shrines are identical. The only difficulty in the way is the inscription to which Professor Macalister refers. But it does not prove that the enter case was made for a shrine preserved at Clones. If the shrine had been in the custody of the comarb of Tigernach, the case would have been made by his order, not merely by his permission. The shrine of the cathach of St. Columba—a Tinneall relic—was made "by" Cathbarr O'Donnell and "by" Donnall Mac Robernath, Comarb of Kells, and the artist who constructed it lived at Kells.² The meaning of this seems to be that O'Donnell, by the good offices of the comarb, had the shrine made by a Kells worker. Our inscription may indicate no more than that, by permission of the Abbot of Clones, a metal-worker of his monastery executed the work which the authorities of Clogher desired. Whether he did the work at Clones or at Clogher is a question of no importance.

It is unnecessary to criticize Professor Macalister's arguments in further detail. But his final "conclusions" must not be passed over in silence. They postulate for the manuscript found in the shrine a date long prior to the last of year, which is itself assumed to be more ancient than the earliest metal plates. The manuscript, on this theory, cannot be later than c. 650. It is suggested that it may have belonged to St. Tigernach, who died in 550. Palaeographers must decide whether the script is consistent with so early a date. But the text is Vulgate with Old Latin mixture.³ That such a text should have been in use in Ireland by 550 or even 650 may be pronounced at least improbable in view of the history of the Latin Scriptures in this country.⁴

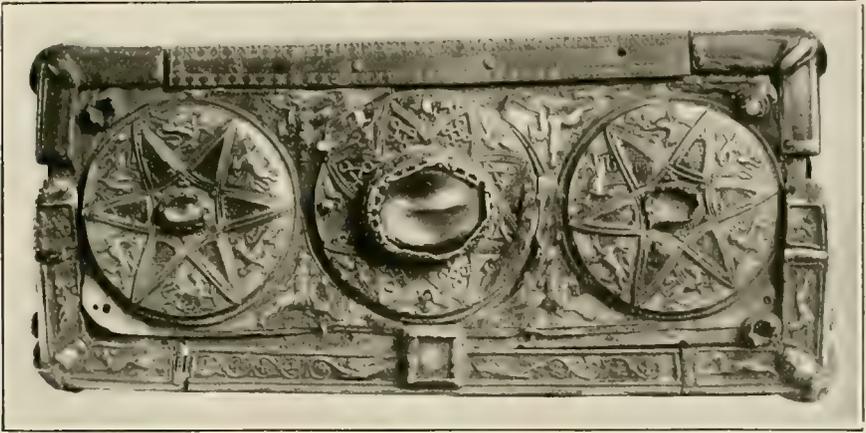
H. J. L.

¹ Clogher Register, Extract viii.

² *Proceedings R.I.A.*, xxxiii C, 391.

³ *Transactions R.I.A.*, xxx, 310 ff.

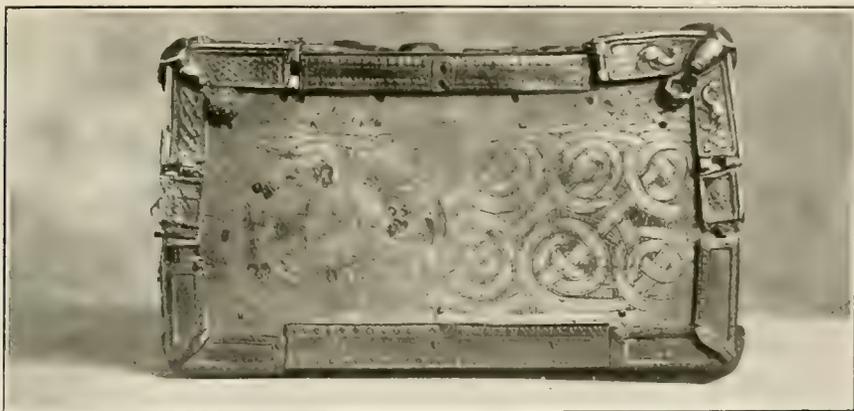
⁴ *Proceedings R.I.A.*, xxxiii C, 314 ff. If Professor Macalister's date (cent. ix) for the Book of Durrow be accepted, the improbability becomes greater.



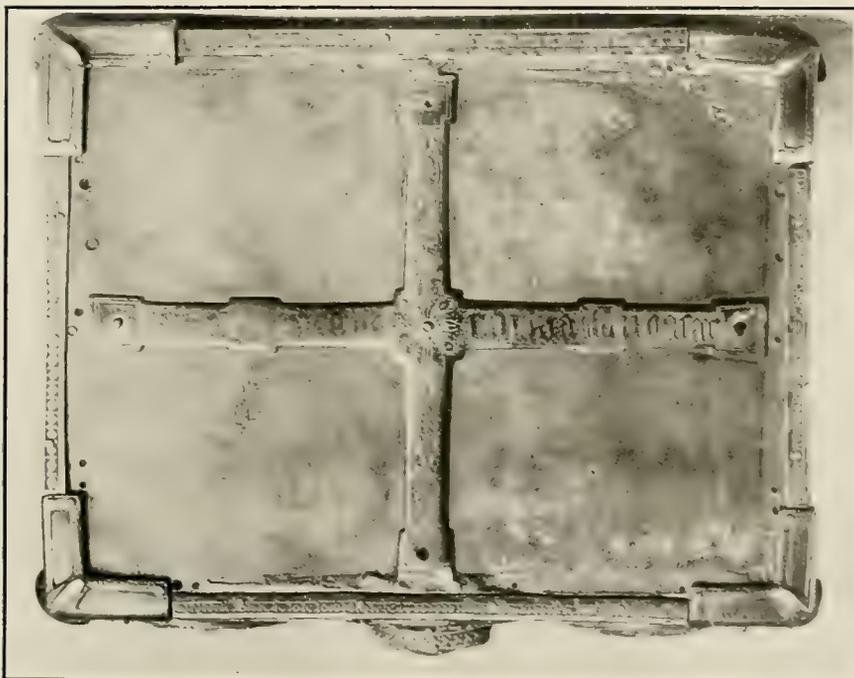
TOP (UPPER PLATE).



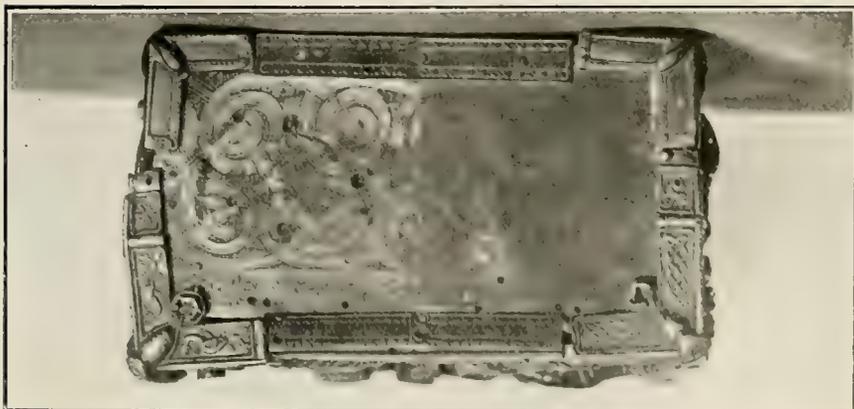
FRONT.



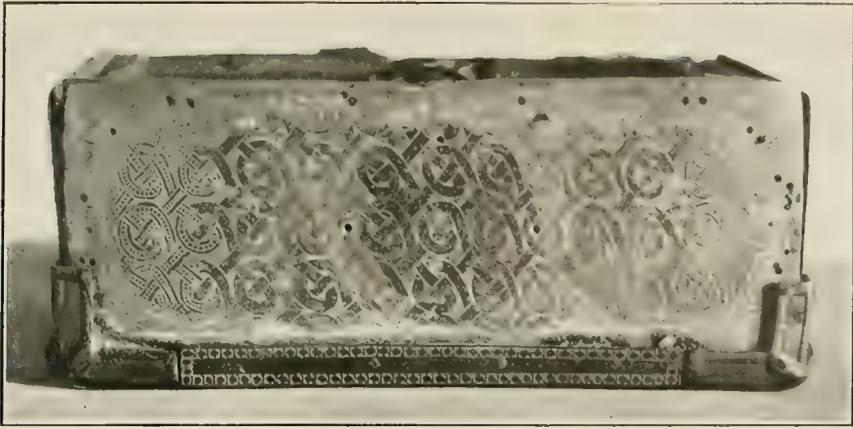
DEXTER SIDE.



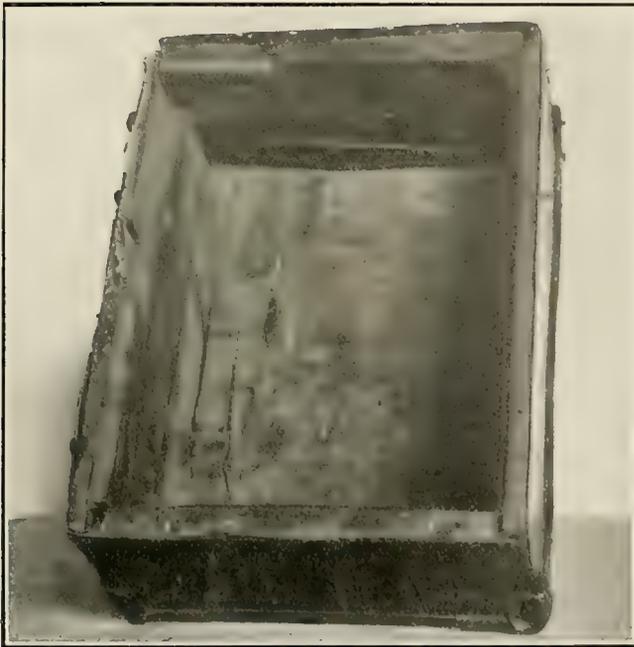
BACK.



SINISTER SIDE.



TOP (UNDER PLATE).



INTERIOR.



BASE.

VIII.

THE EARTHWORKS, TRADITIONS, AND THE GODS OF SOUTH-EASTERN CO. LIMERICK, ESPECIALLY FROM KNOCKLONG TO TEMAIR ERANN.

BY THOMAS JOHNSON WESTROPP, M.A.

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PLATE VI.

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THE subject of Irish local mythology¹ has never, up to the present time, been studied on scientific lines. Save the great sanctuaries,² no attempt has been made to localize the centres of the worship of the Celtic gods. In Ireland, the usual method has been to bring together a crude heap of legends of all periods and districts, and try to bring order out of the chaos as it exists. Naturally no consistent results emerged from so unscientific a process; there was always a large waste product, as in an abortive chemical experiment, and

¹ I use the following abbreviations among more obvious ones:—R. Soc. Antt. Ir. = Royal Society of Antiquaries of Ireland, under its successive names; Dind S. = Dind Senchas (Rennes and Metr., metrical); Hib. Lect. iv = "Celtic Heathendom," J. Rhys, Hibbert Lectures, iv, 1886; Ir. Myth. Cyc. = "Irish Mythological Cycle," H. D'Arbois de Jubainville (tr. Ric. Best, 1903); Encyc. Relig., Professor MacCulloch, on Celtic Religion, Encyclopaedia of Religion and Ethics, vol. iii; "Leab. Gabh" = Leabhar Gabhala i, MacNeill and Macalister; "Silva Gad." = "Silva Gadelica" (tr. S. H. O'Grady); "Keating Hist." = "History of Ireland" (Ir. Texts edition); "Agall" = Agallamh na Senorach (version in Silva Gadelica) ii. "Holder," Alfred, "Alt-celtischer Sprachschatz."

² Since this paper was written, Professor Macalister's important monograph on Tara has been read.

this was ignored, or "written off," with a light heart, as "inconsistent with the facts," i.e. with some one group of facts. The fault is that such workers failed to see that we have stories told of the gods in various tribes (contradictory even where ancient), and a huge mass of corrupted theories and chronologies, later than A.D. 1050, formed without realizing its contradictory nature. There is no "in the beginning" in Irish mythology: and even of the ending, "the last great battle of the gods,"¹ we have a duplicated and irreconcilable account, not a clear-cut tale, like that of "the days when Ymir dwelt," or of Ragnarök, in the Norse mythology. It is our duty to begin research, even if we have to penetrate many a labyrinth leading to nowhere, and to lament the loss of many a plausible system. A false theory negatived is a positive result. I make no claim for my own theories, but that they seem to contain the facts known to us at present: in no confidence, but in much uncertainty I am entering on an unexplored country. I was disappointed that my 'Aine papers' (a portion of the present larger study, then nearly completed) drew me no helpful criticism. I only got evidence of the existence of a deep prejudice against folk-lore and mythology, in such criticisms as "buttressing superstition" and "bringing legends into the study of facts." Now we alone in Western Europe, have a large mass of very early literary material to help us, and (anywhere but here) it is a truism that every ray of light should be concentrated on a subject. Ireland being "the last resort of lost causes," preserved record of a European "culture" as primitive as that of the South Seas, and therefore invaluable for the history of human advance,² elsewhere its existence is only to be established from hints and equivocal survivals. Our early tales are no artificial fiction, but fragmentary bolters of the pagan period, equally valuable for topography

¹ The "First Battle" (*Revue Celtique*, xii, p. 57) mentions Norse coins, and is evidently "rationalized" and localized. Rhys hesitates to accept the battles as one, but the "First" battle seems a euhemerized version of the other. De Jubainville (*Et. Myth. Cycle*, pp. 84-9) argues for their identity. The *two* battles first appear with *Fraim* of *Monasteran*, c. 1050. The battles coincide with the feasts of Midsummer and Sandwich. *Saints' Charms* (ed. W. Stokes, p. 123) mentions one battle; so does *Cinead Ua Aitheen* (970), this being the so-called "second" fight. See also *Eriu*, viii, pp. 17, 25, 45, and Squire, "Mythology of the British Isles," p. 75.

² *Supra*, xxxiii, p. 9, p. 444; xxxiv, p. 47.

³ "Survivals of Totemism among the Celts" (*Rev. Celt.*, xxi, p. 269): "Human Head Trophies," *Celtic Rev.* iii, pp. 68, 81. *Encyc. Relig.*, vi, pp. 534-8. *Rev. Celt.*, xxxiv, S. Remak, pp. 38, 255. "Human Sacrifice," *Eriu*, ii, p. 86. Dr. Joyce, "Social History of Ancient Ireland," i, p. 279. Human skulls were found under an altar inscribed to the Celtic war god. *Encyc. Relig.*, vi, p. 534. Such heads are the "mast crop of Macha." "Three Irish Glossaries," W. Stokes, p. xxxv; *Echtra Airt in Book of Fermoy*, f. 139; *Eriu*, iii, p. 155. *Ordeals, Irische Texte*, 3rd ser., 1st pt.; tabus, notably the *Book of Rights, the Death of O'Connell*, *Bracon De Dunga*, also paper by Miss E. Hull. *Folk Lore*, xii, No. 1.

and for mythology. Topographical comment—I will not say criticism—has been equally inefficient.¹ A theory is not refuted by saying “all the great antiquarians are against you,” “the Psalter of Tara (!) refutes that,” or “O’Donovan has set the question past all doubt.” These remarks only prove that we have hardly commenced scientific archæology in this country.

(A)—THE BORDERLAND BEFORE HISTORY.

Ireland being cut off so much from the world-centre in the beginning of our era, naturally got little record from Greece, Italy, or from those who have left us so little independent material about themselves as Gaul and Britain have done. A great geographer, about A.D. 160, collected the names and positions of several nations and places in our island. Beyond that, we only get a tale of an expelled chief, who, late in the first century, sought aid from a foreigner against his countrymen; a hint of an unrecorded landing “beyond the shores of Juverna”; sketches of “the Scot” (doubtless our Niall of the Nine Hostages) “making the sea foam with hostile oars”; of his defeat and the grief of “icy Ierne” at the slaughter of her sons—little else. Our native material in general was handed down (much, presumably, in mnemonic verses) by schools of bards and druids till Ireland, fully Christianized, reduced her tales to writing in the late sixth or earliest seventh century. There is little doubt as to our having some slightly altered material preceding, perhaps, the fourth century. Unfortunately this has been recast, so that even its broad outlines may be questioned. Ptolemy knows nothing of Tara or the Milesians;² all his tribes are of the “tributary” or “non-Milesian” races³ and the Ulidians and Piets. However, much of value escaped, for Roman culture never intervened, and Christianity in Ireland was a tactful, warm-hearted mother, and learned the stories to tell to her children.

Of course, we should not presuppose that the ancient Irish had no writings. Their Gaulish and British kindred had them. Probably rituals and mysteries were not written;⁴ but genealogies, lists of chiefs, and even

¹ I discuss the one valid objection made to the identity of ‘Oenach Culi at the end of this paper.

² This may arise from his only giving coast tribes.

³ I use this term “Milesian” for the fair races presumably British, but commit myself to no theory in using these conventional names. Mil seems to have been a god, not unknown in Europe, so also was his father Bile. Rhys regards Mil as “the Celtic Dis” (Hib. Lect., iv, p. 582). Nuada was son of Beli in Welsh story. Beli was adored at Uisnech.

⁴ I have not noted any definite pagan ritual save the sunward turn, certain formal curses, the offerings of men, cattle, pigs, milk, corn, and brushwood, and the excessive prostrations before Crom Cruach [but, since this was written, Professor Macalister’s very suggestive paper on Tara gives much food for thought.] See preface to “Three Irish Glossaries,” pp. xxxv-vi.

tales may have been recorded briefly and on perishable materials; the ogham was not suited for literature. Ethicus of Istria, early in the fourth century, claims to have examined books of the "unskilled philosophers" and "uncultivated teachers" of Ireland. St. Patrick reckons "Gaulish rhetoricians" among his opponents in Ireland: Juvenal tells us, "Gallia caudicos docuit facunda Britannos." Perhaps, these "spread the light" to Ireland. The "Yellow Book of Lecan" has a story how the saint burned 180 druidical books: and Mac-Theni (ante A.D. 698) tells of an ordeal by which Patrick and a druid tested the merits of their respective books.¹ To argue that the tales of the long survival of Fintan and Oisín imply a belief that there was no early written record is to go too far. Only such a being as Fintan could tell of colonies lost in the Deluge or exterminated, to the last life, by a pestilence (indeed, the Fintan story is evidently a clerical recension of an archaic tale of rebirths: while the Oisín cycle is confessedly late, too late to give a clue as to belief in the early fifth century—the omniscient "eagle (or hawk) of Achill" were as good an "authority"!

Taking the less popular (and on that account less corrupted and more archaic) cycle of tales of the Red Branch, we have probably Ulidian legends of the opening centuries of our era, with no trace of the tribal pre-eminence of the Milesians of Tara, or the provincial arrangements, or the ancient political importance of that place, or the dawn of the Milesian tribes at Magh Femen, (Castel), and Thomond. The Etnai and Mairtene loom large; the manners and customs are identical with those of the Gauls just before our era; and some of the legends² are outrages on all the ethics and prejudices of the clerical writers, and evidently remotely ancient and almost unexpurgated.

Now, for our own district, we have a great mass of tales from several different, and even hostile tribes; no mere fictions, but once told to those who believed that gods dwelt on the great blue peaks of Galteemore and

¹ "Cosmographia Ethici," "Social History of Ancient Ireland" (Dr. P. W. Joyce), i, pp. 403-5; cf. Juvenal, "Satires," xv; Petrie, "Tara Hill" (Trans. R. I. Acad., xviii, p. 47); "Yellow Book of Lecan" (Irish Review, v, p. 3); "Tripartite Life of St. Patrick" (ed. Whitley Stokes, p. 44), from "Book of Armagh." See also "Battle of Magh Leana," p. 21; "Manuscript Materials" (Eugene O'Curry), p. 505. The opening "geasa" poem in the Book of Rights is partly pagan, save a "redeeming" verse (pp. 1-25). See also Book of Ballymore, p. 129. J. MacNeill (*op. cit.*, xxvii, p. 333) gives evidence for early Christian hostility against Irish pagan culture.

² "Celt. Rev.," iii, p. 65 (Miss Eleanor Hull); "New Ireland Review," xxvi, p. 130, p. 84 (J. MacNeill); "Duanaire Finn" (Ir. Texts Soc.); introd. (same).

³ These of Druad, Chetara, Bred, of Chugha, and Ness; see R. Soc. Antt. Ir., xl, p. 184; Keating's "History," vol. ii, p. 233; "Met. Dind S.," x, p. 45, and "Coir Anmann" (Irische Texte Ser. iii), p. 403.

Mish, on the hills of Luachair and Slievreagh, and even on low ridges like Knockainey and Knockfrina. The hearers gloried in a physical sonhood from Lugh or Nuada. The tales were probably largely preserved by a notable guild of Druids round Cenn Febrat, or Slievreagh, round which so many of them centre. "Since the Tuatha Dé seized the soil of Fotla, above the ranks of the noble druids in general is the branch of Cenn Febrat."¹ They were attached to the sacred mounds and tombs of Cush and Ballinvreena, where the chief gods and heroes of Corca Laegde "Ernai" dwelt, or were buried, at Temair Erann. This treasure of legend was common property of the tribes of Dairfhine and Dergthene, and passed to their bards and historians. Whether some of it came from the chief religious centre of the latter tribe, the home of the great god Bodb, on Slievenaman, we cannot distinguish; but its proto-history begins with MacNiad of the Ernai, Conaire, and Mog Neid, and his son Eogan² "Mog Nuadat," in the second century, and ends abruptly with Eanna Airgthech, just before the introduction of Christianity³—a very eloquent fact. We, too, are fortunate in having much of it in a form preceding the synchronizing euhemerists of the tenth century and their incorrigible successors.

Now what do we gain in broadest outline from these tales and poems? There is no chronology; after the "servile revolt" so called (which is very possibly a shadow of some then recent Milesian invasion), we see the so-called "serf tribes" covering all western and southern Ireland, and new tribes only gradually spreading their power in Connacht (the seed-bed of the Tara kings), the Boyne valley, and at Tara, farther south in Leinster and in south Tipperary. Ptolemy shows at least one British tribe, the Brigantes, settled at the south-west corner in Wexford.⁴ The Dergthene tribes of Magh (Feimhin) Femen in southern Co. Tipperary stand alone wedged among the "pre-Milesians" in Munster; the Ulidian tribes and the Picts fill up the north-east angle of the island, from the Boyne northward.

In south Munster the arrangements on Ptolemy's map agree well enough with the earliest sagas. In the latter the Erann, or Ernai,⁵ occupy the south-

¹ "Metrical Dind Senchas" (ed. Gwynn, Todd Lecture Series), x, p. 230.

² In Gaul "Eugen" is equated with "Esugen," son of Esus. Cf. "Les Celtes," p. 30.

³ There were Christian settlements on the south coast, at Cape Clear and Ardmore, and at Saighir Cairain, before St. Patrick. The alleged monotheism of Cormac mac Airt is plausible, as he introduced water-mills, a trained army, and a large oblong hall, and so sympathized with Roman culture.

⁴ Were these the Siol Breogain, whose name suggested to Ptolemy the British tribe name?

⁵ Ptolemy's "Iouernoi," from whom Ireland seems to have been named. Cf. Ernai, Ierne, Iouernoi, Iuvernii. As I shall endeavour to show, "Ernai" is a vague term like "Firbolg" or Milesian. In early literature it seems to include the Corca Laegde, Clann Dedad and the Muscraige, and Corca Baiscinn.

west from the "Genann" tribes at the Shannon mouth; the middle is held by the Muscraige; above them lie the Mairtene; above these again the Uaithne and Arada, north of the Saimer or Morningstar River. So far the arrangements in the *Tain bó Cualnge* persist, but a new tribe has come into sight in Femen. If its tribal genealogies may be trusted, it is a branch of that archaic tribe, living between the Brigantes and the Ernai, which called its chiefs "Maqi mucoi Netasegamonas," and recalled Nia Segamain, a great king's name¹ and little else, in the past, before Cuchulaind was born. This may suggest a British origin, for there seems no other trace of the war god *Segomus* in Ireland: perhaps they passed up the Blackwater valley from Ardmore² to Seskiman, where their monuments are found, or by the great ancient road, the Rian bó, up the passes between the Knockmeildons and Comeraghs, into the Shevenaman foothills.³ They were a feeble folk, under their chief, Mog Neid, and suffered from the might of the Ernai; but Eogan Mog Nuadat, probably by alliances or foreign weapons, asserted himself. He was believed to have divided Ireland with Conn, the King of Tara; at least "Conn's Half" and "Mogh's Half" were so explained; at most a nominal question of spheres of interest was touched between the "fair races." In the tale, he and his father fell in battle, and his tribe was pitifully overthrown. His son Oiholl Aulom⁴ was more fortunate (the alternative succession of the Dairfhine and Dergthene is probably as mythical as that of the Eoganachta and Dal Cais), but he appears as closely allied with the Dairfhine and fosterer of their prince Lugaid. He outrages the sanctuary of the Mairtene of Knockaney; joins the land between it and the hills to Conn Febrat, where he makes Dun Cláire, above which he is buried, at the opposite side to the cemetery of the Ernai at Teman Erann. As his son Cormac was buried at Duintheague, this may imply that the great cemetery of his race, "Oenach Cúilí" or Clochar, was founded later perhaps by Fiacha.⁵ Oiholl and the Ernai go

¹ "Of the *Sihra*"; his pretended chronology runs from about B.C. 150 to 50. He appears in all the Dergthene Pedigrees, though elsewhere very variant.

² Ardmore is in Deisi; if (as seems established) the Dal Cais were "the northern Deis" (B. of Leinster, f. 319c 5; B. of Ballymote, 171b 39; B. of Lecan, 174b 10), this is a remarkable coincidence that both people of the Deis were Maqimucoi Neta Segamonas. The Eoganacht prince in A.D. 630 is "King of the Deisi of Magh Femen" (Eriu, v, p. 35).

³ "Battle of Magh Leana" (tr. E. Curry, Celtic Soc.), p. 1.

⁴ *Supra*, xxxiii, p. 479.

⁵ *Supra*, xxxiv, p. 50.

⁶ A territory had a right to establish an óenach (Ancient Laws of Ireland, v, p. 484). An óenach was marked by a *clach* (*ibid.*, iv, p. 221). For Irish kings' priestly functions see *Rev. Celt.*, vi, p. 168.

⁷ Fiacha Millethan appears in one legend as a *wuthra* king, if it be not another of the same name.

to war; after alternate successes he is left, old and feeble, uninjured, living to see the victor's ruin and death.

Now this story (whatever be its truth) is very remarkable. It evidently preceded the firm supremacy of the Dergthene apparent at the dawn of history. It is impossible to fancy court poets of either them or their rivals celebrating the overthrow and gross errors and follies of their princes, the dotage of Oilioll, or the ruin of Mog Nuadat and Lugaid mac Con, unless both tribes regarded the unpalatable story as beyond impeachment, "the memory of man going not to the contrary." The subsequent slow advance of the Dergthene and quietude of the Ernai in the third century tells of exhaustion from war. The late "discovery" of their later sanctuary, Síd Druim (or Cashel), some say by King Core, son of Lugaid, in the fourth century, marks their slow advance. As its name implies, it was "the abode of idolatry and druidry" (like Tara) when the idols fell on their faces at St. Patrick's approach.¹ The great warrior kings, Lugaid Meann and Conall, similarly, are followed by the long obscurity of the Dal Cais during the fifth and sixth centuries, when the Dergthene tribe had split into two, and the lesser tribe, the Dal Cais, was struggling to hold its own against Connacht until A.D. 620. Oilioll's son, Cormac Cass, was mortally wounded in battle at Knocksauna, evidently trying to extend his territory westward. A century later all the east side of the Maigne valley was held, up to Carn Fhearadaig or Carnarry.² When Lugaid Meann's conquests were consolidated, we see Dal Cais colonies up central Co. Clare to Inehiquin Lake and the present north border of Co. Clare, a limit never exceeded. The tribes of the Tuath Echtge, the Corca Modruad, the Corca Baiscinn, the Aradha and Uaithne and the Ui Fidgeinte were allies, or allowed some nominal suzerainty to the tribes of Cass.³ Of course in the legends there is a great admixture of frankly mythical elements; still these are in essentials common to all folk stories, and sometimes attach to late historic persons (even to Garret, Earl of Desmond, and Oliver Cromwell) in the same region. Ethnology has advanced too little

¹ "Ancient Laws of Ireland," i, pp. 22-23; v, pp. 472-5. "Tripartite Life of St. Patrick," pp. 41, 195. Cashel, founded by Core, see *ms. R. I. Acad.*, 23D 5, p. 99.

² Despite the usage of "Carn Feradaig" for Carnarry till after 1530, and its always being defined as on the *northern* border of older Thomond, O'Donovan places it on the *southern* border on the authority of a chaotic poem naming it, Slieve Claire, etc., in no order. It was seized by Tigernmais from Conmael after the battle of Oenach Macha. Feredach, son of Rochorp, was buried in its cairn (*Metr. Dind.*, x, p. 267), of which the base remains (*North Munster Archaeol. Soc.*, i, p. 168, P. J. Lynch, and *Proc. R. I. A.*, xxvi, p. 88).

³ The chronology is usually—Oilioll Aulom, A.D. 190-230; Cormac Cass and Fiacha Muillethan, mid. third century; Mogh Corb, 334; Lugaid Meann, 350; Conall, 378; probably the first authentic date in their history.

to help us. All that is clear is that, unlike the dark "Fir Bolg races," the two Cashel tribes were fair, ruddy, large men, with golden, or red, hair, and blue, or green, eyes; the same is told of the Tara tribes.¹ The legends, unlike the Red Branch ones, belong to the "horse-riding period." Much may yet be done by our scientific colleagues to solve racial questions; till then, archaeology alone can do but little.

Myths are to be expected in early tales; the goddess Edaoin, making her favourite, Mog Nuadat, appear like a stone pillar while his enemies hacked actual rocks and pillars;² Oilioll's ear bitten off by the outraged goddess of the Mairtine; Cormac Cass and his singular medical treatment, can easily be classed, but a few other more intrusive matters in the more historic parts call for a note. I am not ready to believe that the mere name "Lugaid" marks a god; "Lugobeeus" (of Lugaid) is common on the ogmic pillars, and Lugaid in the later history; "Nuada," on the contrary, nearly always connotes the idea of "the Severn god," Nuada Argetlamh. There is a legendary "Lugaid Lambelarg" in the chaotic past of the Dal Cais descent;³ the epithet is transferred to Lugaid Meann, on the edge of the historic period; the pride of Munster and opprobrium of Connaught, he is entirely devoid of more supernatural features than attach to most favourite conquerors. Lugaid macCon, also, though in a mythic past, seems a mere mortal; as for his epithet we have "Cunogenus" in Gaelish inscriptions, and "MacCon" among the descendants of his stepfather, the MacNamas and others, to this day. With his sons, however, we have pure god-myth, though, I think, rather late, when the *triad* was infecting everything; their names are Oendia, Caimlia, Trendia⁴ (one god, gentle god, mighty god, but they are evidently intruded into some of the king-lists (not all) merely to assert the poisonous myth of the alternate succession, for which history (even in the tenth century) was falsified and warped; "Lugaid Delbaeth" seems an old god, returned too late to earth.

¹ Cormac mac Art had "golden hair, like blue bells were his eyes"; "his eyes were like (the bloom of) the sloe" (*Irish Texts*, Ser. i, p. 294). The Dal Cais—"Lachtina, a fair man from Oughthah" (*Book of Munster*, *ibid.* A. D. 847); "Dalehaia of the yellow hair" (*ibid.* A. D. 900); *Book of Rights*, p. 81; "fair-skinned" (*Wars of the Gaedhil*, p. 79); and many allusions to their red and golden hair and green or blue eyes, in *Cathreim Thoirdelbaith* from 1240-1318).

² "Magh Leana," pp. 30-31.

³ The *Cedraige*, certainly from their name non-Milesians, are stated to be a branch of the Dal Cais (*Battle of Magh Leana*, p. 173).

⁴ *New Ireland Review*, xxvi, p. 135. So the three sons of the Boyne goddess are "Tear-bringer, Staff-bringer, and Sleep-bringer" (*Rev. Celt.*, xxiv, p. 276); and the gate-keepers of Tara are "Key, Post, and Valve" (*ibid.*, xxii, p. 309).

⁵ As by the alleged "Dal Cais kings" of Cashel, Aodh, 573, and Lorean, son of Conligar. (See *supra*, xxxiii, p. 450.)

⁶ "Delbaeth, son of Nét," the war god (*Leab. Gabhal*, p. 153)

He kindles five streams of magic fire, from which his sons, the fathers of the Delbna tribes, spring,¹ and they are affiliated to the Dal Cais, undoubtedly without old warrant, for a mere political end. The horrible, and equally archaic, legend² of the worm of Cian seems transferred from the god Cian to the human eponymus of the Cianachta, who had also to be affiliated to the Dal Cais. These show that, under political stress, tribal pedigrees, like the later "Roll of Battle Abbey," had a caddis-worm-like tendency to attach extraneous rubbish to themselves.

Lastly, the simple churchman of the pre-Norse times (who tolerated god tales, and, at most, tried "to lure them into decency") was replaced two centuries after by a priest full of the evil and wrongs of Norse heathenism, so gods had to become human—kings, wizards, jesters—anything but "gods." The old god reappeared at different intervals in archaic literature, so the later reviser made him not one man but many. It is with these transformed gods and their local cultus that I am most concerned in the first half of this paper, as I am more concerned with the tribes and their legends and history in the second. Both studies are needed to elucidate the character of the earthworks (residential or sepulchral) of the ancient Clú mhail mhic Ugainne in south-eastern Co. Limerick.³

(B)—THE GODS IN CLÚ.

We ventured to embark on the dark and stormy sea of Irish mythology to search for the uncharted subject of the local sanctuaries in Clú at Cush, Knockainey, and Clogher. We established the objects of our search: but a mass of material of equal importance remains about other places and gods,⁴ both on the ground and in our literary sources, so we cannot leave it aside, but must deal with, and leave it to the amendment of the students of its obscure and difficult subject.

It takes courage to attempt to deal with the Irish gods. The very word causes a nervous feeling that one's work might get confused with the work of the older antiquaries, who sat and created, without study, visions of Phœnician, Cuthite, Indian, serpent-, cow-, and even pig-gods worshipped

¹ *New Ir. Rev.*, xxvi, p. 130; xxv, p. 73.

² *Hib. Lect.*, iv, p. 392.

³ Clú and Luchair evidently overlapped in the debatable land of Coshlea. Luchair extending to the east of Cenn Febrat and to Tul Tuinne, Dun Tultha (or Tomtinná), on Loch Derg (*Metr. Dind S.*, x, p. 239). Glenlara, named in the "Battle of Magh Leana" as apparently near Killarney, is more probably Glenlara on Cenn Febrat, to which a defeated prince flying from Magh Feimhin to the south coast at Beare might more naturally have sought temporary refuge among its tangled oak woods and streams. The territory of Curoi mac Daire extended between Knockainey and Slieveragh (*Mesca Ulad*, p. 17).

⁴ *Supra*, xxxiv, p. 53.

in Ireland, or with that of inventors of druidical rituals and arrangements of earthworks to form eagles or serpents¹ on the map of Ireland! One must prepare for bitter hostility, not only from the unexpected survivals of these discredited theorists, but from students of the old schools, whose faith in the pseudo-chronology and pseudo-history scientific antiquaries must endeavour to demolish.

I will avoid the terms "fairy" and "elf" for the *Síd* folk, for each suggests the English idea and gives us false an idea of the hero-like *Síd* as could well be imagined. The terms "demon" and "goblin" are, perhaps, even more misleading. There is no necessary implication of ugliness, or wickedness and malignity, in "the bright gods of elder time." The *Badhb* was usually beautiful and stately—a Pallas or Artemis. She only gradually reaches the nadir of bathosness and horror—"not uglier follow the night-lag" than she—in late works, culminating in the *Cathrean Thoirdeolbaigh*. Even to the present day some goddesses—Ariann, Aine, and Clodua, for example—kept all their supernatural beauty.

There were two main groups of gods in old Ireland,² the Tuatha Dé Danaan (many of whom are traceable in Gaul and Britain) and the Fomoríge. As in other primitive myths the "departmental" allocation of divine functions elaborated by the later keen Greek intellect and accepted or able by the unimaginative, puzzled Roman) was not followed by the Celts. The gods overlapped each other in attributes and functions. Lucian was irritated and scandalized at the mixture of Hercules and Mercury in *Ugulus in Gaul*, the god *Nobens* seems to have resembled Mars and Neptune, with, perhaps, a trace of Apollo and Pluto, so we cannot take absolutely the identifications even when made by their worshippers) with the Roman gods. I find no trace of the other family of gods outside Ireland, nor, indeed, in *Celtia* (unless, perhaps, of *Bress*) and even he is a half-breed. *Basilus* (his, however) and the *Aine* family was of the Tuatha Dé), are a number of gods of other races, often, possibly, non-Celtic, from the great *Badhb*. Drop in the obscure mountain-gods like *Clu*, *Domn*, and *Febra*; and ancestral ones like *Cathar*, *Mus*, *Dorgidene*, and *Deda*, with his forty sons.

The subject in its crude beginning leaves no excuse for dogmatism.

¹ I know the possessor of this remarkable map, but not its author.

² For the general subject present various articles on the Gaulish and Irish gods in "Revue Celtique"; *Hib. Lect.*, iv; "Ir. Myth. Cycle"; Arthur B. Cook, "The European Sky-God" (*Folk-Lore*, xvii, p. 28); "Encyc. Relig.," iii; Charles Squire, "Mythology of the British Isles"; Dr. J. A. MacCulloch, "Religion of the Ancient Celts."

I state what seems to me most probable views; but some, at least, must get overturned by further research. Though we have a substantial mass of early statements, even good, but slightly later, authorities do all they can to contradict the obvious facts, and make the Tuatha Dé not “demons or fairies, but descendants of Japhet.” All such euhemerist assertions are worth nothing. The “Fomorigh,” or “under-sea folk,” were probably gods of non-Milesian tribes. Only in the ranks of the Tuatha Dé do the gods of Gaul and Britain appear. The “Fomoraig” are “champions of the *Síd*,” probably of the holy mounds, not of their rival gods. We have a similar phrase in “the host round the cairns,” in St. Columba’s poem, and the *Coir Anmann* says that Cormac Coinloinges, “who watched at cairns,” was called *Nia in Chairn*, “the champion of the cairn.”¹

Of the Tuatha Dé we have full evidence from Gaul of the worship of Lug, Ogma, Neman, Net, Danu, Grian, Brigid, and Anu, with, perhaps, Midir² and Bile. Along with them we have the three crow-like goddesses of war, one called Bodbh of Battle, “(C)athubodua,” and the divine bull of the legend of Cualnge, “Donnotaurus.”³ The worship of many of these gods in Britain is equally well established. Llew or Lugh; Nudd (or Ludd) Lamereint, Nuada Argetlamh; Manawyddan, son of Llyr (or Manannán); Dón or Danu; and Govannan or Goibniu. The sacred mounds were divided between the divine races by Manannán and Bodb Derg; but they were “people of the *Síd*” (whatever exactly was intended), probably long before our literary sources begin.

Traces of the worship of the following gods I have so far found in Clíu:—Lug, Nuada, Nechtan, Cuil, Aine, Ferfi, Segomo, Net, and Manannán, of the Tuatha Dé. Of the non-Milesian gods I may note Bodb Dearg, Clíu, Dairine, Dergthene, Deda, Garban, and Febra, Donn Firinne, Edaoín, Cliodna, and a swarm of the relations of Deda, son of Sen, including the mountain goddesses Mís, Echtge, and Eblinn, and the river goddess Sinann.

¹ *Loc. cit.*, p. 403.

² This I doubt, as the bull and Phrygian cap suggest that “Medros” is Mithra (Rev. Celt., xxv, p. 47). The question whether Berekyntia and Brigendo are the Irish war goddess Brigid deserves more study. I venture to suggest that the mortal representatives of certain gods bore their patrons’ names; the priestess of Knockainey may have been “Aine.” I do not think (as has been suggested) that kings were called “Nuada”; the name at different periods arises from chronologers dating the same god at various generations. Lastly, the equation of Bile with Balor rests only on similar but doubtful pedigrees.

³ Borne by human chiefs, as by the prince of Helvii. For Tarvus Trigaranos see Rev. Celt., xviii, pp. 253-4.

(C)—LITERARY TRACES OF THE GODS.

It is a widespread commonplace in Ireland that our ancient literature says nothing about the early gods. This arises from the acceptance of the euhemerist statements, and, like them, is unfounded.¹ The pagan gods are fully recognized as such till the late tenth or even mid eleventh century. High clerics, like Cormac, felt as little hesitation to name them as St. Luke felt when he named Zeus, Hermes, Ares, the Dioscuri, and Artemis. Evidently the new prejudice roused in the wars of the Norse and Danes rendered it desirable to sweep away every trace of a pagan deity, though the survival of so much ancient literature rendered the effort unsuccessful.

Let us trace this decline from the frank statements of the early writers.² *Tain Bó Cuailnge* (edited and written down in the early seventh century, and, in its existing form, as old as the eighth-century glosses) was fragmentary when first transcribed. It tells of the direct intervention of Lug, Neman, Manannán mac Lir, the Buidé, and the Morrigan, daughter of Ernmas, and it regards Cu Chulaind as the son and re-embodiment of the sun-god Lug himself.³ Phrases like "the blessing of gods and non-gods" occur in the archaic *Fíad Éireann*.⁴ Even the "godless" *Tain Bó Flidais* has an apparition of the war spirit. *Leabar na hÚidre* plainly calls Conchobar and Dechtire gods and earth-gods,⁵ and Dechtire's son, Cu Chulaind, is a god, descended from the gods Net, Elathan, the Dagia, Cernait, Lir, and Mac Cúil, the husband of Ireland herself. A passage from the very early "Yellow Book of Slane" speaks of Cu Chulaind's holy mound, Síd Setanta, in Muirthemne.⁶ *Tír na nÓg* (A.D. 656) tells how St. Patrick and his com-

¹ This notion occurs in "Book of Ballymore," *ibid.*, xl, 34v, 39. See the *Leabhar Gabhala*, pp. 141-189 for list of Tuatha Dé, though it has clerical colouring, such as their wars being with the Athenians against the Phoenicians; also *ibid.*, p. 169; "Battle of Magh Tuired" (*Ériu*, viii, pp. 17, 36, 45), and the late "Cath Finntraga" (ed. Meyer), p. 15.

² The earliest works are—*Tain Bó Cuailnge* (c. 650); "Sagas Chormaic" (c. 896); *Leabhar Lá Fhionn*. For the later phases—*Cinead Ua Articain* (974); *Cuan Ua Donn* (1024); *Frann of Meenester* (1060); *Cath na Columban* (1079).

³ *Tain Bó Cuailnge*, ed. J. Todd, pp. 30-31, 100-107; the Morrigan, p. 178; Lugh, 182 a; Buidé, 27, 29, 188, 191; Manannán, 190; some euhemerist interpolates "The Tuatha Dé were bred their men of learning to be gods and their husbandmen non-gods." *On Laws of Ireland*, 144. "Buidé's corpse-fod," p. 188, is a pile of bodies; "Torches of Buidé" are weapons.

⁴ "Fíad Briann" (*Ir. Texts Soc.*, ii, pp. 57, 61, 67, 76) in a ninth-century recension. "Death of Cu Chulaind" (*Rev. Celt.*, iii, p. 175, and *ms. F.C.D.*, B. 2-27). We hear of Cu Chulaind's "Folks of might whom he worshipped."

⁵ *Leabar na hÚidre*, p. 101b, *Book of Leinster*, p. 123b.

⁶ "Sag. Book of Cu Chulaind" (*Annals*, i, p. 390); also "Heroic Romances of Ireland," A. H. Leahy, No. 2, p. 66; *Dá Derga's Hostel* (*Rev. Celt.*, xxii, p. 66).

⁷ Published in "Tripart. Life," vol. ii, p. 315.

panions were mistaken for “men of the *Síd*, or earth gods,” and were asked, “Are you of the *Síd* or of the gods?” Note how little a Christian writer then hesitated to tell facts; but Tirechán’s candour is as nothing to that of Cormac, King-Bishop of Cashel (about A.D. 896). In the latter’s *Glossary*¹ we find—“Art, a god”; “Ana, mother of the Irish gods”; “Brigid, a goddess worshipped by poets”; “Diancecht, god of the powers, god of healing”; ‘Manannán, the Irish and British call him god of the sea’; “Neit, a god of battle with the pagans of Gaul”; “Nemon, his wife”; “the three gods of poetry”; and he often refers to sanctuaries and magic rites. He calls his predecessor, Eogan, “Mog, son of Nuada,” and mentions ‘Aine, daughter of Eogabál. *Coir Anmann*² has many early notes—“In Munster was worshipped the goddess of prosperity, whose name is Ana, and from her was named the ‘Two Breasts of Ana,’ over Luachair.”³ It mentions the gods Nuada Derg Lamh, “Nia Segamain of the *Siabra*”; Nuada Salfada, son of Engus; Nuada Necht; Nuada Finn; Nuada Argetlamh; beside more definite entries—“Manannán mac Lir, god of the sea”; “the Dagda, the fire of god; he was a beautiful god, for the Tuatha Dé Danann worshipped him, for he was an earth god to them,”⁴ and “Diancecht, deus Salutis.” Even the rather late “Battle of Magh Leana” (p. 90) tells of Conn’s “powerful friends,” the Tuatha Dé, helping him in that combat, and the Mesca Ulad names “the great Dagda, son of Ethliu, the good god of the Tuatha Dé,” with “Delbath, son of Ethliu,” Aengus Og, son of the Dagda and Cermait honeymouth, “three noble youths of the Tuatha Dé.”⁵

In *Táin bo Cualnge*, *Bruden Da Derga*, and *Fled Bricrenn* abound many allusions to pagan gods⁶—“I swear by the gods by whom my people swear,” “by the god of my people,” or “of my tribes” or “by whom the Ulster folk swear,” “by the gods whom I adore,” and “we give thanks to the gods for our return to Erin.” Indeed it was impossible to expurgate the old paganism and its phraseology. They even got copied into late works like the *Agallamh*, which, despite its sturdy euhemerism, says—“the Tuatha Dé Danann, who are unfading and whose duration is perennial.”⁷ The common sense of the old scribe of the *Táin*, in the Book of Leinster, looked facts in the face, but did not omit them—“I, who have transcribed this history, or rather fable, do not

¹ “Sanas Chormaic” (ed. W. Stokes), pp. 3, 4, 17, 23, 47, 56, 67, 90, 99, 114, 122, 145.

² *Irische Texte*, Ser. iii, 12, 1897, pp. 239, 291, 295, 327, 355, and 357.

³ Also note Doonass (Easa Danainne) rapids on the Shannon.

⁴ A curious outcome remains of euhemerist attempts to clear away gods like Lugh, MacCecht, &c., by giving *them* other gods.

⁵ Mesca Ulad, pp. 31–33.

⁶ Even if euphemisms for a divine personal name, they still “call gods ‘gods.’”

⁷ *Agallamh* ii, p. 203.

believe some things (in it), for some are delusions of demons, some are poetic figments, some seem true and are not." It is curious to find some belief in the Sid folk in even so orthodox a person as Rev. Geoffrey Keating, about 1639, where he does not understand how the euhemerists obtained tidings of such early events and wonders, was it aerial demons, the *Sid* lovers of the oldest inhabitants, who told it? or was it engraved on flags of stone?

The gods so recorded are of the Aryan type, not the grotesque fiends of America and Asia, the gloomy but impressive, gods of the Euphrates and the Nile, but supermen, like those of Olympus or of the Valhalla: "departmental gods," not almighty, subject to fate, wounds, mutilation, and pain, and the joys, passions, and sorrows that beset mankind. Sometimes great nature powers, like the Sun and the Ocean, they were yet compelled at times to seek human aid, and were parents of men, by mortal lovers and protected, though they could not always save their mortal offspring or favourites, as Zeus could not save Sarpedon.

Their tale continued to be written and (when at last it passed into the hands of ardent poets, bent on giving Ireland a prehistoric history, at least to the days of Noah) it was an invaluable quarry from whose fragments masses of false history and imaginary king lists could be made. These waifs and wrecks (washed up from a past ten or twelve centuries before the writers) became, not the exquisite stories of Greece or the fine sturdy tales, full of human and paths, of the Edda, but dried and mutilated husks, depleted, split up, or blended with others, set in contradictory frameworks of chronology, where a god, like Nuada, becomes various persons in the year before our era, 1741, 1697, 699, 179, 112 or 59, and the Milesian invasion took place in the 1769, 1229, 1066-71, 564, or 531. There are yet persons living who regard any criticism of this colossal mass of perverted compilation as blasphemy against the greatest glory of our land, but their time is past, and soon the pre-Christian annals will be ranked with the tales of Geoffrey of Monmouth, and left to mere country archaeologists of the older schools. Then, when we have removed the strain of euhemerist fiction and rubbish² from the ruin, the foundations and beautiful fragments of the once noble fane of Irish mythology will stand clear to the sun. Doubtless when that is done men will wonder no less at the large amount which has escaped the destruction of over fifteen hostile centuries than at the credulity that so long held against all reason and evidence, the mass of late fiction which concealed it to be the only true history of early Ireland.

¹ Like the divergent versions of the *Battle of Magh Tured*.

² "Rubbish," like the pre-deluge legend, Keating, "*History*," i, sect. v.

(D)—LOCAL CULTUS OF THE GREAT GODS.

LUG LAMHFADA. Most glorious of all the gods of Erin is "Lug of the long hand," "the god, twin-born with the day," the sun. His epithet was a note in many a religion, the creed of every high religion that "God's hand was not shortened," and recalls the pictures of the Disc God of Egypt with his hand-ended rays blessing his devotees. The euhemerists could not conceal Lug's nature—"Lug, like the sun is the splendour of his face, men are unable to look upon it"; "as brilliant as a summer's day he rose from Manaman's territory in the east"; "he rode the steed of Manannán (the white-maned wave), swift as the bleak, cold wind in spring"; when he is in the west men ask "what else than the Sun is it? It is the radiance of Lug Lamhfada."² He was "Master of all the arts," "Lug, with whom are all the arts." Caesar when he spoke of the Gaulish Mercury, "the inventor of all the arts,"³ evidently meant *Lugus*. In Gaul he was a centre of cultus; the towns called "Lugdunum"⁴ were his special seats, three still echo his name—Lyons, Laon, and Leyden; the fourth is now St. Bertrand de Comminges, where the Lugnasad festival was kept in August, as it was in Ireland. He seems to have been personified (like the war goddesses) by a raven, "Lougos," being so translated;⁵ so Odin had two raven spies. He and his divine "boy," like Lug and Cu Chulainn,⁶ were represented in Gaulish carvings.

Not to repeat his long story in Ireland, he was son of the Dagda, but his mother was Ethniu, daughter of the horrible darkness god Balor, the god of the evil eye. Lug's slingstone drove the eye through the fiend's head, as his Greek equivalent Hermes slew Argos, the many-eyed night.⁷ He was worshipped by Mac Greine, one of the three divine husbands of Erin. Men were called from him *Mog Loga*; his great sanctuaries were at "Lugmagh," or Louth, and Naas, which last was known as "Lis Logha"; perhaps its note

¹ Hib. Lect. iv., p. 384; "Ir. Myth. Cycle," ch. xiii.

² "Fate of Children of Tuireann" (Atlantis, iv, p. 161); "Feís tige Chonain," Ossianic Soc.), p. 25.

³ Rennes Dind. S. (Rev. Celt., xvi, p. 77), "Irish Nennius," p. 47.

⁴ Hib. Lect. iv, p. 419. A fifth Lugudunum belonged to the church of Le Mans. "Lugnasad," see Sanas Chormaic, p. 99, Hib. Lect. iv, pp. 418, 419; but, to contrary, Rennes Dind. S., Rev. Celt., xvi, p. 51.

⁵ Folk-Lore, xvii, p. 164, ravens appeared in flocks when Lugdunum was built. Manuel de l'Antiquité Celtique (Dottin, 1906), p. 64.

⁶ L. na hU., f. 101b; "The Cuchullin Saga" (Miss Eleanor Hull), lvi, lxii, pp. 15-20; "Compert Con Chulainn" (Rev. Celt., ix, pp. 1-13; "Tain bo Cualnge," p. 96. Cuchullain and Lug were too individualized to merge into one. For Gaulish carvings see Rev. Celt., xxvii, p. 319; xxviii, p. 224, "Lug and Cu Chulainn, his son, in Gaul."

⁷ "Ir. Myth. Cycle," p. 113.

was at first his *Síd* mound.¹ He also dug the great earthworks of Tailti, at Telltown, Co. Meath. The rainbow was his "hurling-stick," and the Milky-way his "chain."² In late times the annalists made him a king, from A.M. 3370 to 3331 (B.C. 1871-1830, but others said 1714-1674), and writers put in his mouth the degrading confession, "I am Lug Mac Ceithlenn, of Adam's race, who have returned from the dead,"³ making him ride a charger as a late feature. Some said his valour was only a seventh of that of Hector, but was (even so) 2401 times that of the bravest "modern hero," Murehad, son of Brian, in 1014! He was, however, cited as an example to fight against the Danes, for he "sprang over every obstacle and exterminated and expelled the foreigners and pirates out of Ireland."⁴ Even so late as 1750, Seaghan O Tuama compares Prince Charles Edward to Lug of the trenchant sword.⁵

Lug was ancestor of the *Corca Laegle*,⁶ and grandfather of Conaire whose son, *Cairbre Musc*, we shall note; his descendants lay in the cemetery of the *Eunai* or *Slieveragh*, and perhaps one of the three tumuli on which "men feared to sit because of the *Tuatha Dé*" was dedicated to the sun god. He was also divine father of the *Corca Oiche* and *Corcamodruad*.⁷ The festival of the goddess *Aine* at *Knockainey* depended on Lug's festival, and was celebrated for three days after, and continuously with it,⁸ for she being a harvest and meadow goddess, and giver of fertility to crops and cattle, naturally needed the sun. It will be remembered that *Art Imlech* gave his name to *Emlygreman*, below *Slieveragh*, and dug the forts there; he was slain by *Bress*. The latter had been taken captive when Lug slew *Balor* and warriors of the *Fomoraign* "as numerous as the son of *Ler*'s horses in a sea storm." To save his life, *Bress* offered that the cattle should give milk all the year round, and that there should be a harvest every quarter, but, only when he told his captors the lucky day for harvesting, was he set free.⁹ In another story, when *Nechtan*, son of the god of *Nuacla*, reigned in *Munster* (his wife's sanctuary was at *Clogher*, near *Emlygreman*), *Bress* imposed on him as tribute the milk of 100 dun cows for every house. "Lugh, who was dutiful on all occasions," helped the overtaxed province. He singed and dyed all the cattle to

¹ *Folk-Lore*, xvii, p. 157; "Manuscript Materials," p. 478.

² *Squire*, p. 62.

³ "Ir. Myth. Cycle," p. 171; "Manuscript Mat.," p. 388, later than 1014.

⁴ "Wars Gaedhil," pp. 187, 188.

⁵ "New Ir. Rev.," v, p. 38.

⁶ So in "Corca Laegle," p. 9, p. 57, which makes him ancestor of the *Dergthene* also. B. of M. *Lenna*, p. 172.

⁷ "New Ir. Rev.," xxvi; "Ancient Ir. Genealogies" (J. MacNeill), pp. 132-4.

⁸ *R.I. Antt.*, Ir., ii, p. 35.

⁹ "Voyage of Bran," ii, p. 178.

dun colour, and made sham cows full of unwholesome fluid, and, as Bress was under a *geis* to drink the milk, the oppressor got poisoned and was buried under Carn Ui Neit (called from him as descendant of the war god Net) on Mizen Head, Co. Cork.¹

NUADA AND THE WAR GODS.—The connexion between the god Nuada and the ruling races and districts of mid-Munster is well established and of much mythological importance. Like most primitive people, the Celt gloried in the divine descent of his tribe and chiefs. Professor MacNeill is most probably right in regarding the ancient accepted genealogies as “ending” with (i.e., leading up to) a god.² Early people claimed not only the personified nature power, but the super-man and super-beast as ancestors. The Gaulish inscriptions give us names like Bodvogenus, Camulogenus, Esugenus, Totatigenus, Morigenus (“Morgan”), and Rhenogenus,³ and the general term Devogenus (God’s son), as the man derived himself from Bodb, Camulos, Esus, Totates, the Sea or the Rhine; while others bore animal names, like Cunogenus (MacCon), Urogenus, and Artiogenus (MacMathgamhain), the non-Milesian Irish tribes Conraige (hound), Sograige (bitch), Gamanraige (calf), and Osaige (fawn, or even *otso*, werewolf)⁴ attest the other phase.⁵

I long hesitated to receive the names in genealogies as actual gods (regarding them as mortal adaptations, like Diogenes, Phœbe, and Silvanus); but the presence of Lug Lamhfada, Manannán mac Lir, or Oirbsen, and Nuada Argetlamh is unmistakable. Nuada was closely bound up with Munster—Cathaoir Mór (ancestor of the Dairfhine, whose tribal ancestor Lugaid Laegde, was buried at Temair Erann on Slieveveagh), descended from Nuada Necht and Nuada Finnfháil. The rival Dergthene not only called their first great prince “Mog Nuadat,” servant of Nuada, but were derived from Nuada Argetlamh in direct descent; indeed, Mog Nuadat (if Cormac’s Glossary be correct) was a *son*, being called “Mog, son of Nuada.”⁶

Now, in view of the prejudice against treating the late eleventh-century imaginary king lists as anything but history, I must first methodize my material to show the identity of Nuada under his various surnames. Nothing

¹ Metr. Dind S., x, p. 217; see *supra*, vol. xxxii, p. 271. Hackett and Borlase regard Leaba Mo Laga as a shrine of Lug (Dolmens of Ireland, iii, p. 769).

² New Ir. Rev., xxvi, p. 134. The Milesian groups of descents converge respectively on Conn of Tara, Cathair Mor of Naas, and Oilioll Aulom (p. 7), and meet in the god Nuada.

³ Cf. “Neilogenes.”

New Ir. Rev., xxv, p. 7. For “Irish werewolves” see Encyc. Relig., viii, p. 207; Rev. Celt., ii, p. 202. Wolf names like Faelchu, Faclad, &c., abound among the Ossorian chiefs. Nuada was “Lord of the wolf,” and Bress was a “wolf-man.”

⁵ “Anthropomorphism among the Celts,” De Jubainville (Rev. Celt., vol. xix, p. 229).

⁶ Of course, like Cu Chulaind and Mongan, he had a human father as well.

was more common than to divide a god so as to adapt him to the Triad formula. Brigid is triple, "of the smiths," "of the poets," and "of the doctors": "Eriu, Fotla, and Banba are Ireland; MacCuil, MacCeht, and MacGreine, her husband; Macha, Neman, and Bodb, the war goddesses, are interchangeable; while triads of separate gods were worshipped everywhere, as "All-dai, Buada, and Buan"; or "Oengus, Boadan, and Elemair," at the great Boyne Tumuli: "Sinann, Dairine, and Macha," at the Shannon; "Eogabal, 'Aine, and Fer Fi," at Knockainey; and "Nuada, Nechtan, and Boadan," on Caibery Hill, above Trinity Well, the source of the Boyne. This well may have been so dedicated to conciliate those who worshipped the old divine triad, in order that, like Patrick, they might "bind themselves to the Trinity." The fertility of the Irish mind in inventing genealogies is exuberant. Even Bunyan, with his convincing parentage and biographies of personified vices, pales before the riches of Irish allegory. We meet endless characters like "Violent, son of Extinction, son of Darkness, son of Ailment" (in the *Dind Senechas* of Carman); "Scrutiny, son of Cogitation, son of Great Knowledge, son of Enquiry" (in Cormac's Glossary); "Yellow, son of Fair," and "Terror, son of Great Fear" (in *Fled Bricrenn*); the Dagda's wives, "Lie, Guile, and Disgrace," and the druid's three sons, "Prophecy Knowledge and Truth" (in the *Battle of Magh Leana*).⁵ This teaches us caution in receiving genealogies as evidence for the non-identity of the Nuada names. Chronology proves it as little. The Nuadas are dated *i.e.* 1741, 1907, 160, 112, or 59; but then (as we saw) the Milesian invasion has the dates *i.e.* 1769, 1229, 1066, 1071, 554, and 331; Queen Medb's father, Eochu, is dated *i.e.* 137, 56 and 27; Eochu Muimhe, eponymous King of Munster, who fell in *Ullin* at *i.e.* 1429, 1275, and 776. Endless other "synchroonisms" show that, so far from being "authorities," the chronologers could not agree to tell the same story. Such systems are less authentic than the very myths of the gods! and it must be remembered that the ever-living gods naturally appeared in different ages in stories which, when

¹ *Ir. Myth. Cycle*, pp. 210, 218; *Hib. Lect.*, iv, p. 579; *Rev. Celt.*, vii, p. 283.

² *W. M. Hennessy, Rev. Celt.*, i, p. 33; *Proc. R.I. Acad.*, x, p. 425.

³ *Metr. Dind S.*, x, p. 27.

⁴ *Silva Gad.*, vol. ii, p. 575.

⁵ "*Fled Bricrenn*," p. 9; "*Sanas Chormaic*," pp. 144-5; "*Magh Leana*," p. 155.

A good example of duplication is in the O'Driscoll pedigree: (57) Lugaid, son of (56) Daire, grandson of (54) Siothbolg, son of (53) Daire, son of (52) Siothbolg, (*Keating*, iv, p. 155), and in the Eoghanecht pedigree three recurrences of the god Nuadha are noticeable, evidently independent documents (*Book of Lecan*, f. 64b). In fact, these pedigrees are heterogeneous fragments stuck together.

⁶ The parentage of several of the great gods (e.g. Mider) is most variant. *Ir. Myth. Cycle*, p. 178 n.

“synchronized” and “rationalized,” compelled the same god to be “distributed” as different personages ages apart.¹

Indeed, divergence of name and epithet is no evidence for the non-identity of a god, or Zeus Dodonaeus, Olympius, Lykæus, or Dictæus; Athene, Pallas, or Tritogeneia; Thor, Ygg, Bolvêrk, Kialar, Sidgrani, or Illorridi, should be so disintegrated. On this account, I think the theory that the various “Nuadas” are reincarnations of the god is refuted by the evidence for identity, as I shall tabulate.

TABLE ON IDENTITY OF NUADA.

(1) Nodens, Nudens, Ludens, Nudd, or Llud.² An early British god of war, light, and rivers. He was worshipped on the Severn at Lydney, and on the Thames at Ludgate. In Irish literature Loden, son of the sea god, was a great cattle-owner; so is Nudd in Welsh literature. The ancient name was *Nudens lam argentios*, according to Rhys, “Ludens” being alliterative to *Lam Ercint* or “silver hand.”³

(2) Nuada Argetlamh, “silver hand,”⁴ king, and war god of the Tuatha Dé, a light god, son of Echtach, or Eochu. He is ancestor of the Eoganachta and Dal Cais princes.⁵ Dwelt at Almu, father of the god Tadg,⁶ succeeded by Bress. (B.C. 1741–1721.)

(3) Nuada Fáil, or Finnfail (“white light,” says Rhys), son of Giollebaid⁷ (cf. “Eochaid”). Ancestor of the Dergthene. Slew Art Imlech of Clíu,⁸ and was slain by Bress, who succeeded him.⁹

(4) Nuada Derg, son of Achi (Echtach), or of Sedna Sithbaice,¹⁰ by Dairfhine, the ancestress of the Corca Laegde, Fosterer of Eogan, who was

¹ It is necessary to repeat these facts for emphasis.

² Hib. Lect., iv, p. 119; Ir. Myth. Cyc., pp. 86, 88, 118; Holder, ii, 754, Encyc. Relig., ii, p. 284. “Ludd Lamereint” appears in the story of Kilhwch and Ollwen. Nuada, Abbot of Armagh, A.D. 810, was also called Noda (Trip. Life, vol. i, p. 82).

³ Hib. Lect., p. 125; Encyc. Relig., p. 284; Hib. Lect., pp. 128, 290. “The cattle of Nudd the bounteous were 20,002,” Folk-Lore, xvii.

⁴ Poem of St. Columba (Ossianic Soc., v, p. 255); the epithet recalls a Pict, “Argentocoxus,” or “Silver Thigh” (Dion Cassius, Book I, xxvi).

⁵ Book of Lecan, f. 64b; “Magh Leana,” pp. 170, 171; Keating, “History,” iv, p. 17.

⁶ Sanas Chormaic, p. 55; Leab. Gabh., p. 149; Atlantis, v, p. 259; Rev. Celt., i, p. 52.

⁷ “Magh Leana,” 170; see also ms. R. I. Acad., 23, K 32, p. 108.

⁸ Book of Leinster, Todd Lect. Ser., iii, p. 171.

⁹ “Bress a wolfman” (Jour. R. Soc. Antt. Ir., xly, p. 38; Giolla Coemhain and Leab. Gabhala, pp. 165, 159; *supra*, xxxiii, p. 47; “Art” means a god (Sanas Chormaic, p. 3).

¹⁰ Silva Gad., ii, p. 5, 9; also 3, 8, 139. Setna was king of Claire (Cenn Febrat) B.C. 909; see also “Magh Leana,” p. xxi. “Second Battle of Magh Tured” (Rev. Celt., xii, p. 246).

thence called "Mogh Nuadat." Dwelt at Almhu;¹ a great landowner and fort-builder; he had a son Glas (cf. N. Derg Lamb, No. 7), and was revered, with Nechtan and his wife Boand, at the source of the Boyne. Nuada, son of Achi, was husband of Almhu and father of Tadg.

(5) Nuada Neacht, son of Setna Sithbaice² (cf. Sithbale, grandson of Nuada, son of Lug, *infra*, No. 10, and Sithbolg, fifth from Dergthene, and sixth from Nuada Airgthech, in Keating). Husband of Boand, who herself met the fate of Sinann, daughter of Loden.³ Ancestor of the Dairfhine; father of Tadg of Almhu,⁴ slain in Clu., B.C. 118, builder, with "Mog Nuadat," of the fort of Almhu.

(6) Nuada Fullon (the beautiful), a magician, easter of magic wisps, B.C. 600,⁵ son of Allot (brother of Bress).⁶ Along with Nuada Fimfiail and Nuada Necht in tribal pedigree of the Dairfhine in the Book of Lecan, f. 64b.

(7) Nuada Derg Lamb, father of Glas, an alias of Nuada Dearg, but dated A.D. 430.

(8) Nuada Salfota, an alias of Nuada Dearg,⁷ with same story of Mog Nuadat and the fort-making, but at Ailinn instead of Almhu.

(9) Nuada Find (note epithets "white," "silver," &c.), reared at Find Mag, or Mag Femen.

(10) Nuada Ainech (Airgthech), Lainghine, son of Lug, grandfather of Sithbale of the Dairfhine, and father of "Daig Dergthene," *circa* B.C. 50.⁸

(11) Nuada Dearglamb, son of Eochu, third from Eber Finn, son of Bile, fourth from Alldod (Allot), son of Nuada.⁹

(12) Nechtan, son of Nuada Necht, husband of Boand, son of Labraid, or of Namat,¹⁰ a great cattle owner. "Cu Nuadat," in one Boyne legend. He

¹ Rev. Celt., ii, p. 84, from "Battle of Cnucha." For Almhu, Agallamh, ii, p. 132. No trace of a fort or cairn remains, but several of these elsewhere have been entirely obliterated (even in my memory), especially those on rocky knolls.

² Sedna was grandfather of the hero Finn (Silva Gad., ii, p. 166, p. 99, and p. 519); see also Genealogy, Keating, iv, p. 42. Sedna is sometimes given as son of Bress (Ms. R. I. Acad., 23 K 32, p. 108).

³ Sinann, Metr. Dind S., x, p. 27; "Duanaire Finn," p. 133; "Boyne and Blackwater" (St. W. White, p. 34, Ten bo'Guinge," p. 148; for Dun Mic Nechtan, see Book of Leinster, f. 65b.

⁴ Silva Gad., ii, p. 519; "Duanaire Finn," p. 137.

⁵ Verse of Senchan Torpeist (c. 630, Todd Lect. Ser., xvi, "Fianaigecht").

⁶ Coir Anmann. Irische Texte (Stokes and Windisch), iii, p. 367.

⁷ Leab. Gabh, p. 153, sons of Elathan, son of Dealbath.

⁸ *Ibid.*, p. 305; "Magh Leana," p. xxi (from Ms. T.C.D., Hs, 18 f 567), and pp. 1, 117; both are called "son of Dairine."

⁹ "Fianaigecht" (Meyer, Todd Lect. Ser., xvi, p. 29).

¹⁰ Keating, Hist., iv, p. 87.

See also N. NECHTAN, &c., in MSS. Brit. Mus., p. 640 and Egerton, 138) of Namat, Keating, i, p. 219; Metr. Dind S., x, p. 27.

sent Eogabál and 'Aine to Clú. His wife, Boand, "of the silver fore-arm" or "silver yoke," was drowned by the hazel well, which similarly drowned Sinann, who was also Dairine. It was identified with the Severn,¹ beside which lay the shrine of Nodens; Cúil, another wife of Nechtan, was patroness of the chief cemetery of the Dergthene at 'Oenach Culi (or Clochair), near Knocklong.²

By this table it is evident that 1 to 5 are identical with the silver-handed god, "son of Eochaidh, father of Tadg," and predecessor of Bress; that 7 and 11 are the same; that 4, 7, and 8, the father of Glas, the red, or red-handed, god, are identical, and 4 identifies them with the first group; that 4, 5, and 10, relations of Sithbaice and Dairfhine, are identical, and only the vague Nuada Fullon is unidentified save with Bress, the successor of Nuada Argetlamb. Nuada was a British god, not hitherto found in any Gaulish place-name or inscription.³ So far from being "an Irish high king," he was (as we noted) a purely divine nature power, god of light, of the deeps (of the earth and sea) and of war. Thanks to the discovery of his temple in 1805 at Lydney Park, Gloucestershire,⁴ and his representation in metal there, we know how his worshippers regarded him. Tablets are dedicated to him as "Devo M. Nodenti," or Nudenti, or Nodonti. He rides in a chariot drawn by four horses, wielding a club, his head decked by a spiked crown,⁵ or by rays. The winds fly round him; he is surrounded by tritons and sea monsters, and a fisherman catches a salmon.⁶ His temple has three cellae, so perhaps he was one of a triad, as at Sid Nechtain, on the Boyne. Many figures of wolves were found, and "Nudd the superior wolf lord" figures so late as the sixth century in a poem of Taliessen. London and Ludgate were traditionally connected with his name "Ludd," and he may have been the god whose temple lay where rises the great dome of St. Paul's. Being a leading war god, he may be identical with Nedem (Net),⁷ Camulos, and Segomo. Net's wife Nemetone (Nemon)

¹ "Cu Nuadat," in one version of Boand legend (*Metz. Dind S.*, x, p. 29). For hazel well, see Book of Leinster, pp. 156 and 191. Identity of river with Severn (*Metz. Dind.*, x, p. 29); for Boand, *Rev. Celt.*, xv, p. 293; xxii, p. 58. Note "Magh Leana," p. 97; *Metz. Dind S.*, x, pp. 27, 293.

² *Supra*, xxxiv, p. 63; Silva Gad., ii, p. 118.

³ Unless he be the "Nuz" of Ker Nuz (*Celtic Rev.*, i, p. 200; Holder, ii, 758).

⁴ "Roman Antiquities in Lydney Park," Figure, Plate xiii, Plan iv, Tablets xx, wolves, xxvii; several torques were found. *Hib. Lect.*, iv, p. 127; *Folk Lore*, xvii, p. 39.

⁵ Similar spikes (perhaps of helmets) have been found, notably the beautiful ones of the supposed bronze crown in the R. I. Acad. collection, and the three figured in the *Journal Ivernian Soc.*, iii, p. 110.

⁶ "Mogh Nuadat" wears a salmon-skin shirt ("Magh Leana," pp. 39, 163). Mr. A. Cook compares this with Nuada's salmon at Lydney Park.

⁷ Col. Wood-Martin makes Neit, Nudd, Nuada, and (what seems evidently wrong) Lir and Ludd the same. "Traces of the Elder Faiths of Ireland," i, pp. 364-7.

is commemorated in an inscription at Bath as "wife of Mars";¹ in Ireland she was identical with Macha, Badbh, Dairrhine, and Sinann. Now beside the last great river, called from the goddess, towers the lofty Craglea; there the Dal Cais venerated their war goddess Aibinn (the "Fair" or "Pleasant"). Could she have been their ancestress called Macha, Net, and Dairine?²

In Ireland Nuada Silver Hand was also a great warrior god; ruler of the Tuatha Dé, and their leader in the battle of Magh Tured: there he lost his hand, which was replaced by a magic silver one.³ The Welsh have lost the legend, but Nadd's epithet "Lad Law Ereint" shows that it existed. In Ireland, as in Britain, he was a wealthy god, with great herds of cattle, a builder of forts from London to Glin, and a god of rivers—the Thames, the Severn, and the Boyne: he was at least venerated beside the Suir. He and his wife, Boand, are distinguished by epithets implying "white" or "silver." *Fine Faid* may even refer to the *Foid*, the *foit* pillar or slab rounded at each end, which formerly lay beside the mound of hostages at Tara.⁴

Now (as a certain war god) Nuada even if not identical with the war gods Camulos, Segamos, or Net, is connected with Dairrhine. The Dergthene⁵ tribes, the later Eganachta and Dal Cais (MacCarthys, O'Donovans, O'Callaghans, O'Byrns, MacNamras, Mac Mahons, &c.) were all descended from him and from the war goddesses. Their great ancestor was son (Mog, Mac), or servant (Mag, of Nuada), his father was Mog Neit (servant of Net). The Eganachta were called Ua Neit, descendants of Net: their ancestor was Nia Segamain (champion of Seg and a Cornish war god). Eterrlamh, son of Nuada Argetlamh,

¹ It was not, however, put up by a Briton, but by a native of Treves.

² Folk Lore, xxi, pp. 126-7.

³ In later legend, his severed hand was dug up and made to grow to its injured limb. The Badb, as a royston crow, had flown off with the hand.

⁴ It fell a few years since and revealed this fact, and that it was little over 6 feet long, not 12, as Petrie wrote.

⁵ Dr. Hubner, ed. of Prussian vol. of Latin Inscriptions, Nos. 131-141; Hib. Lect., iv, p. 126. Squire defines Nuada as Zeus and Ares in one.

⁶ Net, in Gaul, was only one war god of several; perhaps he had at one time in Ireland rivals in his position.

⁷ Dergthene, "red fire," was Cu Chulainn, suggesting his descendant's epithet Oilioll Aulom (Coir. Anm., Nos. 34-41).

⁸ See O'Riordan, pp. 8, 72. Egan was also named Neacht and Neacht Egan ("Magh Linn," &c.). For divine fosterers note Manannan as Cu Chulainn's foster father, and Dea⁹ Gae of Druic. For another Mag wife Nuada, the enemy of St. Patrick, see Sanctus Mag., c. p. 5. Gae may represent a contest with a priest of Nuada. A Mag wife Nuada was plundered by Asat: cf. Drom Asat in Co. Limerick. (*Ibid.*, p. 65.)

⁹ Mag, Neit, was a deity for the storage of food, and presided at fort digging ("Magh Linn," &c.). Another name of some divine ancestor, Art Inlech, built the forts below Slievoreagh (Coir Anm., p. 293).

¹⁰ Dr. Todd uses the signification, Wars of Gaelial, p. 19. "Eganmacht Ua n'Eoach (from Eochaid, son of Cass) Ua Neit."

was connected with Glenlara, in Luachair Deagaid. This is probably Glenlara on Cenn Febrat, for evidence shows that the great and holy hill was in that district before Luachair was curtailed.¹ Nuada Derg (or Salfota) was son of Dairine, ancestor or ancestress of the Ernai. The Dergthene tribes dedicated their chief cemetery and assembly place to the wife of Nuada's son, and their chief mountain home (Craglea) to a war goddess. Nearly all the southern tribal genealogies² meet in Nuada Argetlamh;³ from his son, Nochtá, sprang the Corea Laegde; from his son, Roma, the Muscraige; from himself the ruling races. All of these divergent lines meeting in the one point can never be a late fiction; they show that the warlike races of Munster gloried in it, and boldly asserted that they "were sprung from the War God's loins," and had the war goddesses for mothers of their tribes.

The glory departed from Nuada by the thirteenth century, though Lug and Manannán held their own. He and his son Tadhg became druids, not the stately hierarchs of the early ages, but tricksters and conjurers; and the author of the *Agallamh na Senorach* calls the great god of the rivers, "Nuada, a pestilent fellow and a magician."⁴

MANANNAN MAC LIOR.—"The King of the Land of Light, in the Tain bo Cualnge;⁵ the great sea god; the British Manawyddan, son of Llyr,"⁶ has not been found named in any Gaulish or British inscription; whatever be true of the British Nodens, the Irish Nuada has nothing in common with him. His name looms large in the legends of Clíu as of all Ireland. He is one of the most definite of the Irish gods; we see him, armed with his red and yellow spears, his terrible sword "Retaliation" (which never failed to kill), and his daggers. Clad in his magic breast-plate and helmet, the gems flashing back the light as his great horse, "Splendid Mane," whirls his chariot along, he is, in later tales, "the horseman of the crested sea."⁷ Drawn by the white-maned waves (his coursers, his silver-horned stags, his sheep, "the fleeces of the flock that knows no fold," or his many-hued salmon) he drives over the flowery fields of the sea, a glorious god, whom the Irish hold in love to this day.

So important was he that he and Bodb Derg of Magh Femen were

¹ See "Magh Leana," pp. 23-25, *Rev. Celt.*, i, p. 36.

² The Leinster men vainly tried to get Nuada Dearg put on their king list (*Eriu*, vi, p. 131, "Magh Leana," p. 3).

³ *Ms.*, T.C.D., L1, 3, 17, p. 173; *New Ir. Rev.*, xxvii, p. 137.

⁴ *Agallamh*, ii, p. 132. So the Morrighu becomes "a prophetess in forbidden knowledge and evil death" (*Leab. Gabhal*, p. 159).

⁵ P. 190; cf. *Ency. Relig.*, iii, p. 284.

⁶ According to Geoffrey of Monmouth, Leir perished in a flying-machine he had invented.

⁷ "Voyage of Bran," from *Book of Fermoy*; *Rev. Celt.*, v, p. 226; *Squire*, p. 70.

appointed to allocate the holy mounds among the two divine races. He gave the gods magic food and drink which kept them young¹ like the apples of Iduna. He, like Nuada, was broken into different personal forms—(1) “the son of Allot, the splendid wizard of the Tuatha Dé Danann”;² (2) Gaer; (3) Oirbsen of Aran, killed by a grandson of Nuada; Loch Oirbsen (Loch Corrib) broke out of his grave;³ (4) the son of Cerp and king of the Isle of Man, in the time of Conaire the king; (5) the son of Lir, the famous merchant of the Isle of Man, and (6) the son of Athlugo, who avenged the sons of Uisnech. He was, under the name “Oirbsen,” divine ancestor of the Clartaige of Kerry, and, under the names “Luguid” and “Connac,” of the Connaicene of Con maic(nemara).⁴ The renowned Mongan in the seventh century was his son by a mortal mother.⁵

There was a sinister aspect (as became a personification of the lovely but deadly ocean) in Manannán. He could not bear victims to be rescued from him. I am told that the father of the late Lord Morris and his sons had difficulties in preventing some fishermen on Galway Bay (usually the best-natured men) from forcing the survivors of a wreck back into the waves—“no man would have luck that tried to save them.” Horses with naked young men on their backs were driven into the same bay on Garland Sunday (the day of the questionable Crom Dabhl,⁶ perhaps the malignant god to whom Tigernmaís offered human victims), but they were allowed to return from the realms of the sea god. Perhaps his altars, like those of the pitiless Teutates, the horrible Esus and Taranis⁷ denounced by Lucan, were “no milder than those” of the Tauric Artemis. In a Welsh tale Manawyddan builds a fortress of human bones and mortar, and a beehive structure of many cells; this is at least suggestive of a grim side to the myths.⁷

¹ Atlantis, ii, p. 385; Ir. Manuscript Ser. (R.I. Acad.), i, p. 46; Agallamb, ii, p. 116.

² Leab. Gabh., p. 169.

³ “Death of Athirne” (Rev. Celt., xxiv, p. 272), Dind S. (*Ibid.*, xvi, p. 276.)

⁴ New Ir. Rev., xxvi, p. 136.

⁵ “Compert Mongain” in Voyage of Bran, i, pp. 24, 27.

⁶ Miss Maevola Redington recorded this interesting story. There is a prejudice against retreating a lot or any other vessel blown into the sea, on the same bay, as has often been noticed. There is much evidence for human sacrifice in ancient Ireland: on building a fort (Emon, Dun Eamys, cf. pig sacrifice at Dunfolline); or for Harvest (Tlacht and Tara). See R. Soc. Ant. Ir., xlv, p. 86, cf. Ir. Myth. Cycle, pp. 59-63: sacrifices to Crom Cruach, &c. (Mstr. Dind S., x, p. 275, Voyage of Bran, Appendix, p. 394). The Epic of the S. sentences men to die; he is perhaps a priest of the mound (Briden Dy Deora, Rev. Celt., xvii, p. 308). I have myself, as a child, “passed through the fire” at St. John’s Eve, near Artylan Co. Limerick. The Dindsenchas of Taltí mentions “the burning of the first-born,” as well as cattle sacrifices, at the Oenach till St. Patrick forbade it. Success boys were offered, and their blood mixed with the soil of Tara to ensure good harvests (Eriu, vol. ii, p. 155).

⁷ Squire, p. 70.

In Clíu, Manannán was the instructor and slayer of Fer Fidail, and the husband (or father) of 'Aine and Aife of Knockainey. In other tales his numerous sons love or wed these goddesses; but, as I shall try to show, these were coast stories brought inland, for the Knockainey stories have no such episodes. The Shannon was called from him "the stream of MacLir."¹

Cormac of Cashel, telling of him as a merchant of the Isle of Man, adds "the Irish and British call him god of the sea." He met the usual fate of the Celtic gods—as "Oirbsen the wizard," Uillen Red Edge, slew him in the battle of Cuillen. A Donegal legend makes him ask St. Columba if the *Síd* folk could be saved; the reply being in the negative, he cries that he will no longer help the Irish till they are weak as water.² In Co. Limerick the questioners are fairies and ask "Crom Dubh." Later writers made him a wizard, but, altogether, he resisted the hostile influences of Christianity better than any other god,³ and remains, in half secret belief on the Mayo coast, a being of great and dangerous power.

(E)—THE TRIBAL GODS.

Beside the great national gods there were a number of local deities, doubtless those of the pre-Celtic tribes. As their worshippers were absorbed, and genealogies invented to affiliate them to the stem of the conquerors, so such gods, in some instances, were affiliated to the divine race of Dé and Ana. Many were probably mountain and lake gods,⁴ a few, river gods, others tribal ancestors; but their connexion with the *Síd* mounds goes far to stamp them as divine, however "parochial" their cultus may have been. The goddesses, Echtge the horrible, who was reared upon children's flesh; Eibliu, daughter of Guaire; and Mer, daughter of Treg, undoubtedly were revered at Slieve Aughty, down to Feakle in Co. Clare, Slievephelim, and the Barnan Ele, or "Devil's Bit."⁵ They, however, are not connected with the group of Clíu, and would overcrowd an already overcrowded paper.

BODH DERG.—Of all the gods of Munster "Bodh Derg," by a general consensus, was ruler.⁶ This probably sprang from his holy hill of Slieven-

¹ Rev. Celt., xvi, p. 276.

² Sanas Chormaic, p. 114.

³ "Voyage of Bran," ii, p. 213.

⁴ Rev. Celt., xxxv, p. 6-9; Encyc. Relig., p. 6; Folk Lore, xxviii, p. 181. The Rennes Dind Senchas (Rev. Celt., xvi, p. 276) makes him a druid and a champion. In Achill he is "a king of druidism and enchantment and devil's craft." (Lanman's "Irish Folk Tales," p. 1.)

⁵ So the Gauls (like all nations) had their holy mountains where gods were called Paeninus (Pennine Alps), Vosegus (Vosges), and Dumiatus (Puy de Dôme). See Encyc. Relig., viii, p. 863.

⁶ Mesca Ulad, p. 15.

⁷ "Legend of Cacht," Book of Lismore (Eriu, viii, p. 35).

man being in the chief and oldest territory of the conquering Dergthene, as their special goddess, Aibinn, became chief banshee of Munster in later days. He was at least affiliated to the great gods of the Boyne, being "son of Aengus of the Brugh, called the Dagda"; but this was a confusion, as the Dagda, "Eochaid Ollathair, greyer than the grey mist," was evidently his reputed grandfather. There seems reason to believe that Oengus was a pre-Celtic god, unknown to Gaul and Britain, whose vast chambered cairn of Newgrange, the noblest monument of the Bronze Age in Ireland, impressed the early conquerors with reverential awe. Invading polytheists were ready to accept and bring into their own pantheon any local god. Even Israel took over the Baals, along with the vineyards and tillage of their worshippers; and the lion-worried settlers in Samaria, and the townsmen of Gezer, took over the worship of Jahveh. A local god "understood the country," and was worth winning as a friend.

As Bodb and the sea god divided the holy mounds among the gods,¹ each was evidently a "commissioner" for a different divine race. Others said that Bodb was "son of Eochaidh garbh, son of Duach temen, son of Bress, son of Elathair; which has this much in its favour, that the predominance of Nuada in the Dergthene beliefs may have brought his successor, Bress, into prominence, and, as we know Bress was celebrated in the legends of Cenn Eibhriat. A "Derg of *Sol Deira*" appears among the Tuatha Dé at Magh Tuirell, and in other legends, the Dagda, not Bodb, allots the mounds, and was himself proceeded in the ownership of the *Bran na n Eilemair* by Eilemair and his wife.²

Bodb, over the *Síd* assemblies of Munster," dwelt on the stately dome of Sliocuanan in southern Co. Tipperary, probably in the cairn on its summit.³ It has however a second cairn, an acknowledged *Síd*, on Knockshagowna, one of the spurs of the hill which bears the same name as another famous *Síd* hill, further north, in Bollingery parish. The great cairn is about 86 paces round and 9 feet high. Close to it (as at Uisnech) are remarkable natural rock-ways with a slab resting upon it, and called "Finn's table," 5 feet 4 inches by 4 feet 6 inches by 3 feet thick; and, farther south,

¹ Ir. MS. Series, R. I. Acad., i, p. 46. We also find Bodbh Derg and the god Midir presiding at a council meeting of the Tuatha Dé, *Silva Gadelica*, ii, p. 116.

² *Silva Gad.*, ii, p. 522.

³ Also aided Conn at Magh Leana ("Magh L.," p. 90); see also "Cath Finntragh," pp. 13, 239; "Coir Anmann," iii, pt. 2, p. 235.

⁴ *Dinds. of Carn Chonaill* (Rev. Celt., xv, p. 478); *Book of Fermoy* (Ir. Texts, R. I. Acad., i, p. 46); *Encyc. Relig.*, iii, p. 283.

⁵ On the *Sliabh* Hills in S. Co. Wick each dery was associated with a peak on which was a stone circle, barrow, or cairn.

resting on four pillars, is another stone, 7 feet by 4 feet.¹ These probably mark Bodb's holy place. Nuada Derg had a fort on the same mountain, and may, perhaps, have been identified with Bodb Derg² if the Dergthene tribe took over the worship of the god of Slievenaman. The hill, as we saw,³ forms a conspicuous and beautiful landmark, when looking down the vale of Aherloe, from the hill of the goddess Aife, over Gleneely and Duntrileague.

Bodb seems to have had two residences—the *Síd*, so widely celebrated as *Síd na mbann*, *Síd bann finn os Femen*, and *Síd Femen*; and a second, somewhere near Loch Derg. Some said he was brother of the goddess Dechtire, and uncle to Cu Chulaind.⁴ He was a god of the more amiable type. When pressed to let his attendants pursue and wound Ler, the sea god, he, with calm dignity, forbade it, saying, "I am none the less king of the Tuatha Dé Danann because he is not submissive." He also controlled his anger when the wicked Aoife said that her husband Ler would not trust his children with him. Like Lug, he is called "one to whom all science has done homage."⁵ He had friendly relations with the mortal rulers of the land, and made a treaty with King Conn of the Hundred Battles, undertaking that neither he nor the Tuatha Dé under his rule would injure the king. Fer Fi of Ainc was a hostage, or perhaps a guarantor, of the treaty. From his taking the place of Nuada Derg in some versions of the Mog Nuadat legend, I venture to suggest that the Dal Cais endeavoured to identify the chief god of their new settlement with the more familiar god, Nuada, whom their ancestors had worshipped before their invasion of Ireland.

Bodb had a numerous offspring.⁶ His "seven sons" and his "three sons" are named. Among his children are Ferdoman; Artrach, who had a *bruiden* of seven doors, and a *liss*, Rath Artrach, once resplendent, but blighted even in Finn's day. Bodb's daughter, Sadb, was plighted to Finn at *Síd Femen*;⁷ but (of course in so evidently late a poem) she was mortal, and her death was announced to "her highborn kinsmen" of the *Síd*, the Tuatha Dé. Bodb's three sons were born in his father's *Síd* at the "many-windowed *Brugh* of the Boyne."⁸

¹ Ordnance Survey Letters, Co. Tipperary (R. I. Acad., 14, F. 18), i, p. 170. One recalls the altar of Zeus on Mount Lycaon, a mound with two pillars facing the sunrise, as described by Pausanias.

² "Magh Leana," p. 3.

³ *Supra*, xxxiii, p. 479.

⁴ Book of Leinster, p. 123b.

⁵ "Fate of Children of Lir" (Atlantis, iv, pp. 115-131).

⁶ Book of Fermoy (Ir. Texts, R. I. Acad., i).

⁷ The poems connecting Finn with Slievenaman are endless, but more striking is Keating's note of Suidhe Finn on that mountain (History, ii, p. 325).

⁸ Agallamh, ii, pp. 106, 171, 225.

Bodb's dependents were less estimable. He kept a sort of training college, which gave "*Síd na mBan*," its name, "the mound of the women." Legend speaks unfavourably of the management. Bodb's own daughter was abducted; so was Delibanna, Conaire's attendant, the wife of Life and daughter of Canann;¹ and Finnachta, who was carried off from it by Seungmann so late as the reign of Dathi, in the early fifth century. Some said that Conula, son of the High King, Conn, when he was lured away by the lovely woman of the *Síd*, went with her, not beyond, or beneath, the sea, but to *Síd Bodb*, by which *Síd Bodb* is probably intended.² Clíu tried to lure Conulann, another daughter of Bodb, out of it.³ In it, too, was educated Aife, the cruel wife of Ler, who turned his children into swans.

Another scandal was attached to *Síd Eir Finnea*, if it be the same place, on the second coast, when, during the absence of Oengus, son of the Dagda, on Sandhuin night, the god Maui carried off to it the unfaithful wife of Oengus, Eir, the daughter of Eilman. Len Lantuilach a retainer of Bodb, of *Síd Finnea*, gave his name to Loch Léan, or Killarney Lake, in Luachair Deasaidh.⁴ His servants were also of doubtful character. His swineherd, "Nose-sputting-with-the-left-eye" sits cooking squealing heads of pigs over the fire and bringing bloodshed to every feast which he "graced" with his presence.⁵ Two other swineherds, Fín and Ríocht, were turned to ravens.⁶ Yet another, Tunnac (in the form of a many-coloured beast), was swallowed, and became the Donn Peil of Chaluga, as he revealed to King Ailill.

It seems doubtful whether the second residence, *Síd Bodb*, was near Portunna or near Killakee. It was beside Loch Derg. Perhaps it was the mountain rings above Ferry Castle, or even the *Síd* of Craglea; but I have no evidence. Tra Buidh Derg, on Achill, also bears his name.

I have nothing but the mere dream of O'Curry to regard Bodb Derg, king of Magh Femen, and his namesake the son of the Dagda of Loch Derg, as different persons. O'Curry had a childlike faith in the historic character of the Tuatha Dé. In the "Dream of Oengus" the king of Magh Femen catches Oengus on his own ground, when he wins him the swan maiden on the lake in the Galtees.

¹ "Magh Leana," p. 1 (and "Tochmarch Momera," p. 155); Rennes Dind S., Rev. Celt., xv, pp. 303, 318; Atlantis, iv, p. 119. I do not know whether it and the "*Síd* of the good Femen" be the same, or whether they be the two courts of Sleeanaman and Knockshegowna.

² Silva Gad., ii, p. 534.

³ Metr. Dind S., x, pp. 41-43.

⁴ Rev. Celt., x, p. 446. Noisiu, son of Nechtan Findguala, was also connected with the lake. (*Ibid.*, xvi, p. 79 and p. 451.)

⁵ Rev. Celt., xxii, p. 313.

⁶ "Voyage of Bran," ii, p. 58; Folk Lore, xvii, p. 166.

⁷ Atlantis, iv, pp. 156, 169n.

Bodb is nearly forgotten, but, like most local "fairies," clung to his own home, and won some little meed of recollection down to the last century.

CAIRBRE MUSC.—The Muscraige tribe bears all the mark of having been broken up by a series of invasions; "islands" of it persisted through Munster, Muscraige Liac Thuill, or O'Noonan¹ of the Ui Fidgeinte in south-west Co. Limerick; Muscraige Mitaine, in Clú among the Mairtene, in the Galtees; in Muscraige Treitherne, Muscraige Chuire, Muscraige Tire, and Muscraige Breogain, in Tipperary, Muscraige Luachra, still Muskerry, in Cork, and small fragments at Tontinna on Lough Derg, in east Co. Limerick, in Magh Femen, and elsewhere.² There was some close bond between it and the Dergthene, especially with the Dal Cais. In legend it was closely connected by descent with the Corca Duibne in Kerry and the Corca Baiscinn in Co. Clare. When the tribal genealogists attempted to "regularize" the position of non-Milesian tribes long before the euhemerist movement, they divided the family god, or eponymus, into a triad, the eldest of whom was (Oengus) Cairbre Musc. But so far from the group belonging to the third century, the *Tain bo Cualnge* mentions "the three Cairbres from Clú" as warriors of fame. More than two centuries earlier legend made them sons of Conaire, High King of Ireland, successor of Conn of the Hundred Battles,³ "B.C. 82." His legend⁴ was certainly pagan, and outraged all Christian ethics. His epithet *Musc* was wrenched into *Mo Aisge*, "inordinate desire," for the Muscraige sprang from him and his own daughter, Duben, or Dovin, whence Corca Duibne. The territory covered the modern Coreaguiny and Iveragh to Valencia Island (Dairbre). In the former section we find several ogmic inscriptions with her name, "Maqi mucoi Dovinnias," one on a noble site, on the entrenched headland of Dunmore, overlooking the Blaskets. It seems very clear that mythology ran mad on this legend. Duben was possibly (as seems implied) the mother and then the daughter of Cairbre; then, to get out of the vicious circle, she was turned into a son. Cairbre's name was equated with *Corbad*, parricide, by some local Fluellyn. His name was said to have been Angus, and he and his brother slew their stepfather, MacNiad,⁵ in the arms of their mother. They were close allies of her last

¹ "Sabas Chormaic," p. 127. The name "Muskry O'Noonan" is extant in the Elizabethan Surveys. For the race of Conaire mór and the coming of the Muscraige from Magh Bregh see Eriu, vi, p. 138, from Books of Lecan and Ballymote. Muscraige tri muige is the Aes tri maige in N.E. Co. Limerick.

² See notes on O'Huidhrin's "Topographical Poem" and the Onomasticon Goedelicum.

³ *Loc. cit.*, p. 351.

⁴ Studied in R. Soc. Antt. Ir., xi, pp. 184-5.

⁵ Keating, Hist., ii, sect. xli, p. 278, tells another story, where Cairbre Musc slays his stepfather Neimidh in his mother Saruit's arms—another proof of the varying nature of these tales. He derives the epithet *Mo Aisge* from this event. See also Eriu, vi, p. 143.

husband, Oilioll Aulom, and Fiacha, his favourite grandson, gave Cairbre Muse all eastern Co. Limerick from Aine to Lough Derg. The mythology of Cairbre Muse seems to have no foothold in fact, and abounds in contradictions. On the birth of his misbegotten sons all nature sickened, and the crops failed. The tribes ordered that the children should be burned, but a druid saved one, Core, putting it on a red cow's back. After a year the sin entered into the cow, who swam out to sea, and became the "Cow Rock," *Bo Bui*.¹ Rhys,² in a very elaborate study (which students should master and assess for themselves), equates Cairbre cinn clait, Cairbre, father of Ere; Cairbre, the enemy of Bress; Cairbre Muse, the owner of the dog, "Mug Eime," and Mac-Kineady (the slayer of Balor, in the Torry Island legend), with the Gaulish "Mercury" and Lug. Be this as it may, Cairbre Muse is evidently from first to last a mythical personage and a tribal god of any date before the time of the Raid of Cuallge to the third century. We are confronted with a difficulty. Keating³ alleges that the descendants of Conaire alone were the Ernai. He tells how Mog Nuadat expelled the latter from Munster, "so many as would not submit." Conaire had an ancestor, Dame Doimhar, who was possibly confused with "Dame" or "Darine" in the Clann Dedad and Corca Laéghde pedigree. Conaire may be confused with another High King, Conaire Mor (c. 110, son of Eilherseol, a descendant of Dezag, son of Sin, and of Oilioll Erann, and successor of Nuada Necht), from whom the Clann Dedad claimed descent. The three tribes possibly were branches of the Ernai by descent or affiliation. Indeed, the *Insularia* of Ptolemy seem to overspread all south-west Ireland up to the Velleaun. The latter have of late been placed as far north as Tirree, but their position may be anywhere from Iveragh to the "Dour."

CLU.—Another eponymus of the extensive district of Clú mhail mhic Uigine, in south-east Co. Limerick and along the Galtees to the Suir, meets us in our district. The naglay mountains bore his name, *Crotta Cliach*, "the haps of Clú," which I venture to suggest are the two hump-like *cooms*, with strags and traces of strom gullies, seen on the flank above Aherloe. *Crot*, however, is probably a pre-Milesian word, as a tribe named Crotraige dwelt along the foot-hills, and the name possibly gave rise to the folk-tale. Clú may have been connected with the goddess Chlúa, for the Mairtene, another non-Milesian tribe near the Galtees, were called "the champions of Clú and the contentious hosts of Chlúa,"⁴ suggesting such terms as "champions of

¹ "Leabhar na hUidhre," 54a, and "Book of Leinster," "Magh Leana," p. 28. The name Bui is found in the Portolan Maps, 1450 to 1593 (Proc. R. I. Acad., xxx, p. 417).

² Hib. Lect., iv, pp. 317-321.

³ Hist., Book i, sect. xl (Ir. Texts Soc., viii, pp. 231, 263, 269).

⁴ "Magh Leana," pp. 77, 78; the passage in our present copy possibly refers to the

the *Síd*," "champion of the cairn," "champion of Segomo," and "champion of (the goddess) Nar."

Legend tells how Clíu was a harper who came to Baine's *Síd*, a place so sacred that the very "Book of Rights"¹ forbade anyone to walk on it "by the light of red fire," like the mounds of Slievercagh, that men dared not sit upon "for dread of the Tuatha Dé,"² and the procession with flaming "wisps" at Aine's mound. Clíu became harper to King "Sinirdub," and used to play on two harps at once, whence the mountains were called *Crotta Cliach*.

He went to the "*Síd* of the Men of Femen," where Bodb dwelt, to carry off his daughter Conchenn. The inhabitants tried to drive him off by magic, but in vain; so, after a year, the lady Baine lost patience, and sprang out in dragon's shape, when Clíu died of the fright. Hence the lake was called "Loc bel draccon."³ It was evidently not the place of its name in Westmeath, but the lake in the Galtees, at which Oengus of the Brug, aided by Bodb Derg, won his swan-wife, "Caerib Ormeith," daughter of Ethal Anbual of *Síd Uamain* in Connacht, whom he found with her transformed maidens sporting on Loc bel draccon.⁴ The *Leabar Breac*⁵ tells a nearly identical story, but the king is called "Smirdubh mac Smáil" of the Three Rosses of Sliab Ban, and Clíu seeks Bodb's daughter at *Síd Femen*, till the water bursts up under his feet, and forms *Loch Béal Scud*, on the mountain. On this "Coerabarboeth," swan-daughter of Ethal, and her fifty companions float; it is also "Loc Crotta Cliach" and "Loc bel dragan." It is evidently some lake, still unidentified, on the Galtees. Rarely in Western Europe do we tread so closely in "the footsteps of the dead old gods" as around Cenn Febrat and the Galtees.

CUIL AND NECHTAN.—Nechtán and Nuada Necht are sometimes taken as son and father, and sometimes as identical. Nechtán encouraged the family of Eogabál to settle on Knockainey; and Cúil, wife of Nechtán, was patroness of the chief cemetery and fair of the Dergthene, called 'Oenach Chulimma, Nechtain, and 'Oenach Clochair.⁶ Nechtán brought the first pregnant cow to

districts, the word *Nia* not occurring—yet there is no evidence for a district of Clíodhna near Emly in the Mairtene territory.

¹ "Book of Rights," pp. 5, 21, the present Knockmany, a Bronze Age cairn chamber. There was also a Cnoc Maine near Killinuan (*Silva Gadelica*, ii, p. 123), probably the place referred to as *Síd Bain* in the Clíu legend. Could it be the mound of Killinuan?

² Agallamh, ii, p. 124.

³ Rennes Dind S. (*Rev. Celt.*, xv, p. 441).

⁴ "Dream of Oengus" (*Rev. Celt.*, iii, pp. 347-355).

⁵ "Manners and Customs," p. 246.

⁶ The place-name "Sciath Nechtain," where Olchobar, king of Cashel, defeated the Norse in 847, suggests the disc barrow of "Cu Chulaind's shield" at Tara and "Sciath Gabhra" where the MacGuires were inaugurated. There was a "Sciath na bfeart" (shield of the burial-place) in Roscommon, and another "Sciath Nechtain" in the Eoghanacht territory.

Ireland,¹ and the euhemerist Flann (in 1050) says he was killed by Sigmall, grandson of the god Midir;² but this is of the warped stratum of legend, not found in the early myths. Some (by the q to p change) identify him with Neptune, but this is more than doubtful; and unless he is Nuada (with whom even then we have to go back to Nodens, in Britain, to find him a sea-god), he has no connexion with the ocean. Old writers equated *Necht* with *Snecht*, snow, because "Nuada Necht was as white as snow," a folk derivative.³ He was certainly Nuada, "fair head" or "red hand," a king of Munster, whose rival, Bress, was slain by Lug's device at Carn Ui Neid,⁴ for Nuada Argetlamb is superseded by Bress, and the king of Munster seems to be Nechtan. Nuada his wife Beand, and son Nechtan, all abound in epithets like "white" and "silver."

Nechtán reckoned the Corca Laegle amongst his human descendants. They owned a fort, Dun mic Nechtán, near Kenmare. I fancy the Co. Clare fort, Cahermacnaughten, is named from a human family. Near Kenmare "River," Inlur Sene, dwell also a namesake, a lady, Necht.⁵ He and his three cup-bearers could alone approach to look on the sacred well at the source of the Boyne and a Loch Nechtán (so far unidentified) lay among the Echtge Hills.⁶ Despite her evident importance, I have so far found no legend of Cuil. She may lurk under an alias name, for what was told of the Hazel Well and the fate of Nechtán's wife Beand was also told of Sinann, Macha, or Dairbhine, the Shemnon goddess, who had many alternative names.⁷

As regards Sinann, her sister "Lechtach" is often confused with "Echtge the Horrible" the goddess of the mountains of Echtge, who was reared on children's flesh, and was given the mountains by her lover, Fergus Lusca Boist. The latter was cup-bearer to Gann and Genann,⁸ who, with Sengann,

¹ Egerton Mss., 138; Catal. Irish Mss., Brit. Mus., p. 640; R. I. Acad. ms., 23. D. 13, p. 146.

² Leab. Gabh., p. 183, "on the Deaths of Tuatha Dé."

³ Dr. O. Shrade, "Prehist. Antiqq. of the Aryan peoples," ed. F. Jevons, p. 412; Hib. Lect., iv, p. 123.

⁴ *Irische Texte*, iii, 368; *Folk Lore*, xvii, p. 30.

⁵ *Rennes Dind S.* (*Rev. Celt.*, xv, p. 439); *Metr. Dind S.*, x, p. 216.

⁶ *Rennes Dind S.* (*Rev. Celt.*, xvi, p. 83).

⁷ The name Nechtán is found among the Uí Fódgorta in Co. Limerick in historic times.

⁸ Beand (it should be noted) comes from the South to Meath (*Metr. Dind S.*, x, p. 37; *Beand I.*). Nechtán Nuada's son of Lalauad, whereas in Beand II he is son of Namat; see also *Rev. Celt.*, xv, p. 430.

⁹ *Rennes Dind S.* (*Rev. Celt.*, xv, p. 458); *Metr. Dind S.*, x, pp. 305-7. In *ms. R. I. Acad.* 26. D. 16, p. 411, is an amazing discovery, an Irish inscription found on a coffin with a skeleton 5.2 feet long of Ossian, King of Ireland, at Breda, Co. Mayo, in 1732. This was written in 1776, and dated 1846! Gorman had seen "9 feet high." His brothers Gann and Sengann dwelt at the Inlur Dairbhine near Lennagh, in Co. Clare (*Erm.*, viii, p. 13).

were eponymi of the tribes in Co. Clare and Connacht, called *Ganganói* by Ptolemy. She was of the Tuatha Dé, and reared at Cuil Echtair, near *Síl Nennta*.¹ Altogether, the important position taken by the Irish goddess corresponds to the high position of the mortal women, queens, and warriors, like Boudicca and Medb. It is notable that great sanctuaries, like Knockainey and Oenach Chuli, are called after women, and that Carman, Tea, Macha, Tailti, and Maistiú loom so large at Carman, Tara, Telltown, Emania, and Mullaghmast. Human sacrifice was offered at Emania, Tara, and Tailti, perhaps to the mother goddesses of the harvest.

DEDA, GARBAN, AND FEBRA.—The great plateau of Cen Febrat, or Slieve-reagh, so prominent an object over all eastern Limerick, was, as we saw, the chief cemetery of the Erann, or Ernai, the Clann Deda, and Corca Laegde. All the outstanding names of their mythic ancestry, save Deda² and Curoi (the latter presumably buried at Caherconrigh), are attached to its monuments and mark it as the great cemetery of the Ernai at Temair Erann,³ so wrongly placed by O'Donovan as near Castle Island. In the later frantic attempt to unite all the tribal genealogies, the Ernai and Muscraige are given "Aillil Erann, the god of the bolg ga,"⁴ as common ancestor; but, in most documents, the Clann Dedad Ernai derive from Deda, son of Sen. Sen⁵ was probably father of a large group of gods of Mountains and Lakes; Deda gave his name to the Clann Dedad, or Degaid, and to Luachair Dedad.⁶ Sen was son of the High King, Eochu Airiúmh, "who was seventeenth in descent from Ugaine Mor, and first dug a cave in Erin,"⁷ and reigned from "B.C. 125 to 110," according to the chronologers. Deda and his brethren of the Clan Rudhraighe were expelled by the line of Eremon from Ulster. They fled (in one story)⁸ to Duach, King of Munster, who gladly received so valuable an army and gave them lands, so they became the Ernai (Ptolemy's Iouernoi). When Duach died, the High King Eochu Feidlioch (Queen Medb's father),

¹ Some made her daughter of Deda, son of Sen (see *infra*).

² Are the Clanna Deagaidh of Deda's line the Clanna mac Deichead or Maqi Deceddass of the ogmic inscriptions? (R. Soc. Antt. Ir., xxxii, p. 30, and R. I. Acad. Proc., xxvii, p. 339.)

³ Tract on the cemeteries. Cf. Metr. Dind S., x, p. 227. See section at end of this paper.

⁴ New Ir. Rev., xxvi, p. 133. He appears in three places in the tribal pedigree—at the beginning, in the middle, and some generations after Deda—another proof of the uncritical usage of old material by the genealogists. Keating makes him 9th in descent from Ugaine and 8th in ascent from Sen.

⁵ Sen was in some documents one of a triad Deitsin, Sin and Roisin, e.g., Keating ii, p. 289.

⁶ Vol. ii, pp. 229, 235, 237.

⁷ Keating, ii, pp. 158, 184, 229. Todd Lect. Ser., iii, p. 197; Metr. Dinds., x, p. 241. Keating ii, p. 158, p. 229; Ossianic Soc., v, p. 288n.

B.C. 137, confirmed Dega as King of Munster, to which he had already been chosen for his prowess;¹ but others said he was confirmed by Lugaid Luaigne, grandson of Nia Segamain,² so he became an eponymus of the Clanna- or Corca-Deagaid,³ "many a spear was in its host in the time of Deda, son of Sen."⁴ So far the story is moderate and even probable, especially if the invasion of the Mile tribes took place not long before our era, as some have supposed. The Ernai Dedad, with the Ultonians and the Feini of Tara, were named as "the three noble races" of Ireland in the *Senchas Mór*.

Dega had forty sons; chief of these was—(1) Daire,⁵ father of the famous Curoi, King of Munster, in the Red Branch⁶ tales. Curoi was rival of Cu Chulaind, by whom, and by the treachery of his wife, Blaithnaid, he fell;⁷ and his son Lugaid avenged him by slaying the "Hound." Forgoll, another son of Daire, was ancestor of Finn and Oisín; and Lugaid, a third son, had a wife Eithne, said to be buried in the group of disc barrows at Cooloughtragh in Temair Éramu. (2) Taeth, from whom Cáin, son of Fergus "Fer Deda," was named "Mogh Taeth"; probably both names are dedicatory to the god Deda and his son. (3) Iar, father of Eterseel, father of Conaire. (4) Fir Ceit, ancestor of the Dal Ceiti, in Munster. (5) Cleite, who died at Cletty, on the Boyne, named after him. (6) Dea, from whom Inbir Dea, the Vartry mouth, was called. (7) Garban, or Garman, from whose grave burst Loch Garman, or Wexford Harbour. (8) Senach, who gave Sliab Mís (Mish) to his bride, Mís, daughter of Cairid. He died, and was buried in his rath there. (9) Ross, the famous Red Branch warrior: he took part in the overthrow of the sons of Urmóir. (10) Coengín Hornskin, in some versions, is said to have married Mís, and given the mountain to his brother, Senach the Rough. (11) Coengín Ghness, perhaps the same as the last, avenged his "brother" (nephew) Curoi, and devastated Ulster till Celtchair of Downpatrick slew him with red-hot spits. (12) Cabadglinni, or Faelglinni, the senior of the tribe in the *Messa Ulad*. He also had a daughter, a mountain goddess,

¹ "Cathroim Conghal Clairingneach" (*Ir. Texts Soc.*), pp. 2, 3.

² *Rawl ms.*, 502, p. 148n.

³ *Rev. Celt.*, xx, p. 336.

⁴ *Metz. Dind S.*, x, p. 236.

⁵ Usually identified with MacNadh's grandfather Daire (Keating, iv, p. 115, *Genealogy of O'Driscoll and Miscellany of the Celtic Society*, "Corca Laidhe," pp. 25, 9, &c.)

⁶ *Loc. cit.*, p. 80.

⁷ *Rennes Dind S.* (*Rev. Celt.*, xv, p. 448, and much other material. For the other sons (2) *Cor Ann.*, p. 497; (3) *Metz. Dind*, x, p. 241; (4) *Proc. R.I.A.*, xxix, pp. 81-87; (5) *Book of Leinster*, f. 166b; (6) *Rev. Celt.*, xiv, p. 429; (7) *Rev. Celt.*, xv, p. 428; (8) *Rev. Celt.*, xv, p. 445; (9) *Ibid.*, p. 478; (10) "Death Tales," *Todd Lect. Ser.*, vol. xiv, p. 27; (11) *Metz. Dind S.*, x, p. 241; (12) *Messa Ulad*, p. 41.

Echtghe the horrible.¹ There are a number of variant tales²—the Coir Anmann³ tells how Duach Dallta Degad, son of Cairbre Lusc (the lame) and ancestor of the Dergthene, had two sons, Duach and Degad (B.C. 168). The latter, being the popular candidate for the kingship, was blinded by Duach. Another story tells how Duach fell by the Ulstermen and Degad, son of Sen, King of the Ernai. The hero Finn descended⁴ from Daire, son of Deda; while his mother, Murni, was derived from Tadg, son of Nuada, son of Achi. Clann Deda held all Luachair⁵ to Curoi Mac Daire's fort on Cen Febrat. Though Deda is nowhere (to my knowledge) called a god, he seems ancestor and father-in-law of a number of eponymi, mountain gods, and connexions of gods. His fame grew on no mortal soil, but is all mythic and superhuman; we need hardly look for a nucleus of fact, if such ever existed. Deda's issue, Corco Deda and Corca Muige (both in western Co. Limerick), are in the list of the Aithech Tuatha.⁶ Probably the pre-Milesian tribe had its own divine beings and ancestry which later scribes tried to euhemerize and connect with those of other tribes.

Febra, son of Sen, Deda's brother, was slain by Caín Dercedualach, husband of the goddess Aife, sister of Aine and Fer Fi; from these heroes the mountain derived two of its names, Cenn Febrat and Sliabh Caín. Garban, son of Dedad, slew his uncle's murderer, and he and Febra, when the gods became mortal, were reputed to lie under two of the pre-historic mounds in Temair Erann cemetery, probably those to the south-west of the spring at the gorge of Glounacroghera.⁷ South from them, Lugaid Laigde, the eponymus of the Corca Laigde, was buried. Garban's other grave, the source of Wexford estuary, we have already noted; he is called "Garman Glas Mac Degann," so his identity is well established. Eithne and three other ladies lay in the conjoined rings of Couloughtragh. She was niece of Curoi. Erc of Irluacra probably lay in the mound in Ballinvreena.⁸ This

¹ Metr. Dind S., x, p. 305. The "Cath Ruis na Rig" (Todd Lect., iv, p. 23) names a contemporary of Curoi, Eochu, son of Luchta, king of North Munster, and the Recartaig Dedad, at Temair Luchra.

² The genealogists ring many changes on Sen, Deda, Daire, MacNiadh, Lugaid, MacCon, and Lugaid Laigde, and move their period over a space of thirteen or fourteen centuries in some instances.

³ *Irische Texte Ser. iii, pt. ii, p. 292.*

⁴ "Duanaire Fionn" (Ir. Texts Soc.), introd.; Yellow Book of Lecan, col. 768; Ossianic Soc., iv, p. 284; Silva Gad., ii, p. 245.

⁵ Mesca Ulad, pp. 17-19.

⁶ Rev. Celt., xx, p. 336.

⁷ Metr. Dind S., x, p. 231, p. 247; Rennes Dind S., Rev. Celt., xv, pp. 115, 442; *supra*, xxxiii, pp. 460-466.

⁸ Possibly Erc, son of Feidhlimidh, drowned in a lake (Miscellany, p. 61).

section gives a faint impression of what a rich mass of legend must have existed about Luachair and its "altered gods."

Now I have used the term "Ernai," not only for the Corea Laegde, but also for the Clann Degaid, and Keating (ii, p. 313) says that it was wrongly applied to these, and should be only used for the descendants of Conaire Mór, the "Museraige," Corea Duibne, and Corea Baiscoinn. This seems doubtful; it is evident that the Clann Dedad and Corea Laegde had the same cemetery and sanctuary on Cenn Febrat, and occupy the very position where the "Iouernoi" are shown by Ptolemy. The Corea Oiche, possibly, are also of this kindred, though they, like the Ui Fidgeinte and the Corea Laegde, affiliated for political reasons in later years to the Dergthene tribes. The *Sanas Chormaic* (p. 16) speaks of the Corea Laegde or "Dairfhine" as descendants of "Daire Dointhech," and it seems evident that an early pedigree existed in which he appears with certain gods and ancestors—Lug, son of Ethleann, Deaga, Sithbolg, Nuada Neacht, and a group consisting of "Daire Símhreachtech, Lugaid Laide, Lugaid mac Con, Mac Niad, and Duach," and a Sen Lugaid. Dairine was equated with Daire. The pedigree was old enough to find a place in the *Saltair* of Cashel. When the Corea Laegde tried to draw nearer to the Clann Degaid, they naturally identified the pedigree names with the latter's ancestors, Sen, Deaga (Deda), and Daire.² Lugaid Laegde was placed sometimes as fifteenth in descent from Ith (circa B.C. 900), sometimes a contemporary of Eogan and Art (about A.D. 300); Daire was first called "King of the West," then "King of the World," and reached the zenith of his power in the Cath Finntraga, when he invaded Conculbne. The *Book of Leana* made him father of Mac Con and the three Fothais, mythical kings of Ireland (A.D. 296). Finally, it is evident that, when the Dergthene tribes of Cashel and Thomond became powerful, the Corea Laegde inserted "Dergthene" into their own pedigree as a common ancestor, as the Trairaga, after attempting apparently to affiliate to the Clannage and Corea Baiscoinn, asserted their kinship to the Eoganacht of Cashel to win favour of the powerful King Fedlimid,³ about A.D. 840. When we recall the extremely mythical legend of the three Cairbres, we see that we are not to let such tales weigh against the general fact that, like Crimthann, Nia Nuir "of the Ernai" at the beginning of our era (one of whose fets stood on Slieveragh near the Ernean cemetery), the term "Ernai"

¹ Identified by some with Lughaidh Laeghde "Magh Leana," p. 9.

² *Museology of Celtic Soci.* ("Corea Laide"), pp. 4, 5, 9, 57, 59. Cf. pedigrees of Duaid MacFirbis, Roderic O'Flaherty, in "Ogygia," and Keating, iv.

³ R. Soc. Ant. Ir., xxvii, p. 497. The Corea Oiche and Corea Muicheat are of the Atheach Tuatha at first, but are affiliated to the Dal Cass after 890.

may be applied, like the term "Fir Bolg" or "Milesian," without any allegation as to blood kindred in the races so described. In Daire, Ded, Mís, and probably Lugaid Laegde we are dealing with gods, or demigod ancestors, not with facts.

DERGTHENE.—We find in the Ancient Laws¹ that "deirbhíne and deirghíne" were tribal divisions, so one suspects that the ancestors from whom the Dergthene and Dairfhine are named were mythical and not even personal.² Perhaps the descendants of Nia Segamain, in the flush of their invasion of Magh Femen, called themselves "*The Tribe*." In some of their pedigrees, indeed, a triad "Dergfhota, Deirgthenic, and Deirg"³ take the place of the single ancestor, the father of Mog Neid. The Corca Laegde pedigree makes him son of Nuada and great-grandson of "Lug mac Ethleann," a god confessed. "Dairine" may also have been a goddess, as the name is identified with Macha⁴ and Sinann. We find a Corc, son of Dairine, a king of the Corca Duibne, who accompanied St. Patrick to Ulster in late story.⁵ Dairine was also father of Nuada "Dearg" or "Salfota," foster-father of Dergthene's grandson, Mogh Nuadat,⁶ and has been identified with Daire, son of Sen. Lugaid mac Con, who is seventh in descent from Dergthene, is contemporary with Oilíoll Aulom, fourth in descent from him—the name Lugaid being as common in the one pedigree as the epithet *Dearg* in the other. Nothing can show more clearly that these and similar tribal pedigrees are built out of disconnected fragments, not consistent or truthful, but real, archaic tradition, warped, but not pure fiction, and so worthy of critical study.

DONN.—This god has the merit of being free from the family complications of the divine fathers of tribes. Donn Firinné⁷ and Aine are the two ancient deities who hold their own in Co. Limerick as Donn Dumach and Aibinn do in Co. Clare. The word *Donn*⁸ has yet to be studied. It occurs in many a guise among the deities of Gaul, Britain, and Ireland, and is not merely the name of men-like gods (of both sexes), but of the Donn Bull, in

¹ Ancient Laws of Ireland, iv, pp. 282-3.

² Sanas Chormaic, p. 55.

³ Book of Lecan, f. 215, also "Miscellany" ("Corca Laidhe") as Dergthenedh, Deagha Dearg, and Deadh manra, son of Sithbholg, p. 57.

⁴ Thus Duben, the sister-wife of Cairbre Musc, was made his son, and Lugh's mother, Eithliu, became his wife, Eithniu. Dairine was Macha, Nith, Neuman, and Baddh (Rev. Celt., xxii, p. 58); Mo Febhis, whose son is Mog Ruith, is mother in L. na h-Uidhre, 74, and father in Ann. Four Masters, A.M. 3751. Hib. Lect., p. 526.

⁵ Agallamh, ii, p. 198.

⁶ "Magh Leana," pp. xxi. 2, 117.

⁷ Firinné, the name of a Spanish Druid (*ibid.*, p. 165).

⁸ "Social History of Ancient Ireland," i, p. 262. Dr. Joyce regards him as a son of Mil. The name "Donnus" is found in a Gaulish inscription at Nimes (Rev. Celt., xiii, p. 303).

Ireland, and its counterpart, the Donnotaurus in Gaul.¹ The Bull of Cualnge and his rival were reincarnations of human beings, and the step "from his brother the beast to his brother the god" was a short one in the ancient faiths. There are a great number of supernatural persons named *Donn* in later Irish literature; perhaps local forms of the same god. In the "Battle of Ventry"² we have a list of the (human) Tuatha Dé, who hasten to defend Ireland against the allied armies of the whole outer world. Seven bear the name, Donn from *Síd* *bee* Uisge, Donn Fritgrinne (? Firinne), Donn Teimneach, Donn Senchnuic, Donn Chnuic an dos (evidently two hill gods), Donn of the Sandhill (Dumach, now Dough, on Liscannor Bay, Co. Clare), and Donn of the Swamps. In the "Triumphs of Congal Clairingneach,"³ appears Donn, a *Síd* king, son of Ionchad, descendant "of the Dagda, of the prime stock of the Tuatha Dé Danann." Another Donn, son of Fionnlaoch,⁴ brought 100 women from the *Síd* of Aed (Assaroe, Donegal), to the *Síd* of Mís (on Slievemish, in Kerry). Among them was Aedh's wife; and she, jealous of her rivals, turned them into deer, and Donn into a stag, which was eventually slain by Bran and Finn's other hounds at "Cenn Maghair," on the coast. The *Bruden da Dorga*⁵ has a Donn Fetscarach of the *Síd* mounds; the Agallamh has Donn, son of Midir, whose *Síd* was assaulted once a year by the Tuatha Dé.⁶ Irish gods (like those of Greece) did not hesitate to fight their own kindred, or we might suppose him of some other race. We are also told that Lir of *Síd* Fionnachad, "the man who excelled in prowess all the Tuatha Dé," was slain by Caerite (a late mark), who also slew Lir, Dub and Donn of the forces of the *Síd*.⁷ It is impossible to regard the Welsh goddess Dón (the Irish Donn) as in any way connected. Cassiopeia's chair was her fort, Llys Dón, but at least we have the name Donn for a god, a goddess, and a holy bull.

Donn, son of Midir, or "Donn of Uisnech," was closely connected with our district, for his sons, Eogabal and Uaimde, and the children of the first, Aine and Ferfi, loomed large among its gods. He was in touch with Nechtan, who recommended the migration, and therefore with Cúil of Oenach Chuli. I think it very probable that the Donn of Firinne, the god of the long ridge,

¹ Hib. Lect., iv, p. 92n. Holder, i, c. 1397, see also "Donnus," *ibid.*, "Regius Domni filius."

² Cath. Finntraga (ed. Meyer), pp. 15, 260.

³ Ir. Texts Soc. (ed. P. MacSweeney), p. 77.

⁴ "Dumaire Fua" (ed. J. MacNeill), p. 131. Cf. other fairy deer, Metr. Dind S. vii, p. 11, and Rev. Celt., xv, p. 273, with a Christian equivalent in the Tripartite Life of St. Patrick.

⁵ Rev. Celt., xxii, p. 39.

⁶ Agallamh ii, p. 224 and (ed. Stokes) p. 140.

⁷ Agallamh, ii, p. 146.

with its prominent cairn-topped dome, so conspicuously seen from 'Aine's cairn, was the son of Mider, and gave his epithet to it—Knockfirina.

I heard as a child, about 1872, from the peasantry at Attyflin much about King Donn. His blue dome was an infallible weather-glass, whence its name, "The Hill of Truth." He was a powerful fairy, who gathered the clouds on the peak. The fairy hares¹ on the hill were his pets, "no doubt," and were often seen. He lived in the Sthrickeen,² the big heap of stones on top. I heard from better educated (and therefore less reliable) sources that stories were told, the same as those embodied by Michael Hogan, "the Bard of Thomond." Hogan describes Donn, "in his chariot of meteors," defeating the Cratloe fairies, and carrying off the young bride of Maccannara of Carrigounnell; but the Ossianic flavour and bombast conceal the local mythology, if any. In a genuine (but probably late) folk verse, "Donn Firinne, Robert of the Carn, and Geroid Iarla, who vanished in the clouds,"³ are the three chiefs of the Munster fairies from "Carnthierna," near Fermoy to the Shannon. Donn of Dough dwells in a large sandhill, in the golf links, near Lehinch, Co. Clare; and I remember (in 1878) when people did not care to pass by night, and lights were said to be seen there. The last of the ancient bards of Thomond, Andrew Curtin ("fallen on evil days and evil tongues," in the eighteenth century) prayed this Donn to take him as his servant.⁴ It was better than depending on the illiterate squires, though Curtin received much hospitality from the MacDonnells of Kilkee, who appreciated Irish poetry; but tradition does not tell that Donn granted the poet any favour.

EDAIOIN.—Though forgotten locally, the yellow-haired Edaoin, the tutelary goddess of Eogan Mogh Nuada, deserves mention.⁵ She resided at Inis Greeraige or Beare Island, so their friendship may have been accidental. She rescued her protégé, and aided his escape to Spain by making the pillar-stones and rocks appear to his pursuers in the forms of his company. The deluded foe vainly broke their weapons on their supposed victims. The story is evidently archaic, though we have it in a late and corrupt form. Elsewhere she appears with Cliodna and Aine as the "treasures of the Tuatha De Danann."

FER FI.—I have said so much about the gods of Knockainey,⁶ that I must

¹ Hares were sacred in Gaul; Boudicca brought one against the Romans. See Hibbert Lect. iv, p. 199.

² "Struadhraicin" (FitzGerald's "Limerick," ii, p. 382), "a specula or place for fire signals." Lewis (Topog. Dict. p. 114) says it is on the site of an ancient temple. Illustrated by Dr. George Fogerty and described by Mr. P. J. Lynch, Munster Arch. Soc. i, p. 108.

³ Rev. Celt., iv, p. 191.

⁴ Mss. R. I. Acad., 23 M. 47, Folk Lore, xxi, p. 196.

⁵ "Magh Leana," especially p. 31.

⁶ *Supra*, vol. xxxiv, pp. 50-56, 59, 60.

confine myself to a short study of Fer Fi, son of Eogabál,¹ and a summary of the legends of his sisters, like that of the Nuadas. As we saw, Fer Fi thoroughly avenged the violence of Oilioll Aulom to Eogabál and his sister 'Aine.² In addition to luring his enemy's family into civil war, he raided and burned Dun Claire fort, which deed keeps his remembrance green at Knockainey.³ He had a holy mound at *Síd Fíraí mhic Eogabail*,⁴ "to the south," perhaps the most southern of the conjoined rings. He first discovered the Slige Cualann road, and was guarantor of the treaty of neutrality between Bobb Dearg and King Conn. Now Cacht, wife of Eogabál, was tutelary goddess of Fingin mac Luchta, an early king of Munster (*circa* A.D. 130), who used to meet her at Kilfinnan, for Luachair Deadaid covered the district at Clíu, at least to the east of Cenn Febrat.⁵ Cacht broke the treaty by warning her favourite against every move of Conn.⁶ Fer Fi's mother is said in a late poem to have been daughter of Crimthann Nia Nair, King of Munster, "B.C. 3 to A.D. 13," who owned a fort of Cenn Febrat. *Nia Nair* commemorates another tutelary goddess, "Nar, the witch of the *Síd* mounds,"⁷ who protected Crimthann on his naval expeditions from Howth;⁸ but his fort there was not at the Baily (as O'Donovan decided), if it was in sight of Meath.⁹ If Fer Fi (as seems probable) was Fer Fidail, son of Eogabál, he was instructed by Manannán mac Lir, and used to bear a trident; but, having abducted and accidentally drowned the Lady Tuan, the sea god slew him.¹⁰ Eter was his wife, and Emer was wife of Uainide.¹² Eogabál's sons were Fer Fi or Fer I, Lu, and Fainle. The others, Ferc, Fermait and Fer Fidail, are possibly alias names of Fer Fi. In the latest edition of the legends 'Aine is also killed by Oihell Aulom. A still later poem makes the latter straighten his bent spear-point with his teeth, one of which got poisoned with the

¹ "Yew fork," a suspicious name in view of the magic yew episode. Were the Knockainey gods connected with a sacred yew as well as with the hazel grove?

² The name 'Aine, Aina, or Ainia appears in Gaulish inscriptions, Holder, i, 71.

So Dr. Douglas Hyde informs me. I could not get any traditions on my visits to Knockainey. He has since published the legend in the *Celtic Review* in 1917.

³ *Onomast. Goedel.*, p. 599.

⁴ On which lay their chief cemetery.

⁵ *Book of Fernoy* (R.I.A. Irish Texts, Ser. 1).

⁶ *Messa Clad.* p. 53. Legends varied as to Crimthann's death; see *Rev. Celt.*, xxiv, p. 175.

⁷ *Coir Anm.*, p. 33, No. 106.

⁸ "Howth and its Owners," Dr. F. E. Ball (*R. S. Antt. Ir.*), pp. 11, 12; *Rev. Celt.*, ii, p. 86, and "Eriu," viii, p. 31.

⁹ *Metr. Dind S.*, vii, Rath Esa, p. 7; also *Dublin Penny Journal*, 1833-4, p. 60; the last is decisive for site of Dun Crimthann being at the mound at the martello tower in Howth.

¹⁰ *Rennes Dind S.*, *Rev. Celt.*, xvi, p. 152.

¹² "Aine's History," *Silva Gadelica*, pp. 75-76.

venomous blood of the banshee. Thus we have a complete evolution in the 'Aine legends, in which she appears as goddess, princess, banshee, and poisonous monster;¹ but to the peasantry only the first stage remains. The euhemerists were discounted, and 'Aine remained beautiful, gracious, helpful, and deathless, as when the five Firbolg tribes adored her, before the coming of the Dal Cais.

THE KNOCKAINEY LEGENDS.—There was no standard of pagan orthodoxy, and every tribe seems to have had its own recensions and divergent tales of the parentage and acts of the gods. Our study of Nuada, and W. M. Hennessy's study of the war goddesses,² make this very plain. The tendency to make triads of the gods, even breaking up one into three gods, began early; the Gaulish carvings show the three birds of the war goddesses. The stories are kaleidoscopic, the same names and events reappearing in different combinations.

In the 'Aine legend³ there were evidently two variants, one an inland version (perhaps of the Mairtene and Dergthene), making her and her relations children of Eogabál; the other a coast version (perhaps of the Corca Laegde), where the sisters were children or connexions of the sea gods.⁴

(1) The Knockainey tales tell how Eogabál and his brother and family come from Uisnech; the outrage of Oilíoll Aulom and revenge of Fer Fi; the magic yew tree, and the semi-historic battles of Cenn Febrat and Magh Mucrima. In one 'Aine is perhaps the wife of Dubthach, on Cenn Febrat, and her sister Aife, wife of Cáin, on that hill. The earliest trace is circa A.D. 886, in *Sanas Chormaic*. " 'Aine's History " has an early tinge; the others recognize the gods as wonder-workers, but liable to violence and death; the latest reduce them to fiends.

(2) 'Aine, Aife, Fer Fi, and Aillen of Síd Eogabail appear, so there can be no question of identity. The ladies are, however, daughters of Manannán, or his ollamh, or his father Ler, or his son Aillen, of Etar, or of Gailian; Etar is son (or grandson) of Etgath. (a) One of the latter gods, usually Aillen or Fer Fidail, desires Manannán's wife. 'Aine gives herself to Manannán, and obtains his

¹ "Poisoned people" and weapons often appear, but perhaps metaphorically (Atlantis, iv, Coir. Ann., p. 307, and Wars of Gaedhil, p. 159).

² Proc. R.I. Acad., x, p. 425; Hib. Lect. iv. p. 43; Rev. Archéol, xvii, p. 425; Prof. Anwyl (Celt. Rev., iii, p. 26); Dublin University Mag., Oct., 1834, p. 463; Rev. Celt., i, p. 39.

³ *Supra*, xxxiv, p. 55, and descriptions of Knockainey, p. 61, and Clogher, p. 63.

⁴ For this table (1) Silva Gad., vol. ii, p. 725; Metr. Dind., x, p. 229. (2) Battle of Ventry, Notes, p. 14. Duanaire Finn, p. 119. Introd. Feis tige Chomain (Manannan and Aife) Duanaire Finn, p. 197; Gailian, p. 119, the ollamh; Rev. Celt., xv, p. 331, Etar. Exchange of 'Aine for wife of M., Silva Gad., p. 196; slaying of Fer Fi, Duanaire, p. 118; Rev. Celt., xvi, p. 152; Eriu iii, p. 151, Becuma.

wife for her pining brother; (b) or Etar's wife is given in exchange; (c) 'Aine's sister Aife marries Lir (she is elsewhere different from 'Aine's sister); (d) 'Aine is daughter, not wife, of Gaidian, or Gailian; (e) the latter seduces 'Aine's foster-sister, Becuna, whom Aine alone befriends; (f) Aife and Fer Fi are pupils of Manannan, who slays the latter; (g) Aife marries Lir.

Outside the connected legends we have hints of many others. 'Aine (daughter of Molann), Lir, and Oengus of the *Brú* figure in one; Aife was daughter of Midir,¹ and the sisters vary as daughters of Eogabal, Eogamal, Durgabal, Lir, Gailian, Dellbaeth² or Midir. Aife, Clidna, and Edaen, "the treasures of the Tuatha Dé,"³ are of Manannán's household, and get drowned when surf-riding at Glandore, whence Clidna's Wave. Etar of Benn Etair (Howth), son of Eogath, pined away and died for love of 'Aine.⁴ Aife, daughter of Dellbaeth of Lir's household, is changed into a crane in the obscure "crane lug" story.⁵ The *Leabhar Gabhala* gives Aidne (Clidna), Aife, and 'Aine as daughters of Putholan; Lir's children are probably the same group, Aoibh, Aoife and Aille, but they are daughters of Oilioll Aroun elsewhere, and the two first are successive wives of Lir.⁶ It is quite evident that three supernatural ladies, Aine, Aife and Clidna, were revered along the coast, at least from Glandore in Cork to Portlaoise in Mayo, and that they give their names to the heroines of many divergent tales.⁷ No better example could be given of the impossibility of wedling our material into a consistent whole, and no better excuse can be offered should one get lost in such a quagmire.

A few closing deductions may be given. We have a mass of material from the seventh to the seventeenth century which can only yield results to very critical examination. The mere heaping up of extracts from every period can yield nothing but contradiction and confusion. Those who regard the least supernatural tales as the oldest, and reduce the stories to histories of mortals, are reversing the true process, as any attempt to arrange the sources by their periods shows at once the god-like god as the earlier. Those who shut their eyes to the results of Continental and British study, and believe the Gaulish gods to have been high kings in Ireland over a thousand years before Christ,

¹ Silva Gad., ii, p. 111.

² *Ibid.*, p. 110; Todd's *Irish Mythology*, p. 127, Ir. Myth. Cycle, chap. xiv.

³ Ancestor of the Ernai and Museraige; perhaps this was their version.

⁴ Silva Gad., p. 299. Another tale makes Clidna daughter of Genand; she drifts asleep in a bronze boat, and is drowned (*Rev. Celt.*, xv, p. 437.)

⁵ Rennes Dind S. *Rev. Celt.*, xv, p. 380.

⁶ Duanaire Finn, p. 118.

⁷ Magh Leana.

⁸ *Leab. Gabhala.*, pp. 25-39; *Atlantis*, iv, p. 117.

and accept the euhemerist "Annals," hardly deserve refutation. Such "irrational rationalizing" as made the Tuatha Dé, flying on the wind to the north coast of Ireland, to be Scandinavians coming in ships, and perverted science by pointing out the forts and skulls¹ of what was a divine pantheon, is outside the true methods of study. Even a knowledge of Homer and Ovid might have shown our students that the heroes of Luachair and Muirthemne are replicas of the demigods who fought before breezy Ilion; that Cu Chulaind was a counterpart to Sarpedon and the divine Achilles, and that Lug and Manannán were but Apollo and Neptune in Celtic attire.

In A.D. 900, gods were recognized as gods; then the euhemerist movement by 1050 brought them down to dead kings and heroes and, later still, to magicians,² protecting spirits, and family banshees, and at last to devils.³ Only the peasantry were faithful to the spirit of the old tales; the god became a wizard and the druid a jester in literature. The gods "who o'er the Celtic roamed the utmost Isles" were as nearly dead as the Aesir and Wanir. Yet the dead weight of the old literature kept back the expurgators. A "redeeming verse" after a pagan legend, the praise of charity above keeping *geasa*, a verse on the Trinity after a poem to the "Seven Daughters,"⁴ reconciled the pious. It was as well, for there is less to offend a Christian spirit in the ancient tales than in St. Patrick's abuse and brutal threatenings in the late popular Finn poems, so unworthy of the "humble and holy man of heart" of his own writings and of the early "Lives," and even stories.

Ireland had no Saemund to give us uncorrupted tales of the old gods, but much survives before A.D. 1000 to enable us to "judge a people by their gods," and get an all-important side-light on the brave and brilliant race, poets and missionaries and warriors, who evolved the gods in their own image before St. Patrick preached. One advantage the Irish mythology enjoyed—there had been no cruel struggle between it and the new faith.⁵ The wise tolerance of

¹ Sir W. Wilde, "Boyne and Blackwater," p. 239; Lady Wilde, "Ancient Legends, Mystic Charms," &c. (1887), pp. 353-7.

² Magicians, *Silva Gad.*, ii, p. 132, and often; protecting spirits, *Nar.* "Magh Leana"; *Cacht* "Book of Lismore"; 'Aine, *supra*, xxxiv, p. 59; Aibhin, *Wars of Gaedhil*, pp. 200, 201; *Folk Lore*, xxi, p. 26; cf. W. Stokes, "Three Irish Glossaries," p. xxxiv.

³ Like Balor in Donegal, *Ulster Journal Archæol.* (orig. ser.) i; maskers disguised as devils for Samhain night, see *New Ir. Rev.*, xxvi, p. 145. King Cormac is slain by the *siabra* in old tales, "by *siabra* and demons," says Keating (*Hist.* i, sect. xli), "a devil attacked him," say the Four Masters. The Book of Ballymote discusses whether the Tuatha Dé "were diabolical demons," or a human tribe. So late as 1317 the Cathreim Thoirdhealbaith makes the *Badhbh* dwell in hell. So the Welsh gods became demons or fairies (*Squire, Myth. Brit. Isles*, "Decline of the Gods").

⁴ *Celtic Review*, x, p. 263.

⁵ In Scotland John Carsewell, Bishop of the Isles, denounced his flock for preferring tales of the Tuatha Dé Danann to the faithful Word of God and other cases. We have

the Church (unlike its actions among the Scandinavians and Teutons)¹ passed no sentence of death on its rival. It had won "by the Word, not by the sword," and, itself thoroughly Irish in a generation, could afford to let the *Síd* faith die out. Christians gathered at the old sacred places for consultation² or pleasure; the pillar was marked with a cross or a holy name;³ the *bile* trees were left to flourish till cut by some hostile tribe, or felled by storm or by old age;⁴ the holy fire was tended by nuns; the wells rededicated and held in new honour: the old tales of the gods were told without offence before priest and pious chief. So, wisely and without hurry, the old faith was let die out, while, had other methods been adopted, the clue not only to Irish but to British and Gaulish paganism had been lost for ever.

PART II.

(F)—THE EARTHWORKS.

It is almost a relief to turn to tangible field-work once more. I may venture to tabulate the main types of the earthworks here. I have often opposed the confident statements of those who imagine they can determine the period and object of an earthwork by mere external inspection. Such theorizing (or rather allegation) is most dangerous to all sound archaeology; so we must try to avoid this great error. It is, perhaps, worse to take any fashionable theory in vogue outside Ireland, and apply it hastily to the antiquities of this country, playing the part of Procrustes in forcing facts to fit in it. In Ireland an error once in print in a journal can never be finally slain, for shallow beginners revive old theories and identifications, without

{1656 to 1678) denunciations from Dingwall Presbytery against cattle sacrifices at an ancient temple, "amonged Mourne," and "Shony, a sea god," the last for a good seaweed crop (Penman's "Tom in the Hebrides"; Mitchell, "The Past in the Present"; Squire, *loc. cit.*, pp. 498, 412). "The Celtic Church in relation to Paganism" (W. J. Watson, *Celt. Rev.*, x, p. 263.)

¹ Elsewhere the Councils [of Arles, A.D. 452, Tours, 567, Nantes, 658, and Toledo, 681] fiercely forbade reverence of trees, stones, and wells, and punished those who practised it, etc. Olaf Trygvason's crusade against paganism in the Heimskringla and the various acts of Charlemagne.

² A trench for a church was marked "in the name of the Lord of the Elements" at the green of the *Brugh* for the first time in A.D. 499 (*Rev. Celt.* xxii, p. 415).

³ "Celtic des Meniers," De Jubainville (*Rev. Celt.*, xxvii, p. 313, and xxviii, p. 222). For Cardinal Gossach's shrine at Clogher, *Celt. Oengus*, ed. Stokes, pp. 186, 187, 378. *Plan. R. Soc. Ant. Ir.*, xxiv, p. 320. Holy names on pillars (*Tripart. Lite*, pp. 90 n, 107). Some eight stones have the god name after "Maqi Mucor" broken (*Proc. R. I. Acad.*, xxvii, p. 363). For pillar marked with Christian emblems in France, see *Life of St. Sampson*. Cross-ribbed pillars are numerous in Brittany as in Ireland.

⁴ Rennes Dund S. (*Rev. Celt.*, xv, pp. 449, 444; xvi, p. 277, yews, ash trees, and oaks.

testing the reasons for so doing, or rejecting where necessary, and seldom trouble to bring their reading up to a date much below 1840.

I shall reserve the traditions relating to Knocklong and Dungrot, and confine myself to the earthworks near the first-named place, which complete the principal remains of the group from Kilfinnan to Kilmallock, Knockainey and Knocklong. I hope to deal later with the important remains of forts and mounds from Cromwell Hill to Dungrot. The first was the site of a *Síd* (though its god is, so far, undiscovered) in 1826. FitzGerald first noted "an inverted basin-like mound called *Sighchann na Fionii*" (*Sídcán*¹ of the Fiana). The fine dolmen there has been already described, planned, and illustrated by Mr. P. J. Lynch and Dr. G. J. Fogerty.

FORTS.—I have to use this unsatisfactory term for ring-walls and ring-mounds, often residential, sometimes sepulchral, and never military; but the usage implies no dogmatic theory in Ireland.

(1) Ring-walls of earth and stone, with (or without) a fosse and outer ring. (2) The D-shaped fort. (3) Roughly square forts. (4) The crescent fort, abutting on a scarp of cliff, like Dunganville. (5) Fortified spur, a mere variant of the last; e.g., one near Templenalaw. (6) The low platform fort, oval or round, with a fosse, and sometimes a ring. (7) The high mote, like Shanid Castle and Kilfinnan; the last with three rings and fosses, but no baily; the former with a Norman keep and baily.

RATHS.—The great ring-forts, like Dun Claire, Ballingaddy, and Ballinacaula, are evidently residential. So, probably, are most of the platform forts, with the vast majority of the lesser raths. The platform forts of Magh Adhair, in Co. Clare, and Cush and Ballinvreena, in Co. Limerick, may have been originally sepulchral, or at least ceremonial. The first was, however, "besieged" in A.D. 877. The lesser house-rings may date down to (or after) the Norman settlement. One rath made about 1240 in Co. Clare. The "square" are probably late; but some in Europe date from the Bronze Age, and the making by the god Nuada of an earthwork with corners is mentioned in the "Battle of Magh Leana."²

CONJOINED RINGS.—These very interesting remains I hope to treat at some length hereafter. The occurrence of such at Knockainey, Clogher, Cooloughtragh (Temair Erann), and the 'Oenach, near Monasteranenagh, mark them as for ceremony, and perhaps for sepulture. They have counterparts. Two, of different periods, conjoin at Tara,³ and others occur at Uisnech, and

¹ Limerick, i, p. 406.

² *Loc. cit.*, pp. 1-4.

³ The eastern, the so-called Teach Chormaic, I regard as the earlier, as the rings of the other join on to its perfect rings. [Since drawing this conclusion Professor Macalister's monograph on Tara has been read.]

near the great fair site of Caherree, near Buttevant. So far I note two varieties, one of several disc barrows or else mounds of the Rathmarrow type, as at Cooloughra (five rings), Kneekainy (four), and Doonakenna, near Banna Hill (three). The others are very low platforms. In Co. Clare there are two types—ring-walls, or rings of earth and stone, like at Teernea and at Lisrilliam, near Croom station; or a ring and crescent annexe (like at Clogher) as at Croevagh, Corbally, and Ayleacotty, near Quin, one at Moyertagh church, and a marsh-fort at Lisnichane, Co. Clare, and Ballinbeg, near Aghada, Co. Cork.

SEPTIZEBRAL REMAINS.—Irish literature is rich in side-lights on such monuments. First there is the *domo*, a tumulus, an outlook, or the raised site of a house. We have an example in the twin tumuli at Clogher, which work probably resembles the "Two Breasts of the Morrigan," in the Great Cemetery of Druge. When going over the site of Tara with Professor Macalister, we found what exactly tallies in site and character with the *Troilma Nosa*. O'Donovan was right as to its nature.¹ It was evidently three small mounds within an oval ring, partly terraced up; but the road has destroyed the middle mound. Such tumuli were probably (as in this case) connected with the gods. We read² how *domo* mounds were made over raths, *domo* over *lathas*, *domo* over warriors. We find elsewhere³ how a *feet* of one door was for a man of science, one of two doors for a woman, and a *wee*, or ring-work, for those dying in a pestilence. When square or suitable stones were not to hand, square seeds were used for the *dartaire*. The conjoined disc barrows at Cooloughra are evidently the joined tombs, traditionally, of Eithne and three other ladies in the cemetery of the Ennai, "side by side." Eithne was sister of Mac Niad, and a daughter of Lugaid mac Dairé, and was mother of Conaire by Móg Láma, and of Lugaid Laga by Móg Noddy. Móg, who was buried near her, was a daughter of Ugainé's son Fergas. The Kneekainy rings were evidently connected with the gods

¹ Dr. George C. Mac N. has done me a plea which, with my own plan of Ballinbeg, I hope to lay before the Academy in a future study.

² A groom named Clancy, long ago, was told by an old labourer not to exercise horses on it for fear of ill luck.

³ For two mounds at Da Chich na Morrighain (The Paps in Kerry) see "Burning of Fiun's House."

⁴ O. S. Letters, Meath. Petrie fancied it to be three concentric rings.

⁵ First Battle of Magh Tured, *MSA. T.C.D.*, 21.2.17, p. 91.

⁶ Book of Lecan, f. 258; Keating's "Three Bitter Shafts of Death," for "small raths of the claidhe" used for burial; see "Tract on the Cemeteries"; Book of Lismore; (*Rec. Soc.*, 1886, p. 325). See also *MSA. T.C.D.*, L. no. 11, also names the fort of Dughas; see *MSA. T.C.D.*, 1886, p. 325. See also *MSA. T.C.D.*, L. no. 11, also names the fort of Dughas. In *Teinmuc*, Feible fifty persons are buried in one ditch in "Cath Craic" (*MSA. R. I. Acad.*, 26 k 37), two druids are buried in *Dumba na ndrúadh*. See also *Cath Finntragra*, p. 87.

⁷ *Silva Gadelica*, ii, p. 524.

—Uainide, with the northern; Fer Fi, with the southern; and, perhaps, Eogabal and 'Aine with the rest.' The brothers of Medb were buried in a *mur* at Rathcroghan, and, in the sixth century, St. Senan was buried in a *dere* or *fert*, a square enclosure with upright stones, such as was connected with his name on Inisceacrach (i.e. Mutton Island), Co. Clare. The shield of Cu Chulaind² was a disc barrow, level with the field, and with a small mound in the centre. *Bowl barrows* occur at Cush (3) and Clogher; *disc barrows* at Cush, Clogher, and Ballinastona, in Co. Limerick; Lislard, Lishaun, and Tyredagh, and George's Head, Kilkee, Co. Clare. (4) *Rounded low mounds*, like Rathnarrow. One remains at Lisdoonvarna, Co. Clare; others at Knockainey and Ballygubba, Co. Limerick. (5) Cairns in a ring—Knockainey, Knockadoon. I have not found a kerbed cairn in Co. Limerick, such as we find at Leana, Poulawack, and Slievenaglasha, Co. Clare. There are traces of large cairns at Knockfierna, Carnary, and at Seefin. (6) The Limerick dolmens are chiefly cists, the Duntrileague one is complex.

KNOCKLONG (Ordnance Survey No. 40).

A fine group of earthworks extends from Clogher through Knocklong, and down the valley of the Saimer, or Morningstar. There are no traces of earthworks on the ridge of Knocklong, whose fifteenth-century castle of the Hurley's and the graveyard are so conspicuous from the railway from Dublin to Cork. It is the ancient Drom Damhgaire, the scene of the very mythical defeat, or rather flight, of King Cormac,³ about A.D. 230. I must study its legend hereafter, and only give a brief sketch of its history and traditions.

The O'Hurleys built the castle late in the fifteenth century, after 1460. The records only begin in the reign of Elizabeth in the "Fiants" of 1568, 1570, and 1584, as Loinge and Knockneloinge. The Hurleys held it till Sir Maurice Hurley lost all in the civil war of 1641-51. His confiscated manor had "a ruyned castle, a mill, two fairs, and Courts Leet and Baron." His lands extended from Dunmoone and Mitchellstown down to Startin (Scarteen) and Ballinalanga on the borders of Co. Tipperary. In 1853 it was said to take its name from *long*, a ship in which Hurley used to sail from it to Emly. It is true that there was a lake at Emly in A.D. 896, named in Cormac's Glossary, and there are traces of several other lake-beds; but no

¹ *Supra*, xxxiv, p. 62.

² *Metz. Dind S.*, viii, p. 17. Similar to this may have been Sciath Nechtain (Wars of Gaedhil, p. 21, A.D. 847), at Skea, Co. Kildare, and Sciath gabhra, or Skea, Co. Fermanagh.

³ Forbais Droma Damhgaire. *Rev. Celt.*, xv, p. 441; Keating's History (Ir. Texts Soc.), ii, pp. 319, 320; O'Curry, "Manuscript Materials," p. 271.

continuous sheet of water could have reached from it to Emly in historic times. Windele found the old legend still remembered, how a "king of the Dandonians" and his army suffered from thirst, and his druid "shot a sleagh," and where it pierced the ground the well of Curraheen, on the north-west slope of the ridge (Slievereah), broke out.¹

Mr. Molony, of Hill House (to whose kindness and hospitality I am indebted), tells me that, when digging a fence above the quarry on the west slope, a layer of bones of men and horses was found. Here John Windele, in 1853 found "a limestone pillar, or *dallán*, 4 feet high and 13 inches thick, on the edge of a precipice." Mr. Molony also tells me that long ago a cave was opened between the castle and the graveyard, and silver candlesticks were said to have been found, and long preserved by a Mr. Ryan.

The railway cuts the group of forts in two. Unfortunately, Windele's untidy method of making notes on any loose bit of paper, and hardly ever writing out a full account while his memory was fresh, deprives his jottings of much of their value, and the Ordnance Survey Letters, as usual, ignore them altogether.

I take them from the north, southward:—(1) The northern mote is 8 feet to 11 feet high circular flat, or slightly hollowed, on top, and 51 feet across. The sides are steep, especially towards the north, with hawthorns on the sheltered side to the south-east. The fosse is 12 feet wide and 2 feet to 4 feet deep, wet and full of "flaggers" (yellow iris), with a trace of an outer ring 10 feet wide and 2 feet high, to the south-east. This, I presume, is Windele's "Liss of Knocklong West," described as a mote "20 feet high," with a deep fosse, 20 feet wide and 56 feet across the top, which is slightly hollowed. It lies beside a little rivulet, in wet fields, now drained. (2) In the same marsh, southward is a curious platform fort and a ring-fort in Knocklong Towland. The first consists of two rectangular platforms, in line, north and south, 5 feet to 6 feet high and 66 feet wide, within a fosse 12 feet wide, now nearly filled; the two divisions had banks round the tops, and have a fosse 12 feet wide between. The northern is 70 feet long, much levelled to the north-west; the southern is 54 feet long. (3) At 63 feet to the south-west is a marsh fort, a ring, 66 feet inside; the rampart is 6 feet thick and high, the fosse 12 feet wide and only 2 feet to 3 feet deep, with an outer ring 3 feet high and 6 feet thick. It was nearly concealed in tall meadowsweet, loose-

¹ Francis Nos. 1765, 2472; Desmond Roll, 1584; Civil Survey, vol. xxv, p. 9; Windele's "Supplement," i, pp. 526-530; *Sanas Chormaic*, p. 93.

² *Mss. R. I. Acad.*, Windele's "Supplement, i, pp. 526-530. Did the pillar commemorate a battle" of *Da Derga's Hostel* (*Rev. Celt.*, xvii, p. 369), "a pillar stone for a rout, a cairn for a destruction."

strife, and flaggers on my visit. Windele describes it as "a mote 13 feet high, with a cave, in which a dog was lost." This opening is not to be seen, and though he places the mote near the oblong platform, he probably means the next mound. (4) The mote near the Elton road is 12 feet to 14 feet high; it has a dry fosse 15 feet wide, and a sort of ledge, such as one finds in bell-barrows, to the east, round the foot of the mound. The flat summit is from 64 feet to 66 feet across, the base about 90 feet. Many hawthorns grow on its side. There is no outer ring. A long circuit through the village brings us past (5), a low liss, a thicket of thorn-bushes, with a fosse and inner and outer rings, to the north of the railway, east from the station. We eventually reach a group with two good forts south from the line, from which they are well seen, with their noble background of mountains. Owing to the increased tillage (from the German submarine campaign), many fields round them were broken up; I carefully, but vainly, looked for sites of hearths or objects of antiquarian interest, but saw none. (6) The fort nearest the railway is a perfect little oval mound, 11 feet to 12 feet high, 42 feet across north and south, by 30 feet east and west on the top. The fosse is 15 feet wide, 4 feet to 5 feet deep, and partly wet, with no outer ring. (7) Another fort, which I failed to find, and could not see from the railway. (8) The most southern, and finest, mote, near the road from Knocklong ridge to Aghadoon, is on the summit of the plateau; it has a beautiful outlook to the Galtees and Slievercagh. It is a very perfect mote, 13 feet to 15 feet high over the fosse, 40 feet to 45 feet across the top, and 70 feet at the base, with steep sides, and thick hawthorns growing on it to the south-east. The fosse is 16 feet wide in the bottom, and over 6 feet deep, being still wet.¹ The fact that so many raised flat-topped forts remain where no castle is recorded is noteworthy, there being, as we see, four at Knocklong, and nine near it at Atheneasy, Aghadoon, Ballinvreena, Cush, Raheenawadra, Ballinscaula, Bulgadin, Glenbrohaun, and Rathtany.² None of these occur in the sanctuary cemeteries of Oenach Clochair and Knock-ainey, though the third and fourth are near Cush. This seems to imply that they are not necessarily either burial tumuli or feudal castles, for what need of four in one townland? and the number precludes the idea of their being inauguration mounds, like their congener at Magh Adhair. I can only draw the conclusion (so strenuously denied) that such flat-topped forts (and the remark applies to Pallas, and to those in Co. Clare, Lisnagry, Lugadoon, Killilagh, Moyarta, Lisnaleagan, and Kiltinnaun) are Irish residential "forts." The bearing of this on Shanid rath is also very clear.

¹ Plans of Nos. 2 and 3, and sections of 4 and 8, are given, Plate VI.

² Ratheneasy in Inq. post mort. of Tho. de Clare, 1287; Rathtany in Memoranda Roll Exchequer 1317, m 82, as to succession of his son Richard.

AGHADOON, KNOCKTORIN (O. S. 40).—The Saimer, to judge from its old channel, was once a goodly stream, and if it be the Saimer of a list of the chief rivers of Ireland, got more than its share of recognition. Now, the great rain-collecting forests being long felled, it, like the Cammoge, has dwindled to a brook. It divided the Ui Fidgeinte from the Arada before the Dal Cais intruded. The ford Aghadoon (Athnaduin), also called "Doon Ford," is marked by the old road from Knocklong to Kilmallock on either bank. It is evidently the Athdunbari,¹ named, along with Laythyrilaw (or Templenalaw, on Slievereagh) and Garthagriffin (Ballingarry in Coshlea), and was named from the Barrys. It is most probably the ford at the earthwork of *Baithin an Imorraigh*, "the little fort of the contest," where, in the "Battle of Knocklong," Colga, King Cormac's chief druid, was slain by the superior magic of King Fiacha's druids, who turned his "handstone" into an eel or serpent,² for the ford lay west from Knocklong and had a little rath near it. The utterly mythical nature of some Irish Sagas never affects their accuracy in topography.

The *Doon* is a low mote in Knocktorin: a shapely mound, carpeted with ferns, violets, and primroses, and planted with sycamore and beech. Through these trees it has beautiful views of Slievereagh to the south, and a glimpse to the north of Thomtanna, over Loch Derg. The mound is well seen from the train between Knocklong and Kilmallock, to the south. It is 16 feet to 18 feet high, the top girt by a low ring, 8 feet to 10 feet thick, and rarely 3 feet high. The platform inside this measures 60 feet across, or 123 feet at the base. There are traces of a fosse, but too defaced to be measured.³ The old road runs from it to the ford, westward down the slope.

ATHENEASY (O. S. 40).—Like Aghadoon, the next ford down the stream to the north of the railway has got a high fort near it, but on the other bank. The name *Ath an Deis* refers to a tribe, the Déis, denizens of the Tara district of Brega in Meath, who are said to have fled for refuge to Oilíoll Aulain in the late second century. Under his agis, one section settled in the present baronies of Decies in Co. Waterford, the other in Deisbeg, or Small County, in Co. Limerick. It is called Athenesy in a papal letter of 1269. In 1335, Elizabeth Milton, widow of Walter de Bermingham, had owned Atheneasy. The church of Aghmedesse was robbed by John Staloun;

¹ Plev Roll, No. 22 of xv., Edw. I (1296), Pars iii, m 48, and No. 42, anno xvii.

² Similar tales of great eels are found near Loch Gur, Rev. Celt., vol. iv, pp. 171, 186. In the *Tain bo Cuinge* (ed. Dunno), p. 161, the Morrighu turns into an eel to wind round Cu Chulainn at the ford; cf. also an eel poist in Co. Kerry (Mss. R. I. Acad., 12c 3 (13), p. 147; Roy. Soc. Antt. Ir., xxv, p. 74), and *Feis tighe chonain*, Introd., p. iii.

³ Knocktorin, bearing with Dunmoone and Elton, Small County (Civil Survey, p. 10).

⁴ Plate VI.

Athnedisse rectory is again named in 1393, and the manor of Andesshe was held by the Rolley, or Raleigh family in 1408 and 1424. It is called, in 1410, Athnedisse, or Beallathenesigh (the latter being the ford), which retained its old name, *Beul Atha na nDeisi*, in 1579.¹ The thicket of trees, and bushes in the mound, keep the fort unknown to many who frequently drive past it. It, like the *Doon*, lies not far from the village of Elton. This name is supposed to be very modern, but it is found as "Elltown, the property of Sir Edward Fitton," in 1586; two years later, James Fox of Elton claimed the land which Fitton held as patentee. Moriertagh O'Grady (I presume as Fitton's tenant) held Elltown in 1610, and it is mentioned very frequently in the Civil Survey in 1655.

The mote is from 18 feet to 20 feet high, surrounded by a fosse 18 feet wide, and rarely over a yard deep, with a stream running into it to the south-west. The mound is 51 feet to 54 feet across the platform, and 104 feet at the base; it is well preserved and the sides are steep, but it is overgrown with hawthorns to the east.

BALLINASCAULA (O. S. 40).—Of a different and more interesting type is the mote of Ballinascuala. On a lesser scale of height and massiveness, it still resembles Kilfinnan in having a raised mound girt by three rings. It lies in a marsh, not far to the north of the railway, and between Bulgadin and Atheneasy. It is locally supposed to mean "fort of the heroes," or "fort of the clouds," being on the map "Ballinascuala," but locally "Ballinascuala."²

Like its neighbours, none of its early records remain. In 1583, Gerald mac Thomas, alias "Tonboy Reagh," a Geraldine, held Glenlarhy, Ballinwryny (Glenlara and Ballinvreena on Slievereagh), and Ballinskaly. It was granted, May 14th, 1588, to Richard and Alexander Fitton as part of their demesne, "Phitton's fortune," long forgotten, along with it, the above lands, Coch (Cush) and Ballenvistellane down, or Mitchellstowndown; the grantors were pledged to erect houses for twenty-three English families; Mahone mac Teige held Ballynscholly under Sir Edward Fitton. The Civil Survey, 1655, gives "Ballinscala, half a townland, mearing on the north with Gormanstown, and with Bulligidyn-Eady to the west and north-east."³ No tradition seems to attach to the forts; Mr. Thomas Bennett, of Summerville House (the owner), tells me that there were traces of other small forts round it, but they were levelled at various times in farming the place.

¹ Cal. Papal Letters, i, p. 370, vol. iv, p. 458, Close Roll, viii Edw. III, 146, Plea Roll, No. 123 (1318-20), Pat. Roll., x Hen. V, pars. 2, No. 24, Ann. Four Masters, 1479.

² Plate VI.

³ Inq. R.I.A., i, p. 75. Inq. Exchr., Nos. 11 & 12. Proc. R. I. Acad., xxvi, p. 185. Fiant 5179 & 5032. Civil Survey, xxv, p. 11.

The fort¹ is a large earthwork in a very marshy field which, before the great drains were dug, must have been a shallow lake in wet weather. It has a low mote in the centre, girt by a ring of level field, fenced by a ring-mound and two fosses and mounds, fairly concentric, and measuring 280 feet over all. There seem to be traces of a causeway through the marsh to the east, but there are no entrance-gaps to that side.

The rings are usually from 12 feet to 15 feet thick, and 2 to 4 feet high; they were probably palisaded, as in one of the Ancient Laws, which describes an earthwork on a headland—"a ditch on one side and a ditch on the other makes a full fence; the (*cladh*) mound, 6 hands (3 feet) high; the palisade, 6 hands also"—no very lofty defence. The fosses are as wide as the rings and are literally filled up with lush marsh vegetation, rushes, peppermint, and such water-loving plants. The interspace round the mound is from 42 feet to 45 feet wide. The mote is from 6 feet to 7 feet high, 60 feet to 62 feet across the summit, 87 feet to 90 feet diameter at the base; it has no apparent house sites. The southern gangway is 15 feet wide.

There is a "satellite fort" to the south-east, about 66 feet from the entrance. Such are not uncommon. I need only recall Rathadrinna and Lismortagh in Co. Fingery, where the little fort nearly touches the outer ring. The "satellite" is well preserved, its fosse is 3 feet to 4 feet deep and 12 feet to 14 feet wide with no trace of the outer ring. The inner bank is 15 feet thick, 5 feet high outside, and 4 feet over the oval garth, which is 60 feet across north and south, and 54 feet east and west. It has a nearly levelled annexe to the west, 18 yards across, and defined by a shallow hollow; the west corners are rounded off.

I may incidentally note that a spell of very broken weather (culminating in heavy rain for a whole day and night) rendered my exploration of these forts and their surroundings very difficult and even necessitated wading. In this manner I was altogether prevented from making a close examination or any measurements of a somewhat similar marsh fort, called Ballinastona, some miles away, near Summerville House, beside the main road from Kilmallock to Bruff and to the west of the same. Judging from the large scale-maps it measures about 300 feet across. It has a low mound like a disc-barrow, perhaps about 5 feet high and 40 feet at the base. The map shows a ring about 160 feet across, a mound and shallow fosse. The rings seem to be only about a yard high, but I could not cross the quagmire and deep drains around it, flooded into a shallow lake. There are several other marsh forts round Kilmallock, mostly small; the largest to the south-west of the town is

¹ Plate VI.

² *Loc. cit.*, iv, p. 139.

called "Poulnadragoon," from a pool in the rivulet near it. It has two rings, 3 feet to nearly 5 feet high, studded with old hawthorns, and with gaps at regular intervals. It measures about 330 feet across the inner ring, and 430 feet across the outer ring, there being a rather wide interspace about 30 feet wide between the mounds.

TEMAIR ERANN

When I recognized the importance of the remains in the cemetery of Cush, and subsequently found its description in Macraith's poem,¹ about A.D. 990, I was struck at once by its rich mythical suggestion, and the lack of mention of the cemetery in other sources. As in the case of 'Oenach Chuli, I could not for the moment free myself from the prejudice of old identifications till a passage most familiar to me seemed to give a new light which made it evident that here, and not near Castle Island,² lay the chief cemetery of the Ernai Temair Erann. Let me restate the case.

If *Cush* be the constituent of Coshlea, "*Foot of the Hill*," and Cossetlereogh or Cosse Clerough, Coss of Cleire, in 1580,³ the Irish must have recognized the cemetery as a suitable place to give its name to the district called Fontymchyll by the English. Macraith shows that, in the reign of King Brian, every outstanding person of the Ernai, save Curoi, was reputed to have a grave on Cenn Febrat, at Cush. There were said to rest Febra, the brother, and Garban, the son of Deda, the eponymus of the Clann Dedad Ernai; Lugaid Laegde, another eponymus of the Corca Laegde; the wife of Daire, father of Curoi; the famous Dodera; Ere from Ir Luachair; Cáin, son of Derg, who, like Febra, gave his name to one of the hill-heads up the slope; and Eithne, daughter of Lugaid, the son of Daire and sister of Mac Niad.⁴ All the mythic valour and beauty of the tribe lay there, "each in his own house." Now, the Tract on the Cemeteries says:—"The Clann Dedat, i.e. the race of Conaire and the Ernai (were buried) at Temair Erann; the men of Munster, i.e. the Dergthene at 'Oenach Culi"; it only names

¹ Metr. Dind S., x, p. 227, *supra*, xxxiii, p. 460.

² So far as I can find, the identification was made first by Curry from the Down Survey, "Sliabh Luachra is laid down . . . south-west of Castle Island" (note "Magh Leana," p. 164), with no further definition, while O'Donovan brought in the Bealahantowragh equation. On this deduction from a single map (despite all other evidence) came the error of placing all the Munster Taras near Castle Island. Wilde places the cemetery at Tara in Meath.

³ Cosseclereogh adjoined Kilmallock and was a "patria" or barony.

⁴ Silva Gadelica, ii, p. 524. Her grave is probably the N.W. disc barrow of the conjoined rings of Cooloughtragh. Eithne, Macr, and Mugain, "side by side on the great hill" in the other three rings, Lugaid Laegde on the slope below the spring in Glounacrogghera; Dodera up the hillside, perhaps, at Gatabaun.

the most important cemeteries, and puts these on a level with Tailti, the burial-place of the Kings of Uíster, the Brug, most famous of all Irish cemeteries, the cemetery of the Kings of Connacht at Rath Cruachain, and that of the Leinster Princes of Oenach Ailbe. Only one other great burial-place is named, also in Leinster, 'Oenach Colmain.' The outstanding cemetery of Cenn Febrat, with a fair still held at its foot, in Ballinvreena (usually a sure mark of old importance), can only be Temair Erann.

It is well known that O'Donovan's only reason for putting Temair Luachra near Castle Island was the name "Bealahontowragh": this place contradicts (as I have shown) all the indications in the *Messa Ulad*,² our only clear authority while the further equation that Temair Erann, Temair Luachra, and Temair Shula are the same³ has not a line or a fact to show in its favour so far as we know. The old-school antiquaries fancied that Luachra lay exclusively in Kerry, never realising its extension, at least to Cenn Febrat, near the fort of Cinnathann Na Nair, and over Muskerry Barony in Cork, and up to Lesh Dog. O'Donovan's unhappy obsession that he could rate a delusion by identifying Duntyleague Hill with Sliab Claire against the clear topography of the Agallamb and other sources, poisoned the whole central Munster topography, and so long as modern students follow blindly his far from infallible authority no sound result can be attained.

The name Temair, if it implies a "wide outlook," is most suitable to Cush, and accounts for the myth of the *Apollonia* bringing St. Patrick to sit on the three bounds of the Featha De, there to watch the great hunt.⁴ To summarise—Cenn Febrat had for its king Salma Sathlaidhe "King of Claire," one of the "rulers" of the 2nd Nuala (ca. 909); the forts in Emlygrenman at its foot were made by Art Imlech (ca. 1019); Cinnathann, lover of the

¹ Cited by Petrus, "Round Towers," p. 101. The Christian writers long spoke freely about their unbelief in the religious excesses. Dathi consulted the druids on Samhain Eve, 422, at Rath Aonach, where they had idols and altars (*Encyc. Relig.*, vii, p. 128; *Manuscript Mat.*, p. 284). Tara was "the chief abode of idolatry and wizardry," (*Depart. Lib.*, p. 41); people worshipped idols and abominations (*Confessio S. Patricii*): *idols fall on their faces in Munster* (*Tripart. Lib.*, p. 105), and idols and images are destroyed (*ibid.*, p. 259), like Crom Cruach.

² W. M. Hennessy's note, *Introd.*, p. iv; cf. *Proc. R.I.A.*, **xxvi**, pp. 62, 63; **xxxiii**, pp. 26, 28.

³ *Book of Rights*, pp. 87, 254-5n, 257.

⁴ Including Oheara on Smeragh, and reaching at least to the fort of Slieve Grot, and Oenach Clochair.

⁵ Which he at first determined correctly as at Slieveagh, *Ord. Survey Letters*, i, pp. 108-114. His attempts to link the Ballina delmen are similarly an offence to all scientific archaeology, *supra*, **xxxiv**, p. 48.

⁶ The *Dual S. Rev. Coll.*, iv, p. 144, says that all places of the name were called after Tea (Téphi), a possible goddess.

⁷ Agallamb, *Silva Gadelica*, ii, p. 124.

goddess Nar, made his fort upon it (A.D. 1),¹ and the Ernai, in the time of Deda ("B.C. 130"), their great cemetery, Temair Erann, whose three tumuli were dedicated to the Tuatha Dé Danaun. These disjointed tales show how large it loomed as a holy hill in the sight and belief of the peoples of the plain.

APPENDIX.

TEMAIR LUACHRA.

O'Donovan and O'Curry identify Temair Erann with Temair Luachra and Temair Shuba.² They give no authority for the dictum, which, so far as I can find, is (as so often) a mere guess. There is (as I have pointed out) some mistake in the *Mesca Ulad*. The raiders pass through the (M)Airtine, into Smertaine, with Loch Gur on their right, across the pool stream of Maig, to Clíu, into Deise beg. They come to 'Aine Cliach, then to 'Oenach Clochair, on by the road to Temair Luachra. The Cammoge, rather than the Maigue, must be intended. Temair Luachra was on the east slope of the hills of Luachair, at least twenty miles beyond the Maigue, and over thirty miles from 'Oenach Clochair. As we have seen, the cemetery of Cush is the chief cemetery of the Ernai and Clann Dedad; it is therefore Temair Erann, and so cannot be the other place. I know of no mention of Temair Shuba but the incidental inclusion among the forts claimed by the King of Cashel, which favours its identity with the once predominant Temair Luachra. We find another curious tradition of the great importance of the latter in the same book. The High King of Ireland, from the royal namesake Bregian Tara, had to send a cauldron to the King of Cashel, at Temair Luachra. It had ceased to be chief centre of Munster in a prehistoric past, but the fact was not forgotten. The King of Cashel indeed was expected to go to it with twenty chariots, thirty vats of liquor, and food in proportion, "to eat the Feast of the Ernai," and stay there for a week.

As to my attempts to fix its site,³ the last were partly based on O'Donovan's identification of 'Oenach Clochair with Monasteranenagh, not with Clogher. This suggested that the route in the *Mesca Ulad* lay to the north and not to the south of Knockfirina, as is evidently intended. This, however, does not necessarily preclude the possibility of Dunganville fort being Curoi's fort; but

¹ The silver bow of Crimthann was carried by the Uladh, after the sack of Temair Luachra, to Cenn Februt, and they wrecked the Cathair and slew the king (Rennes Dind S., xvi, pp. 73, 78). Was it Dun Claire? For other allusions to Crimthann (other than those connected with Howth), see *Mesca Ulad*, p. 53; Keating, ii, pp. 232-6, 242, and i, p. 44.

² *Book of Rights*, p. 225.

³ *Supra*, xxvi, p. 62, and xxxiii, p. 26.

I must confess that no decisive argument can be made save against the old identification with the site near Castle Island.

It is strange that the name should have died out where so many of the other Etruscan names survive. One more point may be noted. The Elizabethan armies frequently followed the same routes. Now Pelham, in March, 1580, passed from Glin to "Dowau," near Portrinard, and thence (say the Four Masters) to Temair Luachra. On July 18th, 1600, Carew rested "upon the midst of the mountains of Slewleghor, at a place called Ballinture, twelve miles from Askeaton" and five from Glin, i.e. somewhere near Athea.¹ As we noted, there is a *Tearaile* between that place and Portrinard. In Co. Limerick *Tearaile* might be expected to become Tower or Tower, for Tower Hill, in eastern Limerick, was "Teauragh" and "Tearaile," in 1655 in the Civil Survey and in 1666 in the Act of Settlement. If the *Mesca Ulad* be right, the fort was on the slope of east Luachra, overlooking the plain and facing the rising sun. Much has yet to be done, as the indications so far give no final result, but perhaps hereafter some hitherto unknown document may set the question at rest.

I lay this paper before the Academy in the hope that the encouraging results attainable by combining careful field-survey with the study of early legends and literature, may lead other workers to extend to other districts the work of scientific identification of the sanctuaries and cemeteries. Venerated by the pagan Irish before Christianity rooted itself in our island, and by their descendants blown to, and sometimes even after, the Normans had settled on the rich plains of Southern Ireland, there may be much to guide us on our search. It rests with us, living in an age of destruction of our ancient landmarks and of the dying out of early traditions and place-names, to save the ancient topography of Ireland for future generations.

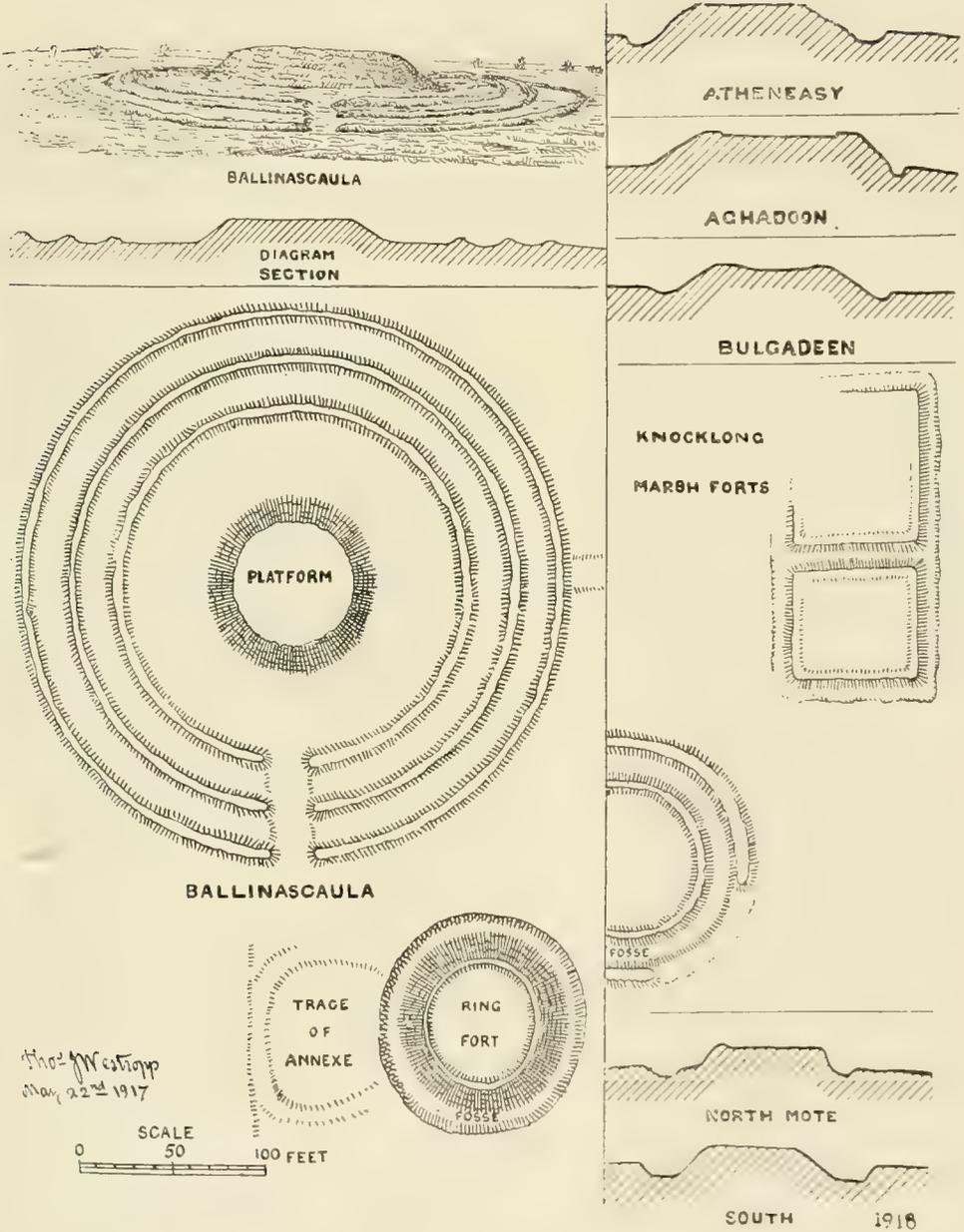
NOTE ADDED IN PRESS.

OENACH CUILI (*PROVERB*, vol. xxxiv, p. 63). Objection has been made to my identifying *Oenach Culi* with *Oenach Clodair*, on the grounds that they are named separately in the "Tract on the Cemeteries" (*Séachas na nÁite*) and the Charter to Monasteranenagh, 1186.²

The older text of the *Tract on the Leach na hUídre* does not name *O. Clodair*. It gives eight cemeteries, *O. Culi* being sixth. The later text

¹ Cal. State Papers, Ireland, 1580, p. 236, 1600, p. 317.

² *Paria*, "Round Towers," p. 97, and note, p. 99. Cal. Documents Ireland, vol. i, p. 21.



Earthworks in County Limerick.

(MS. H. 3. 17, T.C.D., p. 745) interpolates after the third and fifth names *Aenach sean Clochair* and *A. Eamhna*,¹ and adds *Martra muintir Finntain*, evidently a Christian cemetery. It nowhere asserts that *A. Clochair* and *A. Culi* are different.

In the charter "*Enachculi in Corbali*" and *Cloghur* (not *Enach Cloghur*) are named apart; the last is probably Clogher, near Dromin, which has only a small defaced earthwork and a liss.

The "Agallamh na Senorach,"² a high authority for topography, with especially minute knowledge of this district, identifies the names, placing between Cullen and Ardpatrick "'Oenach Culi mna Nechtain, now called . . . 'Oenach sen Clochair.'" Its allusion to Nechtan, who appears in independent poems at the neighbouring Knockainey and in the Dalcassian pedigree, shows local knowledge in legend as minute as in that of the topography round Cenn Febrat (Slievereagh). The *Mesca Ulad*³ places 'O. sen Clochair between Knockainey and Slievereagh. Lastly, Corbally adjoins the townlands in which the group of earthworks are found near Clogherbeg and Clogher Hill. The remains are similar to those at the other great 'Oenach cemeteries—Tara, Brugh, Slievereagh (Temair Erann), and 'Oenach cairbre at Monasteranenagh. It is most improbable that the Dergthene had two cemeteries in that small well-defined area. In face of this cumulative argument I see no reason to revise my former statement for what is evidently a late marginal note inserted out of place in the later text.

¹ "Aonach Macha" at Emania (Ann. Four MM.), A.M. 3579.

² Silva Gadelica, vol. ii, p. 118.

³ Ed. Hennessy, p. 19.

IX.

PLACE-NAMES AND ANTIQUITIES OF S.E. CORK.

PART II.

BY REV. PROFESSOR PATRICK POWER.

[Read DECEMBER 10, 1917. Published SEPTEMBER 18, 1918.]

PARISH OF CAHERLAG.

This parish, which belongs to the Diocese of Cork and is of comparatively small extent, lies on the summit and along the southern slope of the high ridge which runs east and west through the bannoy. Owing mainly to the parish's proximity to Cork city and its consequent exposure to Anglicizing influences, its ancient place-names are neither numerous nor well preserved. Neither are its antiquities many or important. There is no Caherlag townland though the proper name is borne by a village, a glade, a church site, and a graveyard, all belonging to the townland of Kilmalishal. Caherlag (Cathair Lag) seems to signify *Saidh* (or *Maidh*) *Stone-fort*. The name appears as *Cathairlagh* in 1290¹ and as *Bathairlaghern* in 1767.² Mr. R. A. Foley and Prof. O'Donoghue, both of whom bring special knowledge of local usage to bear on the subject, tell me the true Irish name is *Cathair Laga* ("Laga's Stone-Fort"). There was a Laga, daughter of a King of Feara-Muighe, but it is not necessary to suppose that Laga the princess, and our Laga of the place-name are identical. The parish took its name from the church, and the latter got its designation from the *Cathair*, and as this last was situated on a ridge-summit, there is nothing about the locality to suggest a *lagh* or hollow. Almost certainly the original church was within, or beside, the *cathair*, of which, unfortunately, not a trace remains. Indeed the church has almost as completely disappeared as the fort, and, even as long ago as the time of the *Dubliners' Survey*, no being native had ever seen any trace of either. Bishop David Downes, however, tells us: he saw the Church of

¹ Tax. P. Nicholas.² First Fruit Records, quoted by Brady, vol. i, p. 51.³ Downes' Tour.

Caherlag in October, 1700. It was "on the top of a hill, on the left-hand of the road from Corke to Youghal, built with stone and clay, the walls half down. A ditch about the churchyard." Besides the graveyard at Caherlag, there are three other ancient (Celtic) church sites in the parish—Kilcoolishal, Killahora, and Killacloyne.

TOWNLANDS.

BALLINGLANNA, Baile an Ghleanna—"Homestead of (in) the Glen." Area, 608 A.

The old bridge of three arches on north boundary of the townland was erected in 1803. At date of the Ordnance Survey there was a distillery "in very bad repair" and a flour mill "in good order." There is a pillar-stone on John Kennealy's farm.

Ballinglanny (Inq. Iac. I).

S.D.D. Maryborough (O.M.); the modern name (derived from a Mrs. Maryanne Palmer) of a mansion and grounds. Other mansion names of similar type are Glenville and Glentown Cottage. A local synonym for Maryborough, *scil.*, "Fillbelly Hall," was in popular use half a century ago.

Poll Cam, "Crooked River-hole," in bed of the Glashabuidhe Stream.

BALLYHENNICK, Baile Uí Shionnaig—"O'Shinnick's Homestead." The place is now called Rockgrove, and is practically all demesne land, in which we may expect neither ancient names nor antiquarian survivals. Area, 220 A.

Ballyhinicke (Inq. Car. I).

BALLYNAGARBRACH, Baile na gCairbreach—"The Carberys' Homestead." Area, 232 A.

There were formerly three lises in the townland; not one of these now survives, though the sites of all are traceable.

Ballynagarbraghe (Inq. Car. I).

S.D.D. Glanmire River (O.M.), on west boundary. Gleann Maghair—"Maghair's Glen": compare Alt Mire and Lis Mire, near Lisscarroll.² O'Donovan quotes Cormac's Glossary for another signification of the word Maghar—*i. miniasg.*

Droichead na nAdharc—"Bridge of the Horns," in allusion possibly to ornamental pinnacles of masonry on the battlements.

Cnocán Ruadh—"Little Red Hill."

¹ Mr. R. A. Foley informs me that in Imokilly the word "Carbrys" means con-acre people.

² O.S. Field Books

Páire na Stagún. My informant could not explain the meaning of Stagún in the context. The dictionaries variously render the word—potato-cake, a jibbing horse, and a frost-bitten potato. I must, I fear, leave the reader to take his choice of the three interpretations.

BALLYNEROON, Baile na Ruamhan; meaning unknown. O'Donovan¹ suggests R. = spades, but *Rámhan*, not Ruamhan, is the word for spade. There is a place of the same name, parish of Lismore, Co. Waterford, which, for reason given, I have interpreted "Irwin's Homestead."² Area, 174 A.

On Mr. Gleeson's farm are two circular lioses of medium size, one of which is partially destroyed, but the other is an excellent specimen, excellently preserved.

Ballynaroone (D.S. Ref.).

S.I.D. Páire a Comhgair—"Field of the 'Short Cut'"; a name of fairly frequent occurrence. In the present instance a much-used path runs through the field.

Páireín a bhFad Sios—"The Little Far-down Field."

DUNKITTLE, Dún Cúil—"Cúil's Dún," the former residence, no doubt, of the local chieftain. There is neither trace of Dún nor reference (beyond the place-name) to its quondam and name-giving occupant, who, judging from his name, may have been a Dane or of Danish descent. Area, 413 A.

The O.M. records a number of the usual modern meaningless, very artificial sub-denominations—Woodville, Richmond, Woodlands.³

Downkittle (Inq. temp. Eliz.).

S.D. "The General Field." Origin of the name is unknown.

S.D. Paire na dTurtóg—"Field of the Hillocks."

KILCOOLISHAL ALS. FACTORY HILL. Cill Cúiliseal—"Church of the Lower Ridge (Low-shouldered Church)." *Lagaid Cúiliseal* as an adjective. It may, however, be, as Mr. Foley suggests, that *Cool*, the second member of the name, = *Comla* (*Cúla*), and that the compound, Kilcool (*Comla's church*), is here qualified by the adjective *iseal*, lower. The name-giving church was almost certainly not Caherlag (though this latter is also within the townland), but a primitive Celtic church which occupied site of the present house known as *Dunslad*.⁴ Area, 442 A.

¹ *Loc. cit.*

² "Place-Names of Decies," p. 20.

Might not use of these fatuous names be made a source of revenue in these lean times? Why not tax the names as other luxuries are taxed? This hint is offered gratuitously to the Chancellor of the Exchequer.

³ Mr. R. A. Foley reminds me that there was a *Comla*, sister of *Laga* (*supra*), dau. of a king of *Feara-Muighe*.

Caherlag graveyard and church site are on the townland. The burial-ground, which is overerowed at the south side,¹ is but sparsely occupied at the north. About centre of the enclosure is a standing grave-stone bearing the following inscription in a kind of cursive script:—

“ T. R.
Mich^l Sinnic^k
45 years P.P., B.
T.D., M.A., N.A.
Died June the 29th 1791.
Aged 75 years.”

The letters N.A. stand for Notary Apostolic; B.T.D. may be the stonemason's rendering of B.S.T., i.e., Bachelor of Sacred Theology. Father Shinnick was, I think, the founder of a bourse, or burses, in Louvain for the education there of Irish students.² *Vid.* under Ballyhennick, *supra*.

S.D.D. Father Mathew's Tower (O.M.). A castellated building erected by a local admirer of the Apostle of Temperance to commemorate the fruitful labours of the devoted Capuchin.

“ Boglands ”—A sub-den. of inconsiderable extent.

Páirc a' Chlampair—“ Field of the Contention.”

Cnocán na Gheimhlighe—“ Little Hill of the Fettered (Beast).”

Glebe (O.M.), on west side of the townland.

KILLACLOYNE, Cill na Cluana—“ Church of the Sequestered Place.” Area, 328 A.

The church which gave the place its name was situated near the north angle of the townland. Its exact site was found, with some difficulty, on Fenton's farm, to west side of the main road—beside a stream in a rather boggy situation at bottom of a shallow glen. Foundations of a building—presumably an early church of oratory type—are faintly traceable; they measure 18 feet by 9 feet. Part of the townland of Killacloyne lies within the neighbouring (Carrigtohill) parish, which see.

¹ The demand for accommodation on the south side of ancient cemeteries must have struck all who give time to their study. Church symbolism furnishes the explanation; I take it to be this—the north was the region of the infidel; the north portion of the cemetery, at least the portion of the latter to the north of the church, was set apart for interment of heretics and others not entitled to Christian sepulchre. Though its symbolism has been long forgotten, the north side of the ancient graveyard is still popularly avoided as much as possible.

² There is a current popular belief in ill-luck following clerical money. Father Shinnick's case might be quoted as an instance in proof. On the priest's death some legacy came to his nephew, a close-fisted man. His wife got access to it and squandered it on her lover. When her husband discovered the pertidy he cut her throat and then his own. His coffin was flung into the river, but as it would not sink, it was buried finally in the wooded steep of Glanmire.

S.DD. "The Gob," a field. "Gob" is, of course, an Irish word—a protruding beak.

"The Leaca." "Leaca," a glenslope.

"The Lag." "Lag," a hollow.

Bóthairín a Ghotair—"Little Road of the Puddle." It is hardly necessary to remind Irish readers that *gutter* in Irish colloquial usage means soft, slushy mud.

KILLAHORA. Cill a Horaigh (or, Hora); meaning doubtful. Killahorige is an old form. Area, 424 A.

The site of the eponymous ceall is marked on the Ordnance Map, and is faintly remembered locally; there are no remains, but circuit of the circular surrounding fence is traceable.

S.DD. 'Ard na Caillighe—"The Hag's Height"; this is a small subdiv., and equates with the present "Windsor Hill."

Go ban Chreabhair—"The Woodcock's Beak"; a field so called from some fancied resemblance to the object named.

Páirc a' Chomhgair—"Field of the 'Short cut.'"

LACKINROE. Leacain Ruadh—"Red Glen-Slope." Observe again the use of the locative for the nominative. Area, 451 A.

The place appears as "Annemount" on some maps. There were two lises, now levelled—one to east, the other to west, of main road—on John O'Donoghue's farm. On O'Donoghue's farm, too, is a ceall site, but no visible remains survive, save traces of an ancient surrounding fence—circular as usual—enclosing an area of approximately half an acre. From the cill site, which is on a detached elevation, there is a beautiful and extensive view to north, east, and west, bounded in the mellow distance by the Galtee, Knockmaeltdown, and Comeragh (Co. Waterford) ranges. The old bally roadway, which cuts east and west through the townland, was the former main Cork and Youghal road.

S.DD. An Chill; the early church site already alluded to.

Páirc na dTri gCúinne—"The Three-Cornered Field." This name is of so frequent occurrence that, for our present purpose, we may regard it as descriptive merely and a common noun; henceforth, therefore, it will not be necessary to record it.

"The Fay Field." Feith (*fay*) is a vein of green herbage, indicating course of a subterraneous spring.

"The Long Reach," a field on Gleeson's farm.

On this townland the Ordnance map also records "Annemount" and "Combermere," two names of modern, meaningless character.

ROWGARRANE, Ruadh Gharrán—"Red Grove." Area, 240 A.

The O.M. records three lises on this townland—scil., two large specimens and one of lesser size. All these, however, have entirely disappeared, the only traces remaining being the field-names, “Fort Field” and “Páire a Leasa,” on M’Carthy’s and Twomey’s farms respectively.

Rowgarron (Inq. Car. I).

S.D.D. Páire na nGearrhiadh (or gCorrhiadh)—“Field of the Hares (or Stags).”

“The Stand Field,” in which races were once held.

CARRIGTOHILL PARISH.

Judging from the great extent of its parish, Carrigtohill was probably a “Mother Church.” The parish contains no fewer than thirty-seven townlands, many of them, however, of less than average area. The region embraced comprises about one-half, arable upland, and one-half, fertile limestone plain. In Carrigtohill village are the remains of a large ruined church, with a strong, square tower attached, and at Kileurfin Glebe are the insignificant ruins of a second and smaller church, while an early church site has been identified at Ballyregan. There are Holy Wells at Woodstock, Ballinbrithig, and Terrysland. The castle of Barryscourt, near Carrigtohill village, is a very fine specimen of a modified peeltower, which, with its courtyard and outworks, is in a tolerable state of preservation. Windele, who was at Mass in Carrigtwohill on Palm Sunday, 1833, describes the congregation as bringing each one his own branch of palm, and holding it up in his hand, to be blessed. The church then existing had, by the way, been designed by the well-known Father Mat Horgan, while he was curate in Carrigtwohill. Over the doorway was an Irish inscription:—“Do Dhia Fo Tharmuin Muire Naomhtha.”

TOWNLANDS.

ANNEGROVE, Baile na Speire. Meaning unknown. *Speire*, David Barry, of Carrigtohill, informs me, would mean a lot of business involving worry or vexation. I find the name spelled Ballinsperry in old documents. The name Annegrove the place owes to a Lord Barrymore, whose wife was Anne Coughlan, of Ardagna, Co. Waterford. Area, 297A.

On the townland are the unimportant remains of a church, Kileurfin, which stand within the ancient cemetery on brow of the range running east and west through the barony. The west gable is practically entire, but so thickly and completely covered with ivy that no window or other such feature is visible. Besides the gable in question there stands a fragment—three yards long by four yards high—of the north side wall, and another large fragment has but

recently fallen: there are also the foundations of the east gable. A local red sandstone is the material used in the masonry throughout. The ancient cemetery—an acre or so in extent—contains nothing of very particular interest. At west side of the enclosure is a roughly squared block of hard sandstone or conglomerate—3 feet by 2 feet by $1\frac{1}{2}$ feet—which looks like an ancient terminal stone. At any rate, it is of evident antiquity. A table-tomb covers the last resting-place of the once notable Coppingers of Barrycourt. The now neglected monument was erected in 1788.

The name *Kilcurfin* is puzzling. Probably it is the equivalent of the popular Irish designation, *Cill Chraí bhí*—"Church of the Little Swamp." It may at first sight seem unlikely that there could be a swamp at such an elevation. Let the visitor to *Kilcurfin* however, but cross the road which runs north and south along the boundary wall of the cemetery, and scale the fence at opposite side of the road. There in the field before him, separated from the cemetery by only a few yards, he will see in the spring pond and boggy patch, a survival of the aboriginal morass. In this connexion, too, it is useful to note that the field adjoining the cemetery to the north is named *Laban*, i.e. *pool*. A difficulty in way of the equation—*Kilcurfin* = *Cill Chraí bhí*—is the substantial antiquity of the farm, *Kilcurfin*. It occurs, for instance, under the name, *Kilcurfin*, in the Taxation of Pope Nicholas (1291). O'Donovan would trace *curfin* to *cora finn*, "white weir."

Kilkillilane, at Killeurhine, at Kilcurfine (Inq. Iac. I).

S.D.D. — "The Cup Well," a well in a field at west side of main (N. & S.) road. It is closed over, and an inscribed limestone slab informs us it was—

Erected by
FRANCIS WISE, Esq.
A.D. 1798.

Carraig or "The Rock," a point on the road where formerly was a rock, cut away "at time of the Public Works."

BALLINAGUNTA Bala na Baintreachaigle—"The Willow's Homestead." Area, 338 A.

"The Mile Bush," a landmark by the roadside.

Carraig Fionn—perhaps "Tossilyng Rock"; compare *Cloch Labharais*, the Western *Farró* also = the outline backbone, or verge. In the present instance the rock is a remarkable limestone outcrop.

It may be interesting to note here that the word *cur* is used locally to designate a small trench, or drain, to carry water, e.g. for irrigation.

Carraigín an Aodhaire—"The Shepherd's Rock"; an outcrop of less striking appearance, and smaller, than last.

"Mile Bush Rock." A large limestone rock by the roadside.

BALLYADAM, Baile Mhic Adaim—"MacAdam's Homestead." MacAdam was the Irish name adopted by a branch of the Barrys. Area, 256a.

The townland is of very irregular shape.

Ballyaddame (Inq. Eliz.).

BALLYBRITTIG, Baile an Bhriotaigh—"Britt's Homestead." Area, 724a. The townland is specially rich in antiquities; the O.M., for instance, records no fewer than seven lioses. There are likewise two Holy Wells, one each on Mrs. Walsh's and Mrs. Murphy's farm. On the holding of Mrs. FitzGerald, where formerly stood three or four lioses, only two now remain; these are both circular in plan, and of small size. There is one lios each on the respective holdings of Jeremiah Corkery, Denis Mahoney, and James Twomey. The lios on Corkery's farm is irregularly circular in outline, and about a quarter acre in area, with its fence partly prostrate and, where perfect, about five feet in height. Mahoney's, Twomey's, and Mrs. FitzGerald's lioses are much the same size as Corkery's, just described, but in a somewhat better state of preservation. "Rounds" and votive offerings are still made at both wells. Of the two the well on Mrs. Murphy's is the better known. It will be found—a quite open, clear, bubbling spring—within a fox-covert, in the side of a small glen, embowered in willows. Although, *teste* Mrs. Murphy, the well is sacred to St. Colman, the "rounds" are made chiefly on St. John's Day (June 24th).¹ The well on Mrs. Walsh's holding is rarely visited now. I found, however, one votive offering (a piece of ribbon attached to a tree) in July, 1917. Forty years ago "rounds" were quite frequent there. The well is on the eastern side of a glen slope. It is overshadowed by a group of ancient whitethorns, and it is approached from above by a flight of steps, fifteen of which are of stone.

S.DD. Réidh na Saileach—"Mountain Plain of the Willows"; a considerable subdivision, regarded locally as an independent townland. The willow in the present connexion is the wild mountain variety.

Páircín na Fairrge—"Sea Field," because it affords a distant view of St. George's Channel.

Tobairín na Naomh—"Little Well of the Saints."

Páircín a' Phiobaire—"The Piper's Little Field."

¹ It is very remarkable, by the way, how many wells are dedicated to the Baptist, and how common are "rounds" on the feast of this saint. In this connexion proximity of St. John's Day to the summer solstice—coupled with the popular bonfires on the preceding evening—is suggestive of pagan association.

BALLYCURREEN, Baile Uí Chuirrín—"O'Curran's (or O'Creaghan's) Homestead." Area, 375 A.

There were two lioses on O'Connell's farm, but they have been levelled of recent years.

S.DD. Tobar an Iarla—"The Earl's Well." My informant—a remarkably intelligent man, John O'Neill, by name—thinks the name-giving Earl was none other than Patrick Sarfield, Earl of Lucan, who was brother to a quondam owner of the estate. This identification, I must confess, seems far-fetched and unlikely. The well has, according to popular belief, shifted its site: it is now in a yard adjoining a labourer's house, but its rightful, original habitat was lower down the road to the south—or Johnstown, where is a waste patch, or piece of commonage, on which a "pattern" was formerly held.

Once a Drama—"Hill of the Ridge." The name is not tautological as it seems.

BALLYLEAMY, Baile Uí Laoghaire—"O'Leary's Homestead." Area, 158 A. The O.M. shows two small lioses on this townland. Only a single lios now survives; this is on Mrs. Barry's farm, and, with its fence now nearly levelled, covers about an acre.

S.DD. An Branar—"The Grafted Field."¹

Páine na Cómhólan—"Field of the Smithy": there is no forge now.

Múchan = "Scatterman": a field so called, no doubt, from the former existence therein of beehive chambers or passages therewith connected. Múchan is primarily a chimney, but, in field names, it generally designates the subterranean passages, &c., of a lios. Mr. P. M'Sweeney, Inspector N.S., informs me that *Múchan* is used in Decies to designate also a field in which occur unexpected cavities or half-hidden and open drains: the name, in this case, was, no doubt, applied originally to the drains, and later—by transference—to the field.

BALLYRIGGAN, Baile Uí Riagáin—"O'Regan's Homestead." Area, 207 A.

The O.M. records a single, large, circular lios: this is a fine specimen, about an acre in extent, on Wm. O'Connell's farm, with a single surrounding fence, some 15 feet in height by 20 feet thick.

There is also a cill, or early church site.

¹ "Grafting," or getting up with graftan or mattock, was an old, common, laborious and ultimately injurious method of preparing a lea-field for a potato crop. The turf in a light strip was first detached with the graftan and then allowed to dry. Next, it was burned, and finally the ashes were ploughed or dug into the soil. The operation secured, it is claimed, a good crop of mealy tubers, but eventually it burnt and reduced the land. The graftan is not yet quite obsolete in Co. Cork; it is used in the cultivation of lazy beds, and, this present year, the writer has even seen a "branar" in process of cultivation within a neighbouring barony.

Ballyregaun (Inq. Tac. I).

S.DD. Cúileach Cam—"Crooked Corner Place." *Cúileach* I take to be a derivative from *cúil*; it is applied, in the present instance, to a hollow or dip in the road.

Ceann a' Bhóthairin—"Little Road Head."

Seana Bhóthar—"Old Road"; on or near the coterminous boundary with Ballinbrittig. The place was formerly ghost-haunted. My informant, however, never saw anything more fearsome than a cat seated at midnight on the summit of a gate pier!

Ceall; an early church site on Mrs. Roche's farm, and near the south-west angle of the townland. Here a low, circular fence on top of the glen slope encloses a space, half an acre, or so, in area.

"The Gary Road." Probably the word is Gaortha—a wooded and stream-watered place.

Cnoc a' Droma—"Hill of the Ridge"; a field.

BALLYRICHARD, Baile Ristéaird—"Richard's Homestead." Area, in two divisions, 392 A.

There is one small circular lios still standing on Kelleher's farm, and another, on Lawton's, has been levelled.

S.DD. "Schratháns." A subdenomination of small extent. *Scrathcán* means coarse land, and the word is of fairly frequent occurrence in place-names. Joyce derives it from *scrath*, a green sward, or a scraw or coarse sod dried for burning. With this derivation Canon Lyons' disagrees. Joyce, however, though—*aliquando dormitat*—is much more reliable and saner in his derivations than the worthy canon.

"The Racecourse"; a field.

BARRYS COURT, Cúirt a Bharraigh—Idem; from the great castle of the Barrys still surviving in a comparatively good state of preservation. According to Michal Deasy, an older name for at least a portion of the townland was Cnoc a Loiscthe—"Hill of the Burning" (i.e. Burned Hill). Area, 699 A.

Ballynwoorige (Inq. Car. I).

On the townland was one large lios which has been demolished recently. The chief surviving object of antiquarian interest is, of course, Barryscourt Castle. It stands now a considerable way from the river bank, but formerly the tide flowed right up to the machicolated walls, and even some perches beyond to the east. There were extensive artificial ponds for ornament and

¹ Cork Hist. and Archaeol. Journal, vol. ii, p. 146.

utility. Till quite a late period, and within the last half century, there were some considerable survivals of the ancient dense yew hedges. The castle of Barryscourt—so, at any rate, it is claimed—owes its original erection (1206) to Philip de Barry, nephew to Robert fitz Stephen of Strongbow's band. In this place, it is likewise claimed, Cambrensis wrote his pseudo-history. The castle, as at present, consists of a great keep, with a courtyard covering about half an acre, and the whole appears to be of somewhat later date than the thirteenth century. Tudor windows and other details suggest a sixteenth-century rebuilding or restoration. Of such rebuilding there is further evidence in an inscription on the stone lintel over the immense fireplace:—

“A° DO. 1588. D.B. ET E. B. ME FIERI FECERUNT.”

This gives us the initials of the rebuilder—David Barry, 1st Viscount Buttevant. The keep, or castle proper, is quadrangular in plan with three flanking towers at the outer angles. The southern flanker is of solid masonry to the height of seven feet. In an upper story is the domestic chapel. There were also three bastions or flanking towers to protect the courtyard. Adjoining the castle is the comparatively modern (1716), but now ruinous, mansion of the Coppingers, who, early in the eighteenth century, became lessees of Barryscourt, as I believe they have ever since continued. Their former residence had been in old Bridewell Lane on east side of North Main Street, Cork. The castle proper has remained uninhabited (except presumably by soldiery) since the days of the last Viscount Buttevant. It was never occupied as a residence by the Barrymores.

S.D.D. Lannagh (O.M.), Oileán Meadhnaich—“Middle Island”; an extensive sub-division, not geographically an island.

Mullaun (O.M.), Mulláin—“Round Hills.” This is a cluster of houses (three at present), surrounded by rounded hills of esker character.

Weir Island (O.M.), Oileán na gCoran. Idem.

“The Round O”: a conical hill of tumulus shape, now planted with timber.

Gróibhín Fóite—“Little Grove of Fota”; a screen of timber.

“The Rosary Walk,” in the castle grounds.

Páire a hChomhgair—“Field of the Short Cut.”

Páire a Bhullan—“Field of (with) the Round Hillock.” There is a small round hill in centre.

Bolharraín Ánd—“Elevated Little Road”: a laneway from the strand to Mullawn village. Elevation here is not figurative but very real.

Clais a' Tobair—“Trench of the Well”; a field.

Clais a' Duine Mhairbh—"Trench of the Dead Man"; now a long timber screen.

Páire na Muc—"The Pigs' Field."

Páircín Fan—"Fan's Little Field." Fan here appears to be a woman's name. I heard from two independent sources that the field embraces the site of a former graveyard.

An Claidh Ramhar—"The Broad Bank." This is a wide earthen fence, bordered by a stream at either side, and leading towards Carrigtohill village. The feature suggests the remark that, in low-lying country liable to floods, a wide "ditch" of this type is often used as a quasi-public footpath. Occasionally, indeed, such a fence is so utilised—without any constraint from floods. This kind of combination path and fence is usually called "a double ditch."

Páircín a' Chodalta—"Little Field of the Sleeping." Somnolency is to be here understood in a quasi-passive sense.

Eibhlín Creaga; meaning unknown. David Barry, grandson and namesake of the poet, and himself an Irishean of no mean order, suggests Oileán Creaga; *aidhlean* means also a palace or mansion. I fear I must leave it at that.

CARHOO, Ceathramha—"Quarter." Area, 97 A.

The "Quarter" was an ancient Irish land measure—somewhat variable, but generally equal to about 120 acres.

CARRIGANE, Carragán—"Little Rock." Area 432 A.

Carrigan (D.S.R.).

There is a reputed holy well on Carter's farm; "rounds" were made there within living memory.

S.D.D. Móinteán na Ráibe—"Little Bog of the Rape Crop."

Leath Hama—"Half Hames"; a field so called from some resemblance to the dimidiated article of horse-attire.

Cnoc Buidhe—"Yellow Hill"; presumably from colour of the blossoming furze.

Bóthairín Nóra—"Nora's Little Road."

An Log—"The Hollow"; a sub-div.

Páire na Mainistreach—"The Monastery Field," on east boundary of the townland.

CARRIGTWOHILL, Carraig Tuathail—"Tuathal's Rock." Area, 566 A.

Maner' de Carrigtohill a/s Barries Court (Inq. Iac. I.).

The ruined Church of Carrigtohill—of unusual interest and importance—consists of nave and chancel, with a strong quadrangular tower at south-west

angle of the former. Carrigtwohill Church was one of the many places burned by the redoubtable Murrough O'Brien. Unfortunately, the building has been considerably modified and interfered with in comparatively modern times to adapt it to purposes of Protestant worship. Part of the nave (eastern end) was roofed over, and the chancel-arch was transformed into an east window. From the occurrence of two arches in the side-walls of the nave, it looks as if the church had a transept or transepts, or, perhaps, aisles. The total length of the church is about 150 feet. In the surrounding large and much-used cemetery are many grave monuments of interest. The most important is, doubtless, the rather elaborately carved tablet which is set into the surviving fragment of the north side wall of nave. The present inscribed slab seems to be a later insertion into a seventeenth-century monument; its inscription reads:—

"This Monument
Was erected by S^r
James Cotter Kt.
For Himself
and His Family Anno
Domini, 1688."

Sir James Cotter, here commemorated, sat as Member for Cork city in King James's Irish Parliament, 1689; he was commander-in-chief of the royal forces in Cork, Kerry, and Limerick, and first sovereign of Middleton (1687).¹

A standing stone (reversed), near south side of the chancel, commemorates:—

"MARGARITA DOULY (or DONLY) QUIN-
QUE TRIGINTA ANNOS
NATA OBIT OCTAVA DIE
JUNII ANNO DOMINI 1735."

In the same grave, presumably for his body was buried at Carrigtwohill), repose the ashes of another Cotter—better remembered in popular story. He was executed in Cork—nominally for rape—in the time of Queen Anne. Cotter was a Papist, and aggressive at that. Debarred by the Penal Laws from possession of carriage horses, he drove into Cork with a team of bullocks, and to emphasize situation and purpose he fastened orange favours to the animals' legs. Moreover, he enjoyed the reputation of a gallant, and was wont—so it was told—to boast of favours from the lady folk of his enemies. All this and more of similar sort did not help him when he stood before a judge who had reason to suspect him of undue influence in his own domestic circle, and before a jury, some members of which bore him more than a grudge. He was convicted, and suffered the extreme penalty at the corner of Broad Lane, in Cork. Cotter's prosecutor was a Quaker damsel, Betty Spurr by name, who had formerly been his mistress. He met this lady on the road from Clonmel and gave her—presumably on her demand—some money and his watch. On second thoughts he demanded the watch back, and finally recovered it, partly by force.

Close to the last is a second small headstone, also reversed, which tells:—

“The Greatest
loss the publick
here has knowⁿ
John O’Leary
lying beneath
this stone who
Died 10^{br} ye 27^{ne}
1763 Aged 78
Years.”

One can only speculate as to the public services rendered; the inscription unfortunately records no more, though we feel that having made so bold a claim it ought to have gone further. Five yards or so to south of choir, and in line with east gable of the latter, is an inscribed stone in testimony that:—

“From This
Stone to ye Wall
is ye Burying Place
of James Sarsfield
and his Family.
W. D. Mar. 23, 1736.
Aged 96.”

W. D. probably stands for “who Died,” and refers to James Sarsfield; for it is not likely that the whole family died on the same day. Finally, a reserved headstone towards west side of the graveyard marks the burial-place of:—

“Ben Griffin
Ju^r who Departed This
Life ye 17 Day of X^{ber} ANN.
DOM. 1723. Aged 24 years.”^t

Windele refers to a peculiar cross-inscribed stone in Carrigtwohill grave-

Cotter is said to have been an Irish scholar; anyhow he, or his father, was the patron of Irish poets and, as may be presumed, he was lamented in many Irish elegies. (Windele MSS. R.I.A.)

¹ Only inscriptions likely to be of some general interest are noted. The student of Irish graveyard lore will doubtless have noticed how the general form of inscription varies with locality. Throughout Barrymore, for instance, direct request (other than R.I.P.) for prayers is not common. The most frequent formulas are: “Here lies (or lyeth) the Body of,” and “This is the Burial place of.”

yard. This, he was informed by Mr. George Martin of Greenville, covered the remains of a Kirwan, who, with his men, held the cross-roads midway between Corrigtwobill and Middleton for three days against the forces of Murrrough O'Brien. Kirwan was finally overcome and slain.

S.D.D. Carraigeán Giarraidheach—"The Kerry-men's Rock." Probably the "Rock" was a natural outcrop. The name is now applied to a cross-roads on the outskirts of the village; the place was "a stand," on Sundays after Mass and on mornings in harvest, for the spailpíns, or wandering labourers, from Co. Kerry, ready to dispose of their services to the highest bidder.

Cúil na Reilge—"Churchyard Corner," a field adjacent to the cemetery. In the same field is a natural limestone cave, called Poll na Reilge.

Bán Mór—"Great Field."

Carraig Tuathail, "Tuathal's Rock"; an outcrop or bluff of limestone, near north boundary of the townland, from which townland and parish derive their name. In this rock was a cave from which ran a subterranean passage, formerly believed to lead to the "Goats' Hole," in Ballintubrid—that is, some two miles to the south-east.

Tobar na Daibhche—"Well of the Vat." *Daibhach* is both masculine and feminine. In the present instance, the name is applied to a well in the village, to rear of the police station.

Tobar Carraig a' Phuill—"Rock Hole Well." The writer met a place of the same name in the Australian backblocks—almost beyond civilization.

CLONEEN, Chuainín—"Little Meadow." Area, 676 A.

Cloinne (D. S. Map).

There was at least one lios, but it survives no longer. It stood in the field now called "The Lawn," in front of Cloneen House.

S.D.D. Sliabh Mór—"Great Mountain," a subdivision—of no great extent.

Clais an tSleibhe—"The Mountain Trench." The name is applied to a large field.

Bán a' Gharráin—"The Grove (or Garden) Field."

"The Tread Mill Field"; so called, I was informed, from the fact that a poor fellow, found stealing turnips therein, was obliged to purge his contumacy on the treadmill.

CLYDEFF, Claishe Dubh—"Black Earthen Fence." Compare Blackditches, Co. Dublin. Area, 111 A.

Cliduffe (Inq. Iac. I.).

Wm. Hackett of Middleton, an enthusiastic, and, for his day, careful and capable antiquary, makes allusion¹ to an ancient *claidhe*, "called 'Cloy an Earla,'" on, or near, the coterminous boundary of Barymore and Imokilly.

S.D. Barr a' Bhaile—"Village Head."

CURRAGH, Corrach—"Marsh." Area, 585 A.

The townland is entirely demesne; hence the paucity of subdenominations.

S.D. Gleann na Muc—"Glen of the Pigs," a glen-side with passages through the underwood.

FAHYDORGAN, Faithche Uí Dhargáin—"O'Dorgan's Green." Faithche, minus the Uí Dargáin, is also in common use. In Carrigtwohill graveyard, near west boundary of latter, is an O'Dorgan tomb of considerable antiquity. Area, 147 A.

There is one small circular lios on the townland.

S.D.—An Faithche—"The Green," a field of some eighteen acres, from which the townland name comes.

FOATY. O'Donovan renders it Fódh Thige (Sod House), or rather he hesitates between this and Feóidhte (Decayed, or Withered, Things). Neither derivation is, to say the least of it, very convincing. *Fiodh*, a wood, suggests a more probable etymology. The local pronunciation is *An Fóidte*, which Prof. O'Donoghue thinks = Fód teith ("Warm-soil"). Area, 221 A.

Fotye (Inq. Car. I.).

Foaty townland, in two parts, occupies the whole island of the same name. Part of the townland lies within the adjoining parish of Clonmel, *qd. vid.* The island is now joined by bridges to Great Island on the one hand, and to the mainland on the other.

S.DD. "The Crescent," a modern terrace of cottages occupied by employees of Lord Barrymore.

"The Causeway," "The Deerpark," and "The Warren."

Loch na Bó—"Lake of the Cow." A pond, supposed to derive its name from a legendary cow—the "Bó Bhán," or the "Glas Gaibhneach."

FORESTOWN, Baile an Fhíréastaigh—"Forest's Homestead." Area, 124 A.

On the townland was a single circular lios of rather small size; alas, its ramparts have been levelled, though the site remains untilled. Evidently

¹ Windele MSS. R.I.A., 12, I. 4.

² Ordnance Survey Field Books, Mountjoy Barracks.

something befell the demolisher of the fence, and deterred him and others from further advance along the Vandalic road. Destruction of this particular lios is specially to be regretted, as the "fort" had a name—Lios Aimhréidh, and it would be most interesting to compare it with the peculiar and similarly named lios on Woodstock townland.

GARRANECLOYNE. Garrán na Cluana—"The Meadow Grove." Area, 170 A.

On this townland stands a ruined mansion (evidently seventeenth century) of the Coppingers.

Garranecloyne (D.S. Ref.).

S.DD. "The Cap-well"; see under Annagrove, *antea*.

Bóthairín na bPáidreacha—"Little Road of the Pater-nosters"; from some pious individual, or family, resident in, or using, the laneway.

GARRANES, Na Garrain—"The Groves." Area, 295 A.

The O.M. shows four lioses, viz., one of fairly large size and three of smaller area. The larger monument, on Fitzgerald's farm, and now completely destroyed, contained souterrains which were opened, explored, and described many years since by Crofton Croker and others. On John Leary's farm is a small lios—not more than a quarter acre in area but quite perfect—with its circular fence about 8 feet high. On Thomas Barry's holding is a similar monument, with a well-defined external trench, and on Mulcahy's holding adjoining is yet another about three-quarter acre in area, and with trench and ring-fence perfect. There is also a fine dallan on Fitzgerald's farm near the cross-roads. The megalith is of the local slate, stands 6 feet high by 6 feet 7 inches by 2 feet, and is cut naturally, on the west face, into a series of two steps.

S DD. Páire a Dalláin—"Field of (in which stands) the Pillar-stone," just referred to.

Páire a Mhóinteáin—"Field of the Boglet."

"The Caol"; name of a field. Caol is a narrow place.

Páire na Machairí—"Field of the Plains." The plural here is strange. Possibly the correct form is "Na Macraibh" ("of the youths").

GORT VECSTA, Gort a Ghósta—"Tillage-field of the Ghost." Area, 23 A.

An enchanted sheep frequented the place, bewildering wayfarers and leading them astray, especially by night. There are certain fields which possess a somewhat uncanny reputation of this kind. People who enter them at night are misled: they wander round and round, unable to find the exit, till morning. The specific superstition is fairly common, and, so far as the writer is aware, it has not been noted hitherto. The present small townland was once, most probably, such a field. Other fields, in other localities, with similar reputations will be noted later.

Gortygoosty (Inq. Iac. I).

GORTNAMUCKY, Gort na Muice—"Tillage-field of the Pig." The qualifying term, in the singular, suggests that the eponymous pig was a legendary creature—akin, for instance, to the boar which killed Diarmuid O'Duibhne. Area, 239 A.

S.D. Páire Liath—"Grey Field."

KILCURFIN GLEBE. See under Annegrove, *antea*. Area, 10 A.

KILLACLOYNE. See under Caherlag parish, *antea*. Area, 184 A.

S.DD. "The Lag Field." Lag = a hollow. The Lag in question is a *slogaire*, or limestone swallow-hole, of great depth.

Poll Con—"Dog's Cavern"; this is the swallow-hole in Lag Field." Mouth of the opening—about a perch square—is surrounded by a thicket of blackthorn, but is otherwise unprotected.

"Brown Island." One of the many small islands in Cork Harbour. Its Irish name, if it had any, is lost. Here is a large stone which Fionn Mac Cumhal flung hither from some neighbouring parish. In the adjoining parish of Mogeeshá is a second "Brown Island," part of the townland of Ballintubrid.

LABAUN, Lábán—"Puddle." Area, 13 A.

This is a single large field adjoining Kilcurfin graveyard on the north side. Its name, in all probability, perpetuates memory of the marshy place from which the ancient church was called.

Labane (D.S.R.).

LACKENBEHY, Leaca na Beithe—"Glen Slope of the Birch-wood." Area, 306 A.

Lackenbegghy (D.S.R.).

The O.M. records two lioses on the townland. One of these is, or was, on summit of the round, or oval, hill known as "Ceall Ghuaire." It has disappeared, leaving only traces and its name, "An Lios," behind. The other, on the farm of Michael Barry, is well preserved and of medium size (about three-quarter acre in area), with its circular fence 8 feet or 9 feet high and practically perfect. There was beside—on Michael Barry's farm—an immense folacht faidh in a low-lying field beside a stream on west side of townland. Hundreds of loads of broken and burned stones and black earth were extracted from the mound. On Buckley's farm was another cooking mound of similar character, but apparently of less imposing dimensions.

S.DD. Ceall Ghuaire—"Guaire's Church." The name is applied primarily to a striking round, or oval, hill, which still bears traces of the birch-growth

that gave its name to the townland. Secondly, the name is applied to a sub-division of some 75 acres. I could, however, find no trace or tradition of a ceall.

I also found the following field names:—Páircín Ubhla-Ghorta ("Little Orchard Field"); Páircín Conny "Little Firewood Field," or, perhaps "Conny's Field"; Páirc a Leasa (the "Lios Field"); Páirc a Phon (the "Pond Field"; Páirc na Claise "The Natural-trench Field"); Ban na Ceardhan ("The Smithy Field"); and Connlach Cam ("Crooked Stubble Field").

LONGSTOWN, Baile an Longaigh—Idem. Area, 128 A.

The O.M. records two lioses—one of them square. Both have unfortunately disappeared, along with a third, which the map has left unrecorded. They were all on the present McGrath's holding.

S.D. Cunnig a Chain—"Corner of (with) the Hollow"; a dip and bend in the road on the boundary of the present townland with Garranes.

LYSAGHTSTOWN, Baile an Aiséadaig. Aiséadaich is evidently the local Irish equivalent to Lysaght. The name Lysaghtstown is scarcely known locally; the popular name is "Haymount." O'Donovan, however, gives the name as Baile mhic Giolla Lasachta, and he adds that the Lysaghts are said to have been a branch of the O'Brien family.¹ **Area, 270 A.**

S.D.D. Haymount (O.M.); said to be derived from a family named O'Hea, recently, but not now, resident therein.

Gleann na mairc—"The Pigs' Glen," on the coterminous boundary with Curragh.

Seana Bhaile—"Old village."

Páirc na gCapall—"Horse Field."

POULANISKY, Poll an Uisce—"Water Hole." Area, 53 A.

S.D.D. "The Chapel Field"; on the edge of a bog on Carter's farm. Most probably the place was the site of a Penal Days' chapel.

Móinteán—"Little Bog."

STANSBELL. The available evidence points to Ballyregan (which see, *antea*) as the original name. **Area, 165 A.**

On the townland is an early church site or ceall.

S.D.D. "Wakenan's Glen," on the coterminous boundary of Annegrove.

"The Ceall" (Cell); the early church site above alluded to. It will be found on Miss Reilly's farm, close to her residence, and is indicated by the still surviving circular enclosing fence.

Connlach Cam. I find the word *caibé* of occasional occurrence in place-

¹ O.S. Field Books.

names, but I am unable with certainty to determine its exact force. It appears—but the dictionaries do not record it—to be a collective or cumulative of *cúil*, a corner.¹ In the present instance the name is applied to a bend and dip in the road. At the spot are two old gate-piers, on top of one of which the ghost of one Joe Wakeman was said to have been seen.

Cnoc a Droma—"Hill of the Ridge," i.e. Ridge-backed Hill.

Páirc na Claise, Páirc Fhada, and Páirc na h'Orna—field-names of obvious signification.

TERRYSLAND, Baile na Speire (meaning unknown) and Baile Nua (as below). The name Terrysland is hardly recognized or used locally; indeed, it looks as if the present were an instance of a place-name officially applied in modern times without warrant of living usage. Ballynoe is the recognized popular designation for at least portion of the townland, and, *teste* David Barry and the general tradition of the countryside, Baile na Speire is the ancient name for the remainder of the division. Area, in two parts, 304 A.

S.DD. Ballynoe (O.M.), Baile Nua—"New Homestead"; a name of frequent occurrence to designate what would be now a very ancient homestead indeed, if it survived. In the present instance the name is applied to a subdivision some 160 acres in area.

Curraheen, Corraichin—"Little Swamp"; another subdivision—this time, of about 75 A. There is no swamp now, but the place is low-lying, and a respectable stream rises, or receives substantial augment, therein.

"St. David's Well"; a holy well, still in high repute. "Rounds" are still made on St. John's Day and the days succeeding. Overshadowing the well, which is close by the railway embankment, is an aged willow-tree.

Cnoc Mór—"Great Hill"; name applied to a field.

Páircín a tSagairt—"The Priest's Field"; probably because his Reverence held it as tenant.

Páircín na Luch—"Little Field of the Mice." This is the only instance in which I have found the word *luch* entering into the composition of a place-name. It is of course possible that the word is Locha—"Ponds."

Bealach an Gbillín—"The Gelding's Roadway." Of course gillín has other meanings which must not be regarded as absolutely excluded by the foregoing rendering. Gillín may signify simply—a smooth-coated horse, or a little horse-boy.

"The Nasty Field." I cannot explain the reference or application.

¹ In this connexion two forms *cúl*, *cúil*, and *cúil*, *cúile*, have already been noted. To these may be added *cuail*, gen. *cuaille*, a pile; *cuaille*, gen. *idem*, a stake; and *cual*, gen. *cuail*, a faggot.

TIBBOTSTOWN, Baile An Tiobóidigh).—“Toby’s (or Theobald’s) Homestead.” Compare Ballytibbot (Tibbotstown), parish of Inch, barony of Imokilly, where the Irish form is Baile Thiobóid. Compare also Ballymackibott (Baile mhic Thibéad), parish of Ardagh, same barony. Theobald was a common Christian name in the Butler and De Burgo families. Area, 228 A.

There were five lioses on the townland, but all except two have disappeared, and even the two survivors—of medium size and circular in plan—have been partially destroyed. One of the completely obliterated lioses was of unusually large size, and was inhabited by an enchanted hare.

S.DD. Seana Bhaile—“Old Homestead.” A name of very frequent occurrence, to denote a former village site.

Seana Mhuileann—“Old Mill.”

Poll Cam—“Crooked Hollow.” A twist and depression in the road, towards west side of the townland.

TULLAHGREEN, Tulach—“Little Hill.” Height, length, &c., in place-names are always purely relative. Here, where the country is almost quite flat, a slight elevation or natural mound, which would pass unnoticed in undulating surroundings, becomes noticeable and important enough to give the place its name. Area, 113 A.

The townland is entirely, or almost entirely, demesne land.

S.D. Acharlóidín. In this guise it is not easy, at first sight, to recognize Abhall-ghoirtin—“Little Orchard.”

WATERROCK, Carrig-an Uisce—Idem. A stream disappears here beneath a rocky outcrop and re-issues some distance away. Area, 349 A.

S.DD. Crann a Bhile—“Large Tree.” The name seems almost tautological, as both *crann* and *bhí* signify a tree. The name is at present applied to a locality where, on both sides of the road, is an outcrop of limestone and a quarry. In the adjoining field, on Coughlan’s farm, many human skeletons have been found.

Talen a Droicéidín—“The Wren’s Well.” The name is now applied to a field.

WHINSTOCK, Bun a Stuaibh. The meaning is somewhat doubtful; the name is written as above in a ms. of David Barry, the poet, who was himself a native of, and resident on, the townland. Mr. R. A. Foley quotes the form *Banasló* from a ms. dated 1822. *Stuaibh* is given in the dictionaries as an arch, a rainbow, a sheet, scroll, gable, wall, pinnacle, or ridge. Area, 581 A.

On the townland stands a remarkable lios, crowning a commanding height which affords a glorious and extensive prospect over sea and land. This is Lios Aindriúdh, covering with its double rampart an area of about three acres, and crowning the ridge-brow on Lawton’s farm. The outer circular

rampart is, perhaps, 15 feet or 16 feet high, while its inner and concentric fellow must be some 2 feet or 3 feet higher. Between the two lies a trench correspondingly deep; the second or external trench, nearly 10 yards wide, has been partly filled in. A feature peculiar to this lios—at least the writer has not seen or heard of a second example—is the difference of level in floor of the interior court. Probably it is to this peculiarity that the lios owes its name. One half (the eastern) of the enclosed circular space is about three feet higher than the other half, and the line of division is quite sharp and straight. Windele, who appears to have been the only one to note the peculiarity, states that the outer rampart (can he have meant the inner?) is called Boen. Another extraordinary feature is a well within the lios enclosure, though latter crowns the hill-top. This well is not easy to find, as it lies in bottom of the fosse between the ramparts on the east side. The basin was apparently cut in the rock and was of great depth, though now it is partly filled in. At date of my last visit (July, 1917), the well was quite dry, but probably a clearing out of the basin would reveal a respectable water-supply. The gateway of the lios appears to have been on the south side. A well, or spring, within his house was a privilege of the Brughfer. On the townland are, besides one holy, and another remarkable, well—a second rath, now half demolished, *scil.*:—Lios Dávon (Dá Bhan?), a third rath, of which only a segment of rampart and fosse remains, and the site, with traces, of a fourth.

S.D.D. Lios Aimhréigh and Lios Dá Bhan.

Tobairín na Cásca—"Little Easter-Well." A "pattern" was formerly held here, but it was suppressed by the clergy, because of attendant drunkenness and faction-fighting. This is the well which now supplies water to Carrigtohill village.

Tobar Bó Finne—"White Cow's Well." This lies quite by the roadside, near summit of Woodstock hill. The cow commemorated is, doubtless, some legendary animal, perhaps the Bó Bán, of Ballynakilla (*qd. vid.*). These frequent references in place-names to the Bó Bán, Bó Riabhach, Capall Caoch, Glas Gambhain, &c., suggest a new, promising, and spacious field of inquiry for the scientific folklorist.

Bánta Gearra—"Short Fields"; three fields, now amalgamated.

Tobairín a' Chapail—"The Horse's Little Well."

Páire na Glaise, Páire an Airgid, Páire Liath, Páire an 'Aird, Páire a Phon, Páire a Ráis, and Paire a Tobair—Field "of the Stream," "of the Money (hidden treasure)," "of the Grey Surface," "of the Height," "of the Pond," "of the Race Meeting," and "of the Well" respectively. The last-named field is on the hill-top, beside the great lios, but it has no well now.

Móintéan—"Little Bog."

Páirc na Cloiche—"Field of the Pillar Stone," on Fitzgerald's farm. The stone appears to have been removed of recent years; anyhow I failed to find it.

Páircín na Céardchan—"Little Field of the Forge (Barry, the Poet's?)." There is no forge now, and no memory of such an institution survives.

Poll na Steille—"Hole of the Water-Splash." The name is at present applied to a field—the most fertile probably in the townland.

Poll na Madraidhí—"The Dogs' Drowning Hole"; a pit more than half full of water, which became a last home for condemned dogs. My informant described it, too, as "a great place for eels." At a more recent period the pit was filled in with large stones and, later still, a house was erected upon the site.

Páirc Leaca Bheithe—"Birch-wood Glen Slope."

Gleann 'Olaidhe. Meaning unknown. Mr. R. A. Foley suggests P. Amhlaidh. It is a subdivision, containing roughly some 30 a.

Poll an Naosca—"The Snipe's Pool": another subdivision, somewhat less extensive than the last.

Gleann na Bó Buidhe—"Glen of the Yellow Cow."

Poll Cam—"Crooked Hollow," a field containing a sandpit.

PARISH OF CASTLELYONS.

The name, written "Castle Olegbane" in an Inquisition of Jas. I, is the anglicized form of the Irish, *Caislean 'O Liatháin* ("O'Lehanes' Castle), from an ancient fortified residence, which would seem to have preceded the later castle of the Barrymores. More than three-fourths of this parish, which extends along both sides of the river Bride, lies within the present barony; the remainder is in the barony of Condons. The district embraced is, for the greater part, a rich limestone plain, with an elevated ridge of old sandstone on its southern fringe. Place-names are of about average importance and number, and the antiquities are probably a little above the average in interest. Among the latter are monastic and other church remains at Castlelyons, a ruined castle in the same place, and another in Ballyrobert, quite a large number of pillar-stones, two or three holy wells, a chambered cairn, and early thugh sites at Ballycran, Kilcor, Killawillin, Kill St. Anne, and Ferran. As a consequence of its quite unusual fertility, the land has been for ages under more or less intense cultivation; hence wholesale disappearance of hedges. On the southern, less fertile frontier of the parish, however, the ancient enclosures survive in some numbers.

¹ *Ibid.* Cork Archaeological Journal, vol. i, 2nd series, p. 240.

TOWNLANDS.

BALLYARRA, Baile Uí Eaghra—"O'Hara's (?) Homestead." Area, 744 A.

An old estate map (eighteenth century) gives the following now unknown subdenominations as adjoining Ballyarra on the north:—Loughnashillidy, Knocknamontah, and Garrigeenaree. The three submerged ploughlands in question seem to be incorporated in the present townland, thus accounting for the great size of the latter. In allusion to the hard-working propensity of former holders of Ballyarra, a wearied spailpin, employed at tenpence per day of twelve hours or more, used the expression, "Lá fada i mBaile Uí Eaghra ('A long day in Ballyarra')," and the saying became a proverb. On MacAuliffe's farm is a pillar-stone, about five feet in height.¹

The "Abbey" of Castlelyons, on Ballyarra townland, was really a Carmelite priory, though it has been claimed as a Dominican house.² Its remains are in a state of pitiful neglect and desecration. The nave of the monastic church has been turned into a ballcourt, and the cut-stone work disfigured and displaced. Fortunately, however, it is still possible to trace the plan, &c., of the buildings. The remains consist of a large monastic church, with a great tower—wide as the church—springing from the junction of nave and choir. On the south side of the church was the cloister, with its garth, surrounded on the east and west sides by domestic buildings. Doubtless these last were continued along the south side also; but all masonry at this side has disappeared. The garth was about seventeen yards square; but no traces of the cloisters remain beyond the projecting corbels which sustained the plates for the pentroof. From the cloisters access was had by pointed doorways to the domestic buildings at west and east, and to the church by the lowest story of the tower. Two doors communicated with the domestic apartments on the west, and one door with the corresponding apartments on the east side. There was a further small doorway at the north-west angle, which opened on to a circular stairway leading to the dormitories on the west side. By the way, both west and east sides were

¹ Apparently there were local fashions in pillar-stones, as there were in Round Towers, and as there are in things more modern. In this region all the stones—or almost all—are comparatively low, wide, and thin—like great flagstones set on end. This type of dallán I have not noticed prevailing elsewhere. This peculiar style of pillar will be alluded to as the Castlelyons type. The local limestone becomes, or became, detached in flat masses or laminae, which the primæval chronicler of mighty deeds and great men found ready at his hand when he would record in letters of stone the story of his day.

² The plan and style of the building are not Dominican: the tower, for instance, is not the characteristic Dominican tower, and there is no transept or Lady chapel, so regular a feature of Dominican foundations. Moreover the cloisters are on the south, and not on the north, side, as usual with the Dominicans.

two-storied, as the putlock holes for the dividing wooden floors indicate. The tower was at least three stories in height, and its upper chambers were reached by a circular stone stairway in the north-west angle. The ground story, which is vaulted, square or nearly so, and ribbed in a curious way, constitutes the chancel end of the church. This is tall, pointed, and narrow, only ten feet wide. The spacious nave was lighted by five windows, viz., two in each of the side-walls, and one in the west gable. All are placed high up and have double ogee-headed lights without, and splay widely inwards. Unfortunately, except in the case of the west and south-east windows, the architectural details have been partially or entirely destroyed. Internal length of the nave is about sixty-four feet and the width twenty-two feet roughly. It had a rather elaborate west doorway in the fourteenth-century style with quintuple mouldings. Doorway and window have been blocked up with masonry—perhaps in the interests of the desecrating ball-players. The choir is approximately seventeen yards in internal length by about seven and a half yards wide. Hardly anything of it, however, remains beyond a scuffling fragment at the north-east angle: the fragment in question is interesting as containing the jamb of the great east window which probably was a five-light opening. The foundations of the side walls are traceable. Within the choir, partly buried in the earth and with partially obliterated inscriptions, are three interesting recumbent slabs, four or five feet long by two or three feet wide. One of these bears a long, graceful, and ornamental thirteenth or fourteenth-century cross. From the circular monument in which its arms terminate the people believe this cross to be a part of scissars, and to mark the grave of a tailor. Close to this slab is a second, carrying the unmistakable insignia of a blacksmith—a hammer and a pickaxe, holding a horseshoe. Evidently this monument, or, perhaps, only the insignia, is comparatively recent. The third slab, lying nearest the former east gable, is inscribed (seventeenth-century style) in raised Roman capitals—

¹ Windele is willing for the tale that this portion of the building was used, a century or so later, as his work-shed by a poor hedge schoolmaster of those bad old times. One day he assumed himself on business leaving his wife in charge, and that fateful day she set fire to the roof, burning the wretched teacher and many of her charges beneath the ruins. (*Windele MSS., R.I.A., 12, I, 11, p. 35.*)

² Tombstones inscribed with craft symbols are comparatively rare in Munster, though they are of frequent enough occurrence in other parts of Ireland. The writer remembers no other example in the present barony, but in the adjoining Imokilly barony there are at least two examples—of the kind seen on the supposed Smith monument in Clonyne Cathedral in a great position. The other example is in Agibó's old graveyard, and will be referred to again and described under Imokilly Barony.

I.H.S. MARIA.
 ANO. DNI. 1614.
 RICARDUS [B] A
 DEMO DON.

The initial letter of the surname is doubtful.

S.DD.

Poll Buidhe—"Yellow Hole"; a field, close to the chapel, so called from a pit which yielded a species of marl or yellow earth.

"The Warrens."

An Carraigín—"The Little Rock"; a field.

"The Pedlar's Rock"; this is a cliff overhanging the river; from it a wandering chapman fell into the water, and was drowned.

Poll a Tairbh—"The Bull's Pool"; a deep hole in the river; perhaps a bull was drowned here.

Poillín Bhriain—"Brian's Little Pool"; another river hole.

Páirc na Cloiche—"Field of the Stone"; the stone is the dallán alluded to above.

Páirc a Ghaid—"Field of the Withe"; possibly from an execution by hanging; for *gad* is sometimes used to signify a halter. The present field has an uncanny reputation. Jack-o-the-Lantern, or some allied sprite, made the place a scene of his nocturnal pranks; see under Gortagousta, par. Carrigtohill, *antea*.

Páirc a Cliamhain-Isteach—"The Son-in-Law's Field." *Cliamhain-Isteach* is a son-in-law who comes to live in his wife's house; *cliamhain* is a son-in-law simply.

BALLYHAMSHERRY, Baile a Hampshire—"Hampshire's Homestead." The family name, Hampshire, is not now known locally; but in 1366 one Thomas Hanser¹ was a tenant of church lands in this locality. Area, 383 A.

Ballyhamshier (D.S.R.).

On the townland, in a field by the roadside (Moore's fann), is a pillar-stone, of Castlelyons type, measuring 6 feet by 5 feet by 2 feet; the pillar is of limestone, and on its south face are some natural markings, suggesting the imprint of four gigantic finger-tips, and indeed believed locally to be such—proof conclusive that the stone was once a giant's plaything!

S.DD. Páirc a Dalláin—"Field of the Pillar-stone"; this is the field on which stands the monument just described.

¹ Rotulus Pipae Clonensis (Caulfield), p. 30. Probably Hanser in the Pipe Roll is a mistake for Hamsir (Hampshire).

Crosaire na Cailliche—"The Hag's Cross-Roads." The cailleach in the present instance was no female of supernatural origin or powers, but a poor, unfortunate old creature, whose dead body was found here by the roadside upwards of a century since.¹

Bealach Abhann—"River Passage"; a ford in the Bride river. The place is now spanned by an iron footbridge; but wheeled vehicles still use the ford, as did their predecessors in the spacious days of Carthage and Colman.

Páire a' Leasa—"Lios Field." There is no lios on the townland at present, but the name shows that things were not always thus.

BALLYORAN, Baile Uí Odhráin—"O'Horan's Homestead." Area, 575 A.

Ballyorane (Deps. 1652).

Towards north side of the townland, on James O'Brien's farm, is a ceall, or presumed early church site. There are no remains of the church, nor even traces or tradition beyond the field-name—An Ceall.

S.DD. Bóthairín an 'Atha—"Little Road of (to) the Ford."

"The Long Quickkeen," a field. I am unable to explain the name; possibly it has reference to a former quickset fence, or it may be coicín, a "cock's comb."

"The Cautheach (Cáitéach)"—"The winnowing place."²

Sean Abha—"Old River"; the brook or stream which drains the townland into the Bride.

Corrach na Druinathinne—"Swamp of the (Legendary) White-backed Cow."

BALLYROBERT, Baile Roibeárdáigh—Idem. According to a note in the O.S. Field Book the castle and townland derive their name from a Robert de Barry, by whom the stronghold was originally erected in 1325 as a frontier defence of his barony. Area, 169 A.

Ballyroberts, als Robertstown, als Ballygobnett. (Deed of sale, 1702. *Vid. Cork Archaeological Journal*, vol. xxii, p. 102.)

Portion of the townland runs into the neighbouring parish of Knockmounie. On the townland are a ruined castle, a Holy Well, and a lios of unusual character—all on Mr. Mackey's farm. The castle stands in the farmyard; its remains consist of a keep, or rather peel-tower, minus its south side, which has been blown completely out. In the second story are

¹ Ordnance Survey Field Book.

² Winnowing was done in the open, and was generally the work of women. The venue was a slightly elevated spot unsheltered by trees or fences, and the time—a day windy but fine. Light sieves were the only implements or machinery used. The operator, facing the wind, raised the sieve of corn to height of her shoulders, and allowed the contents to fall in uniform stream to the earth. Needless to add, the ground was covered with a winnowing sheet.

traces of vaulting. A curious feature is the *outward* splay of the opes; evidently the design was defence rather than light. Ballyroberts was a Barrymore castle in the seventeenth century, and as such it was besieged in 1645 by the Earl of Castlehaven.¹ Probably destruction and final abandonment of the castle date from the Confederate period. Thenceforward, owing to the development of ordnance, there would be but little inducement to castle-rebuilding. There is a sketch of the castle in the Windele MSS., 12 I, 11. R.I.A. p. 239. Close to, and partly underneath, the east boundary fence of the townland is a rather noted Holy Well, popularly dedicated to the Blessed Virgin under the title of Lady's Well, with devotions on August 15th. The Pattern had degenerated into a scene of drunkenness and faction-fighting, till it was finally abolished, nearly a century since, by Mr. Mackey and the local clergy. At date of my visit the well was in a very neglected condition—dirty, bare, and nearly empty. Close to the well, separated, however, from the latter by a fence, and, therefore, within the townland of Grange, is a pillar-stone, at which "rounds" are also made! perhaps it would be more correct to say that the well "rounds" were prolonged to the pillar-stone.² The lios is a remarkable specimen, covering about an acre of ground, and defended by no fewer than three perfect concentric ramparts, of no great height or strength. This fine monument will be found within Mr. Mackey's lawn close to the entrance lodge. Near the lios there was found in 1838 a fibula of pure gold, which was sold in Dublin for £27.

S.DD. Poll Buidhe—"Yellow Hole," from the yellowish, marly soil. The name is applied to a field within which is a fox-covert.

Tobar na Faille—"The Cliff Well," by the riverside.

Clais na gCoiníní—"Trench of the Rabbits."

Páire na Móna—"Turf Field."

BALLYTRASNA, Baile Trasna—"The Homestead Across (the Stream)." Area, 419 A.

Ballytrasney (Inq. Car. I.).

There is a single circular lios of medium size on Ivis's farm.

S.DD. Collatrom (O.M.). This is the name of a stream which forms the eastern boundary of townland, parish, and barony. There is a place of the same name in the parish of Kilbrogan, near Bandon, and in the latter case Canon Lyons³ renders it Caladh-Trom, i.e., "Holm of the Elder-bushes." Prof. O'Donoghue thinks it most probable the name is *Caladh-*

¹ *Vid.* Waterford Archaeol. Journal, vol. x, p. 9.

² See under Grange, *infra*.

³ Cork Archaeological Journal, vol. ii (1893), p. 9.

from, while Mr. P. M'Sweeney suggests *Caladh-tirm*. On either supposition the stream would derive its name from the river-meadow.

Tobar-Nat—"Nat's Well."

An Scairt—"The Thicket," a field.

Barr a Bhaile—"Village Summit," another field.

CORRIN, Carn—"Sepulchral Stone-Pile." Area, 714 A.

The name-giving carn, now unfortunately ruined, is itself Carn-Tighearnagh.¹ Tighearnach may have been the great man whom the monument was intended to commemorate. Alas, nothing of him, beyond his bare name, survives. Perhaps the assertion is too sweeping; within the tumulus were found, in 1833, two fine burial urns of Bronze-Age character. One of these was broken, and the other passed into the hands of the Rev. Joshua Brown Ryder. The ultimate fate of the surviving vessel I do not know; but, fortunately, a good drawing, or rather an engraving, of it survives. It was $5\frac{1}{2}$ inches high, by 3 inches in diameter at base and $5\frac{3}{4}$ inches at mouth, and was furnished with a conical cover. The cairn, before its destruction, is described as somewhat irregular in outline, 19 paces in circumference at base, 26 paces in ascent, and 11 paces in circumference at the top, where it was crowned by a stone pillar, 8 feet high.² Croker adds that, surrounding the cairn at a short distance, there was a circle of cyclopean stones.

Local folk-lore connects our carn with the prince (in this case, Robeard-a'-Chaim) for whom death by drowning was foretold. The anxious father, to remove all danger, proximate and remote, of the prophesied end, had the child removed for nursing to the summit of this wild and waterless peak, where at the height of 727 feet, a residence was built for him. But futile all efforts to escape the stern edict of fate; the child met the end decreed in a basin of water. Croker has embodied the story, with yet another tale of Carr-Tigherna, in his "Fairy Legends of the South of Ireland." On Corrin townland are likewise two, more or less holy, wells; also the sites of two lioses—one each on Coghlan's and May's farms.

S.D.D. Tolerendowny, (O.M.). Tobar Ríogh an Dombnaigh—"The Lord's (St. King of Sunday's) Well," i.e., well at which devotions were performed on Sundays. This is on Coghlan's farm, and "rounds" are still occasionally made.

Tobar na Naoimh—"The Saints' Well"; notwithstanding its name, the sacred character of this well is somewhat doubtful: at any rate, the well is not so emphatically "holy" as its sister spring, just described.

¹ Carn Tigernaich in territory of Fear Muighe Feine (O'Clery's ms. Life of St. Finnbar).

² Windle mss., 12, I. 11, R.I.A.

Loch a Phréacáin—"The Crow's Pond." This is on the southern boundary of the townland.

Bóthairín an 'Atha—"Little Road of the Ford"; it crosses Corrach-na-Druimfhinne, and leads, incidentally, by and to the ceall on Ballyoran.

"The Priest's Road"; it runs up the south-east side, or shoulder, of Corrin Hill. The name is probably due, as in similar cases, to the fact that construction of the road was owing to efforts, or representations, of the parish priest.

Corrach-na-Druimfhimme (see under Ballyoran, *supra*). This is an extensive bog, lying on east side of the townland and adjoining Ballyoran.

Local Irish speakers had a legend of the name-giving Cow, but, unfortunately, I failed to find an Irish speaker who remembered it. Legends retailed in English for edification or delectation of the Sasanach are mostly spurious. Associated with the swamp was likewise a second legend of a supernatural, or magic, eel.¹ It is believed, too, that the bog was anciently a lake, and that the latter was drained to defeat the fate predicted for the prince of Corrin legend. In this bog, Mr. J. W. Sherlock of Fermoy discovered, about 1843, the entire skeleton of an elk, which he presented to Lord Mountcashel. In the same place, or neighbourhood, a Rev. Mr. Mockler found a second specimen².

The Leaca (Leaca—a glen-side); a field.

DEERPARK. Páil an Fhiaidh—"Fence of the Deer." The form is unusual; cf. Deerpark, parish of Lismore (Co. Waterford); Deerpark, parish of Carrick-on-Suir (Co. Tipperary), &c.³ Area, 336 A.

On the townland were three lioses. Two—of circular outline—have been utterly destroyed, but a small oval specimen survives. On the townland is likewise the site of Killawillin early church and graveyard—from which it is pretty evident that Deerpark is a detached portion of an ancient, and larger, Killawillin. The present townland was the deer enclosure of the Earls Barrymore, whose principal residence was at Castlelyons. The Ceall site is marked by a large ash-tree on Patrick Shinnick's farm.

S.D.D. Carraig na Cille. "The (Early) Church Rock"; site of the Ceall alluded to; there are no remains.

¹ Since writing the above I have found the legend in the Windele mss., R.I.A., vol. 12, I, 11, p. 243. The Carn was long ago called Leaba na Lun, from "The Lun," a wonderful animal which abode there. This monstrous creature had four legs, great prominent eyes, and a tail, a single lash of which would uproot an oak. The monster turned itself into a *piast* for the purpose of milking the Drimin at night. Finn and his hound were, however, sent for: they came, saw, and conquered; valiant Bran attacked and killed the Lun.

² Windele's Notes, R.I.A., 12, I, 7, p. 572.

³ Place-Names of Decies, pp. 27, 246, 260, and 266.

“The Weir Hole”; in the Bride river.

GLENAROUSK. Gleann na Rúsc. Meaning somewhat doubtful. The dictionaries have not the word *Rúsc*, which is also unknown in the colloquial Irish of the locality. O'Donovan, however,¹ renders the word—a marsh or fen. Canon Peter O'Leary, in whose parish the townland is, thinks Rúsc = Ruadh Uisgue (*i.e.* Red Water). In older Irish *rúsc* = a push, drive, rush (of water). The word *rusc* in the name Drumrusk, Co. Waterford, I have²—following O'Donovan³—rendered “fleeces.” Rúsc occurs again in the name Roosa parish of Tubrid, Co. Tipperary; and in Roosa Cross, near Cloyne. Area, 1059 A.

On Hayes's farm, towards west side of the present extensive townland, and in a field called Páine-a-Leasa, is a small pillar-stone, known as “The Dallán.” In a neighbouring field, on same farm, is a well to which a reputation for sanctity in some degree attaches. On this farm there are likewise three small circular lioses or traces of them.

S.DD. Pope's Well (O.M.); near south-west angle of townland.

Barley Bog (O.M.); near north-east angle. A cannon-ball, weighing 7 lbs., was found here about seventy years ago.

Lady's Well (O.M.). No “rounds” are made there now.

Brownmarsh (O.M.). Bán an Imris—“Field of the Battle,” from a skirmish here between the Cromwellian and Irish forces in which the latter were defeated.

“The Barnack Field”; so called from a cluster of labourers' cottages.

Páine a Leaghe—“Field of the Leaping,” from athletic contests of which it was once the scene.

Páine na Stáigle. I do not know the force of the qualifying term in this or similar names. (See under Ballynagarabach, parish Caherlag, *supra*.)

Páire a' Leasa Uí 'Ogáin—“O'Hogan's Lios-Field.”

Páirín a' tSúil Théir—“Little Field of the Hayseed”; or, perhaps, P. a tSoiléir—“Field of the Cellar.”

Páine na Cloiche—“Field of the (Pillar's) Stone.” As the stone has been, long since, removed and destroyed, we can only conjecture its character.

“The Poison Well.” An enterprising, but not law-loving, band found the water here suited to their illicit purpose.

FARMS. **FARMS.** “A Farm.” In place-name usage I find the term *farm* often or generally applied to Church-land—a globe on the tenanted land of an abbey. On O'Brien's farm is a coal or early church site, close to Bóthairín an 'Atha. Area, in two divisions, 207 A.

¹ Ordnance Survey Field Books.

² Place-Names of Decies, p. 212.

³ Field Books as above, Co. Waterford.

S.DD. Shanowenadrimma Stream (O.M.), Sean Aba na Druimfhinne—“The White-backed Cow’s Old River.” The Ordnance Surveyors apply this tautological name to the stream which forms the eastern boundary of the townland.

“The Lios Field,” on Broderick’s farm, where there is no lios now.

GRANGE, Gráinseach—Idem. A grange is more especially the out-farm of a Religious House. Area, 337 A.

On this townland—just within its boundary fence, near the south-west angle—is a pillar-stone of the same type as the Ballyhamsherry monument. The present dallán is deeply embedded in the earth and is, in some way, associated in popular estimation with the Holy Well on Ballyrobert. A few years since there were three lioses, but only one—a large specimen—now survives. On Andrew Meade’s farm in low-lying, wettish land, are two or three folacht-fiaidhs or prehistoric cooking places.

S.DD. “The Castle Field.” This is on Andrew Meade’s farm. Cannon-balls have been found here; also the foundations and other remains of ancient buildings.

Páire na Bó Mairbhe. “The Dead Cow’s Field.”

KILCOR, Coill na Coradh (or, na Corra)—“Wood of (beside) the Irrigation Dam (or ‘of the Round Hill’).” According to Canon Lyons,¹ “Corradh” signifies a homestead. Area, in two divisions (including a considerable portion of mountain), 1427 A.

Killeurr (D.S.R.); Kilnacor, Kilnecur, and Coilnecurra (ancient authorities quoted by Windele—MS. R.I.A. 12. I. 11, pp. 191, &c.).

This townland lies on, or contiguous to, the southern boundary of the parish, and on it are two cealls, together with the site of an ancient castle. The beauties, glories, and memories of Kilcor were celebrated in a popular song, which began :—

“Coill na Corra cois Brighde.”

S.DD. Kilcor Castle (O.M.). According to local tradition, this was a castle of the O’Briens, who held under the Barrymores, but were obliged to return to Clare (by transplantation) in the middle of the seventeenth century. The tradition almost certainly embodies historic fact. Compare the document quoted under Pellick, below.

Cill na Corra. The ceall site, on Pyne’s holding, close to the castle.

Páire a tSéipéil—“The Chapel Field,” on Hegarty’s farm. The name suggests merely a chapel site of the Penal days, but the tradition of a graveyard attached points to an early Celtic church site.

¹ Cork Archaeological Journal, vol. ii, pp. 169, 170.

Móin Ruadh—"Red Bog," a subdivision, containing 53 acres.

Poll a Tairbh. See under Ballyarra.

"Putty Hole," a hole in the Bride River: probably from *póta*, a pot.

Cnoc a Mhadra—"Hill of the Dog (wolf)."

Orean—probably, *Eo Crion* (i.e. "Withered Yew-tree"), a field.

Páirc na gCloch—"Field of the Stones." The stones here are not dalláns but surface boulders and smaller stones, in which the place abounded.

Páirc a Tolain—"The Well Field": almost the only interest in the name is that there is neither well nor trace of one at present.

"The Nursery," a field.

The Gawnach Well. Gawnach = a yearling heifer; the eponymous bovine may be the legendary Glas G.

Gleann Caoin—"Pleasant Glen."

Cnoicín na bPoll—"Little Hill of the Holes (Fox Earths)."

Sruthán a Ghabha—"Little Stream of the Smith."

Páirc a Ráibe—"The Rape (crop) Field."

KILLWORTH, Cill a Mhóilín—"Church of (near) the Mill." Area, 540 A.

Kilnemollan (Deps. 1652).

The present mill, from proximity to which the coall got its name, stood close to the site of the present Bride Bridge. The coall itself is really in Doonpark (see below, p. 217). There was also a single large lios of which only a small one survives. Possibly, when he had got thus far, some mishap overtook the land-labourer and put an untimely end to his labour. On O'Connor's farm is a curious boulder, which, however, lacks a name.

S.D.D. Poillín Bhriain—"Brian's Little Pool": this is a hole in the river.

"The Well Ford": an old crossing-place of the Bride.

KILLST. ANNE, Cill Sant Anna—"Church of St. Anne." Almost certainly there was an early Celtic church, called perhaps by name of the original patron, and to this the name of the Biblical saint was substituted in the early post-Invasion period: cf. Kill St. Laurence and Kill St. Nicholas, Co. Waterford. Area, in two divisions, 844 A.

On the townland are the remains of Castle Lyons parish church, the ruins of Barrymore castle or mansion, and an early church site—probably the name-giving Coall. The extensive remains of the mansion indicate a Tudor

¹ See, I think, however, Mr. R. A. Foley has suggested to me that the name is really Cill Sanctain, "Church of S. Sanctan."

erection, rebuilding, or modification. The castle was destroyed by an accidental fire, July 22nd, 1771. It is said that the ravages of the fire could have been easily stayed, but artizans, anticipating repairs, made no effort at salvage, and so the great building was gutted. Decay of the township followed as a result. Within thirty years from the fire not a shrub or tree remained of the once well-kept grounds and beautiful gardens. Of the Barrymores of Castlelyons almost the only one who has left a memory is Earl James, who earned the reputation of an able general in the Peninsular War (1807-14). Subsequently he fell into disgrace, and lost his command. Returning to Ireland, he tyrannized over his tenantry and retainers, at the same time that he lavished hospitality on his friends. His bust, in white marble, adorns the family mausoleum at Castlelyons.

Of the ancient parish church of Castlelyons but little survives; this little, however, is sufficient to indicate that the church was of rather unusual size and architectural importance. In fact, the remains suggest rather a conventual than an Irish parochial church. An ivy-clad, square-planned tower, twenty-two feet to the side interiorly, and of which only the north-west angle stands entire, rises to a considerable height. This appears to have marked junction of nave and chancel. Practically nothing remains of the nave, which was 22 feet 6 inches in internal width; its site is occupied by the present Protestant church. A mausoleum of the Barrymore family, in hideous taste, has been erected on what was the east gable and end of chancel, and it is scarcely uncharitable to assume that the materials of the chancel were used up in erection of the monstrosity. At any rate, both north and south side walls of the chancel have disappeared, though their foundations are traceable. A high, pointed chancel-arch, forming the eastern support of the tower, still stands; it is 12 feet 6 inches wide, and its walls—indeed all the ground-floor walls of the tower—are 3 feet 10 inches thick. From presence of a second similar arch, at right angles to the chancel arch and forming the northern support of the tower, we infer—(1) position of the tower itself, i.e., at junction of nave and chancel; and (2) that the church had either a north transept or a north aisle. The early (apparently fourteenth-century) Gothic window in the east gable of the modern church was, I have little doubt, transferred to its present position from (probably the chancel of) the older church. This handsome window is 48 inches wide, and is divided by two upright mullions into three lights. The well-kept cemetery, about three-fourths of an acre in extent, and crowded with tombstones, possesses no inscription or monument of special interest—at least, a fairly careful search, made in a downpour of rain, did not reveal anything such. Probably the oldest record is that borne by a standing stone at east side of

the Barrymore vault, whither, presumably, it had been removed at building of the mausoleum:—

“Here Lyeth the
Body of John Newton
Who departed this
Life the 26th of July
1748 aged 27 Y^s.”

S.D.D. Loughapreacane cross-roads (O.M.). Loch a Phréacáin. See under Corrin, *antea*.

Aghmageragh (O.M.). ‘Ath na gCaorach—“Sheep Ford”; perhaps sheep were washed (or drowned) at this place.

An Strapa—“The Stile,” a field.

“Thom’s Hole,” a river hole, in which the man from whom it takes its name was drowned.

“Flower Hill,” a subdivision—now almost forgotten—containing about forty acres.

“The Long Walk,” a field.

“The Ceall”; on Barry’s farm.

Paire a Bheistín—“Field of the Little Vest.” A battle is said to have been fought here. This was, doubtless, the battle of 1645 (May 10th) between the forces of Broghill and the Irish, in which the latter were defeated.¹

“The Long Walk,” “The Castle Garden,” “The Great Meadow,” and “The Chapel Field” (at back of castle) = fields.

MOHELA Mothara—“Ruins,” according to O’Donovan² (probably Stone

¹ Broghill, reporting to the English Parliament, thus describes the fight: “I ordered Major Paisley to keep the road with eighty horse in four ranks at the side of the hill which at some distance from the enemy looked like four battalions, with order when he had discharged his carbones to fly and rally in my rear. And having told my men that I would fight, and by God’s blessing beat the enemy, I drew them to another piece of ground $\frac{1}{4}$ mile further from the enemy who boldly came up, and having routed Paisley, pursued in disorder till they perceived the rest of the horse in eleven battalions which encountered them fiercely: but 800 Irish musqueteers coming up by the side of a ditch had like to ruin all if Captain Paisley with my own troop had not leaped over the ditch and defeated them with the loss of a hundred men on the spot. However, the Irish fought so well that one troop ran away to Castlemartyr with the news that all was lost, but the rest stood to it so well that we gained a noble victory, and if we had but 500 foot we might defeat their whole army, and had done it as it was but for an Irish sergeant with forty musqueteers, who, being posted in the wood, fired so often as though their whole foot were there. We did not lose one officer, and had only a few wounded. My horse was shot in the neck. The men had been twelve hours either marching, drawing, or fighting. Ridgeway, though drunk, killed mine that day with his own hand; his drunkenness was due to two tumblers of Rigley ale which he had from an Irish Sutler.” (Ms. in Lismore Castle, quoted in Ord. Survey Field Book.)

² Field Book, Ord. Survey.

Fort in ruins). The usual plural is Mothair. The local pronunciation is, however, Machaire—"Plain (or battle field)." Area, 904 A.

The sole object of antiquity is a pillar-stone of the type which I have designated Castlelyons. The present specimen, which stands on Sweeny's farm, measures 5 feet by 5 feet by 2 feet.

S.D.D. Páirc na Carraige—"The Rock Field," in which stands the pillar-stone just mentioned.

"Barrymore Barn" (O.M.).

"The Piper's Bush," on the road to Coole.

Bóthairín an Phúca—"The Pooka's Little Road," leading towards Coole.

"The Camp Field," "The Yeomen Field," and Páirc Mhairghaid ("Margaret's Field") = fields.

PELLICK, Peillic. Meaning obscure. Very likely the name signifies "Hide-Covered Hut": *cf.* the Latin *pellicula*. Compare also Ballinphelic, barony of Kerrycurrihy. Canon O'Leary, however, in whose parish the townland lies, considers that *Pelic* must be the same as *Bel-leicc*. Against this has to be recorded the fact that no stream or river flows through the townland. Area, 324 A.

Pellicke (Inq. Car. I).

On the townland is, or rather, was (for it has been destroyed), a large circular lios. Here I got the following place-name *rann*:—

"Peillic na gaoithe, 'Ard Ráth an draighneach,

"Agus Baile mhic Shíomoin. Trí Baile is measa cois Brighde."

Windele¹ quotes a petition, dated Sept., 1667, from Kennedy O'Brien, of Peillicke, to Lord Barrymore, in which the petitioner complains that, till transplanted, he had an interest in the ploughland of Peillicke, with his son; that he compounded afterwards with Lord Barrymore for said ploughland; that the son died, and that now the son's wife refuses to acknowledge her father-in-law's claim. In response to this petition the daughter-in-law is summoned to appear and plead a defence.

S.D.D. An Maoileann—"The Bleak Eminence."

Páirc a Leacht—"Field of the Grave Monument." The Leacht has entirely disappeared.

"Mundher Wall," a field-name, of which I can make nothing.

RATHBARRY, Rath an Bharraigh—*Idem.* Area, 47 A.

¹ Ms. R.I.A., 12, I. 11, p. 161.

Rathbarry (Inq. Lac. I).

As the name makes one expect, here was formerly a large fort, but it has entirely disappeared.

SPURREE, Sporaidhe Cloch—"Rock Spurs." Area, 276 A.

Spurryclogh (Estate Map, 1768).

S.D.D. Corrach a Chipín. Meaning uncertain. Of course *Cipín* means a little stick; but it is here probably the diminutive of *ceap*, a piece of ground; cf. Curraghkippane (Corrach a' Chiopáin), near Cork.

Páire a Ráibe—"Rape Crop Field."

TOWERMORE, Teamhair Mhor—"Great Elevated Place (commanding extensive view)": cf. Tara, Co. Meath, &c. The name is a word-picture of the place in the case of the Cork, as of the Meath, Teamhair. Area, in two parts, 406 A.

Towermore Upper is entirely demesne land. Towermore Lower appears to have been formerly part of Rathbarry. On the latter there is now no lios; but there are two on Towermore Lower.

S.D.D. "Dringily": origin doubtful; the name is applied to a field, and is, probably, a derivative from *drachlean*, blackthorn, or from *dronn*, a hump.

"Upper Kennedy": applied to another field; origin also unknown; possibly from *Canna Fhuda*; more probably, however, from *Cinn (Ceann) Mór*, a form very commonly used in the adjoining barony of Imokelly to designate the best field in a farm, townland, or district.

Páire na Claise—"Field of the Trench."

Páire a Bhamann. The meaning is not clear; perhaps B. = Bainbhín (a suckling pig).

PARISH OF CLONMEL.

The present parish—which is entirely island—comprises the western half of the Great Island (Oileán 'Arda Neimheadh, a/s. Oileán Mór an Bharraigh, i.e. "Island of Neimheadh's Hill, otherwise Barry's Great Island") and the western portion of Foaty Island. Within its circuit lies portion of Queens-town, as well as the villages of Rushbrook, Carrigaboe, and Belvelly. It will be recalled that our Great Island was the reputed scene, according to Keating, of the death of Neimheadh and two thousand of his people. Oileán Mór was one of the limits set to the portions of Orla and Fearon, sons of Partholon, in the legendary first division of Ireland. The name, Clonmel, is not in popular use for the parish does not share it with a townland. Teampull Iarthair, or T. Thia (West Church), is the name popularly applied to the ancient parish church. Doubtless, as the parish name is non-ecclesiastical,

¹ Keating, Ed. *Irish Texts Society*, vol. i, pp. 104, 170, and 180.

there was an original Clonmel (Cluan Meala, i.e. "Vale of Honey") townland. As may be assumed from character of the parish—largely suburban and demesne—old place-names are not numerous. Modern villa names, of the usual provocative type, abound, but our present work takes no note of them; they mean nothing, and their study leads nowhere. The antiquities are the ruined church, an abandoned castle, a Holy Well, some lioses, and a primitive church-site.

TOWNLANDS.

BALLYHETTRICK, Baile Sheitric—"Sitric's Homestead."¹ Area, 15 A.

Ballyheatrick (D.S.R.).

S.D. "The Little Orchard"; the name is applied to a field.

BALLYLEARY. Baile Uí Laoghaire—Idem. Area, 332 A.

Ballylary (D.S.R.).

On the farm of Denis Higgins, in this townland, is a Holy Well at which, till quite recently, "rounds" continued to be performed.

S.DD. Baile Thall—"Homestead on the Far Side," a subdivision containing about forty acres.

Carrigaloe (O.M.), Carraig Uí Lughadha—"O'Low's Rock." The personal name incorporated is, like numbers of such names, obsolete—at least locally. Many other explanations of the name have, I know, been given, as, *e.g.*, from *Luaidhe*, lead. I can only say that at least half-a-dozen local speakers sounded the Uí Lughadha distinctly. By the way, Carrigaloe, and generally the island side of the West Ferry, was formerly known as Passage; that also is the name by which this place is alluded to in the Records.

Tobar Ríogh an Domhnaigh—"Sunday Well," the Holy Well referred to above. "Rounds" were made here chiefly on Easter Sunday, but also on other Sundays, and occasionally on week-days. Till a few years since, votive offerings were in evidence, but now there are hardly any. The well, which is covered with a cap of masonry, is claimed, or believed, to be specially efficacious in the case of sore eyes and of ague.

BALLYNOE.—Baile Nua—"New Homestead," generally Anglicized—Newtown. Area, 254 A.

S.D. Tigh na Glaise—"House of the Streamlet." The name is now applied to a hamlet of four or five houses. At this place (in south-west of the townland) ships formerly took in fresh water.

¹ Irish place-names suggesting Danish or Norwegian association are surprisingly rare, and are practically confined to coastal districts. Their rarity, indeed, suggests that the northmen settlers on the land were comparatively few, and that they were very soon swallowed up in the native population.

BALLYNACRUSHA. Baile na Croise—"Homestead of (at) the Cross-roads." Area, 380 A.

Ballynecrussy in Magna Insula in Bar. de Barrymore (Inq. Gul. et Mariae).

There was one lios upon Sweeney's farm, but it exists no longer. The old chapel of the parish—formerly there was only one—stood also on this townland, where now is Kirby's farm-house.

S.D.D. Baile Iochtarach—"Low-lying Homestead"; a subdivision containing about forty-seven acres.

Berry Hill (O.M.), another subdivision. The Irish name is Dá Fhichead Umair—"Forty Ridges." The "Berry" of the official name may be derived from the 'O Breasail Bheire, whose home was here.

An Seomra—"Drain (or moat)." The name is applied to a stream which rises in Ballyleary bog and flows through the present townland towards Cuskenny Bay, into which it finally empties itself.

Múintóin a Rince—"Little Bog of the Dancing." According to Mr. Fergus O'Farrell there formerly stood a tumulus here, upon the flattened top of which dancers disported themselves.¹

BALLYVOLOON. Baile Uí Mhaoileóin—"O'Molone's Homestead." Mr. R. A. Foley suggests Baile Bhalúin, from *Baldwyn* Hodnett. Area, 265 A.

Ballyvellane (D.S. Ref.).

S.D.D. Cúadh—"Cave" the present Queenstown which got its modern, and now better known, name on the occasion of Queen Victoria's visit thereto in 1849.

"Thick Knock." This is a subdivision, more commonly known as Castle Oliver. The first name is the local rendering of the Irish, Cnoc Ramhar.

Coill Ghabhann—"St. Gabbán's Church." The primitive church-site lay within what is now Queenstown. Kilgarvan was, at one time, another name for the parish, or for part of it.

BROCKLY. Béal a Bhleathigh—"Mouth of the Roadway." Here was practically the only ford by which access could be had to the island from the mainland. O'Donovan gives Béal a Bhile which is certainly incorrect.

Belvally (Inq. Car. I).

On the townland is a thirteenth- or fourteenth-century castle of the Halmets in a good state of preservation. This guarded the only practicable passage into the island, and the present bridge, erected by public subscription in 1897, marks site of the ancient ford. Close to the castle is a Martello Tower erected in 1815, with four others, for defence of Cork Harbour, at a total cost of £3,500. On this townland there is also, near the south-east

¹ Cork Archaeological Journal, vol. iii (1892), p. 35.

angle, a small circular lios. A small detached portion (4 A.) of the townland forms the apex of the Marino promontory. This seems to indicate that the point in question was formerly joined to Belvelly major by continuous dry land where is now a mud flat.

S.DD. Cúil Móna—"Bog Corner."

Crann a Chreatháin—"Shaking Tree" (the Aspen).

Poll a Ghliogair—"Hole of the Empty Noise"; a cave and passage in which the tide rises with a gurgling sound.

Carragán—"Little Rock," a sub-division containing some five acres.

Baile 'Ard—"High Village (or Homestead)," another sub-division; it contains, approximately, a hundred acres.

Páire na Béice—"Field of the Uproar." This is a field, on Coffey's holding, in which is a well where, I was informed, "rounds" were made in times past.

Crann Mór—"Large Old Tree"; a place called from a large and venerable ash-tree, long since destroyed.

Páircín Críon na nAbhal—"Little Withered Field of the Apples."

Seana Bhláth—"Old Flowery Place."

Móinteán na nDamh—"Little Bog of the Oxen."

DEAN AND CHAPTER LAND. No Irish name, but, doubtless, this was the original Clonmel or part thereof. Area, 30 A.

On this townland stands the ruined church of the parish within the ancient cemetery of Clonmel. The cemetery is now of great extent, and, at the present rate of interments, further extension will be required in a few years. In a special space towards south-west angle of the enclosure are buried the victims of the "Lusitania" disaster. The small ruined church is a comparatively late structure, and hardly deserves description as an antiquity. Its side-walls stand about 18 feet high. Beside the doorway, on the outside, is a small standing stone inscribed—as was frequent at the period of its erection—in freakishly mixed large and small letters:—

"Here Lyeth The Body
of Stephen Towse Who
departed This Life the
26 day of OCTober 1698.
also His wife ELiZ
Towse W11O departed
Her Life The 10 day Of
FebrUary ANd IN The
54 Year of Her Age
Anno dOMINI 1713."

Lying flat in the north-west corner of the ruined church is an inscribed slab which covers the mortal remains of Rev. Charles Wolfe, author of the immortal *Elegy on the burial of Sir John Moore*.

DONEGAL, Dun na nGall—"Fortress of the Foreigners."

The "foreigners" were almost certainly Northmen (*i.e.* Norwegians). Cf. Donegal Co.; Donegal, parish, Inishlounaght, Co. Tipperary; and Donegal on the Ilen River, Co. Cork. Area, 127 A.

Downygall (Inq. Iac. I).

S.DD. 'Ard a Bhóthair—"Top of the Road."

Bun a Bhóthair—"Bottom of the Road."

FOAY, Fóidthe, probably—"Warm Soil." See under Carrigtwohill parish, *supra*. Area, 544 A.

LISANISKY, Lios an Uisce—"Water Lios." Area, 94 A.

This is a name of fairly frequent occurrence. A "water-lios" was apparently a lios, the trench or concentric trenches, of which could be filled with water, somewhat after the manner of a mediæval moat. At the present time there is no water close to the lios by which the trench could be flooded, though the Ordnance surveyors state, or insinuate, that there was a well within the enclosure. At a higher level, however, twenty or thirty perches to the north, there is a spring which would yield a sufficient water-supply. The name-giving lios is on Brockley's farm; it is of small size, half an acre or so in area with a circular rampart, about five feet in height. On Miss McCarthy's farm there was a second lios, now demolished, except a small arc of what was the second or outer ring. In both cases the field in which the lios is is called *Páirc a' Leasa*.

MARNO, Seana Chuir—"Old (Manor) Court." Area, 329 A.

Ould Courte (Inq. Car. I).

Old Court was a residence of the Ronaynes. Philip Ronayne, who lived here, and is referred to by Smith, is popularly believed to have practised magic.²

S.DD. *Páirc an Dúna*—"The Fort Point." John Hegarty, a remarkably intelligent native of the locality, and an Irish speaker, states that the name-giving *Dún* was the conical hill immediately to the west, or north-west, of Marino House. The hill in question is of purely natural formation;

¹ "The 't' in *Laité* (*Laito*) and in *Fóite* (*Foto*) is aspirated in books, but pronounced here according to our Munster usage, just as we pronounce the 'th' in *crath* and the first 'd' in *oidheadh*." Canon Lyons in *Cork Archaeol. Journal*, vol. iii, p. 65.

² See Croker's "Fairy Legends."

but, though no traces of a vallum now survive, an artificial earthwork may once have crowned it.

Páirc a Dalláin—"Field of the Pillar-Stone"; this is on Stewart's farm; but the monument has disappeared.

OLD COURT, Seana Chuir—*Idem.* Area 17 A.

S.D. Tobar na Spáineach—"The Spaniards' Well," because Spanish vessels trading to Cork took their fresh-water supply hence.

RINGACOLTIG, Rinn a Chomhaltaigh—Meaning uncertain. O'Donovan¹ makes it "Promontory of the Fleet," and no doubt ships in number waited off the point for fresh water and a favourable wind. The qualifying word is undoubtedly *comhaltach*, but it is not so easy to determine the sense in which it is used. Area, 135 A.

There was one lios, of medium size, on Kirby's farm, but it exists no longer.

RINGMEEN, Rinn Mhín—"Smooth Green Promontory." Area, 251 A.²

Rynemyne (D.S.R.).

S.DD. Newtown, a small subdivision.

Bán na gCloch—"Field of the Stones"; another (or the same) sub-division. The *clocha* here are not pillar-stones, but ordinary surface boulders. Newtown and Bán na gCloch seem to be names applied to the same area.

PARISH OF CLONMILT.

This is not of more than medium extent, and it embraces an undulating, or rather decidedly hilly, country, with a limited area of mountain. The place-names are as interesting as the physical character of the country would lead one to expect—that is, they are above the average in variety and importance. Though the parish name be the name of a townland within the parish, singularly enough it is not the name of the townland on which the ancient parish church stands. The antiquities comprise slight remains of the ancient church, a holy well, some pillar-stones, two other early church sites, an unusually large number of lioses, and the remains of a cairn, with its stone circle. Portion of the parish runs into the neighbouring barony of Kinataloon.

¹ Ordnance Survey Field Book.

² Ownership of Ringmeen and Ballinterry was the subject of a lawsuit in 1634, when it was established that these lands were the ancient patrimony of the Barrys. Later on, in the same seventeenth century, the two ploughlands in question were declared forfeit to the Crown, and were granted by King James II to the ancestors of Lord Middleton. Dr. Caulfield, by the way, thinks that Ballinterry may be the present Ballyleary. (*Cork Archaeol. Journal*, vol. xxi, p. 178.)

TOWNLANDS.

AUGHNALYRAGH. 'Ath na Laghraich—"Ford of the River-Forks." Area, 61 a. Aghnalrin (Deps. 1652).

BALLYARD. Baile 'Ard—"Elevated Homestead." Area, 349 a.

S.D.D. Bán an Mairbh-eich—"Field of the Still-born Foal."

Bóthairín Nua—"New Little Road."

Bóthairín na Spioraide—"Little Road of the Ghost."

Bóthairín an Phúca—"The Pooka's Little Road."

Bán a' Phúna—"The Pound Field."

Páirc a' Dalláin—"Field of the Pillar-Stone."

Garraidhe na mBráthar—"The Friars' Garden."

BALLYEIGHTRAGH. Baile Iochtach—"Lower Homestead." Area, 306 a.

On the present division is the ancient church (or rather its site), an ancient cemetery, a glebe, and (on Crean's farm) a small circular lios.

S.D.D. Tobar a' Chnuic—"The Hill Well."

Bán an Mhallaun—"The Mill Field"; there is no mill now.

Na Cairn—"The Cairns (or Heaps)"; the name is applied to a field; there is also Bóthairín na gCarn.

Páirc na bhFotharach—"Field of the House Ruins."

As usual throughout Ballymore the ancient church has almost completely disappeared. All the foundations indeed are traceable, and the side-walls, grass-covered, rise to the height of perhaps a couple of feet. Within the former church-space is a large table-tomb with an all but illegible inscription—the last resting-place of the once well-known Powers of Clonmult, extended by many a wretcheding hand of the Gael. The inscription reads:—

This is the Burial Place of
Pierce Power Esq. of
Clonmult & Family.
He died 10th 19, 1770.
Aged 34 years.

By what was the eastern wall of the ruin is a similar second Power tomb inscribed:—

This Tomb was Erected
by Hugh and Catherine Power
of Ring in memory of their
Beloved & Only Child
Pierse Power Esq.
who died the
day of Jan 1777.

An upright headstone in the general cemetery records that:—

“ Hic Jacet
Adm. Rev. Dom. Timotheus Murphy
Canonicus et Parochus Cloynensis ”

who died Jan. 27th, 1826.

The name Smiddy occurs frequently, and in various forms, on tombstones in the graveyard:—Smiddy, Smithwick, Smeist.

CLONMILT, Cluain Molt—“Lawn Meadow of the Wethers.” I think, however, the more ancient name of the place was *Garraidhe Caol* (“Narrow Garden”), and that for this, at a later period, the old name of the parish came to be substituted—hence “Garry Koel” in an Inquisition of James I. Garrykeal is still in use as the designation of a sub-division of the townland. Area, 466 A.

Cloynemolte (Inq. Car. I).

On the townland are two lioses—one (moderate size, single-fenced, and fairly well preserved), on Loughlin’s farm; another (partly ruined and covering about an acre) on Sweetman’s. On this townland are likewise the old mansion-house, kennels, &c., of the Powers of Clonmilt.

S.DD. “Garrykeal,” the sub-division above alluded to.

“The Kíltha River”; on boundary with Condoustown; perhaps from *coillte*, “woods.”

Páire a’ Dalláin—“Field of the Pillar Stone”; there is no dallán now.

“Bóthairín na Muc—“Little Road of the Pigs.”

Páire na gCloch—“Field of the (Pillar) Stones,” from some dalláns, long since broken up, which stood there; one of the pillars is described by a person who saw it standing as about 7 feet in height.

Tobar a’ Chaipín—“Well of the Little Cap”; from a conical covering of mason work.

CONDONSTOWN, Baile an Chondúnaigh. Idem. Area, 43½ A.

There is one lios—double-ramparted and circular in plan.

S.DD. Cnoc a tSleibheáin—Perhaps “Hill of the Little Mountain”; the name would not be as tautological as the English rendering represents it. Mr. R. A. Foley suggests C. a tSleibhe bháin or C. a tSleibhe mhéadoin, and very likely the latter is the correct name.

Páircín na Cloiche—“Little Field of the (Pillar) Stone.” Alas, the pillar exists no longer.

An Leitreach—“The Hillside.” The name appears to be a form of, or derivative from, *Leitir*.

'Ath a Duine Mairbh—"Ford of the Dead Man," *i.e.*—Ford in which the corpse was found.

An Loch—"The Lake," a natural water-filled basin, an acre or so in extent, situated in a mountain patch.

GARRYDUFF, Garraidhe Dubh—"Black (*i.e.* Peaty) Garden." Area, 578 A.

This townland, though belonging to the present parish, really lies within the barony of Kinataloon. Like the adjoining Garrylaurence, it is unusually rich in antiquarian remains. There are, or were, five lioses—three, at least, of them chambered; there is also an interesting ceall. Of the lioses the most remarkable is "Lisard," on William Mahony's farm. This monument is well deserving of its name; it crowns the apex of a conical hill, commanding a magnificent view—bounded to north and east by the distant Galtee, Knockmaeldown, and Comeragh ranges. Lios 'Ard is chambered and double-ramparted. Its outer wall must be over ten feet in height, and the inner court about half an acre in extent. In the same farm is a second lios—Lios Iseal ("Low-lying Lios"). Connery's farm had a small, circular, chambered lios; but this has been completely destroyed. A fine lios, however, survives on Shea's farm; this is of large size, surrounded by a high rampart, and is also chambered. There was a fifth lios—on Daly's farm—but it, too, has been levelled. During demolition operations a curious object was found: this was a cross-inscribed stone 11 inches in length by 9 inches wide. The inscribed cross, which is 8½ inches tall by 5½ inches across at the arms, shows rude Celtic character at top and base of shaft. Transfixing the cross diagonally is a groove about 3 inches long, and an inch or so wide; whether this is accidental or an intentional addition, it is difficult to decide. This discovery of a cross-inscribed stone in a lios is remarkable. The ceall or killeen, on Mahony's farm, is well over an acre in area, occupying the eastern slope of a small hill. Plan of the enclosure is oval rather than circular. A fence from 2 feet to 7 feet in height, surrounds the once sacred place in the usual way, and, within the enclosure, at its eastern side, lie two or three large flagstones. Close by, but on the outside of the fence, is a boulder, 6 feet by 3 feet, bearing on its face a cup-shaped hollow (*bullán*) 9 inches in diameter by 8 inches deep.

S.D.D. Lisínidhe Riabhacha—"Little Grey Lioses"; the strange name is now applied to a laneway.

Lios 'Ard—as above.

Cill 'Ard—"High Early Church Site"; the ceall on Mahony's farm, above described.

Páirc na Carráige—"The Rock Field."

Páircín a' Strae—"Little Enchantment-Field." See under Gortagousta, parish Carrigtwohill, *antea*.

Cnoc a Bhodaigh—Apparently "The Churl's Hill." Bodach may, however, be, I think, an Irish form of Hodnett.¹

GARRYLAURENCE, Garraidhe Labhráis—"Laurence's Garden." Area, 800 A.

Garrylawras (Inq. Car. I).

The townland is remarkably rich in antiquities. Besides three lioses, there is a holy well, an early church site, site of an ancient castle, and considerable remains of a sepulchral cairn. The largest lios is on Michael Callaghan's farm. There the outer rampart is practically perfect, enclosing within its circuit an area of an acre or more, thickly covered with willow and hazel. A smaller lios, on Maurice Callaghan's holding, has been practically demolished; its site is quite overgrown with furze. The outline of a third lios can be traced on a field of Dineen's called Páire a' Leasa. Close by—in the same field, I think—is the site of the ancient castle. St. Laurence's Well is within a small copse, surrounded by a fence, beside the road. The well itself is covered over by a structure of mason-work, 7 feet high by 4 feet in internal diameter, and domed overhead. Surmounting the conical roof of the little building is a much weather-worn effigy of St. Laurence, and a cut-stone cross, bearing date 1842. The doorway of our well-house resembles the doorway of a Round Tower. Within the building is a niche, in which is kept an iron drinking-ladle, attached to a chain. Votive offerings of the usual character decorate the tree branches which immediately overlook the sacred fountain.

S.DD. Cahergal (O.M.), Cathair Gheal.—"White Stone-Fort." This official name, however, which is absolutely unknown locally, is certainly incorrect. The real name is "Carn Geal," *i.e.* "White (Glistening) Cairn"; probably shining quartz stones were largely used in its construction. The cairn, which stands at an elevation of 771 feet, is now in a very ruinous condition. Most of the material has been carried away—presumably for fence-building or road-making. In fact, hardly anything survives except portion of the stone circle which apparently acted as a retaining wall for the central pile. The circle, and consequently the stone pile, was about ten yards in diameter, and slightly more than one-half the circle (northern side) still stands. Eighteen uprights, of which the largest stands five feet above ground, remain *in situ*. The cist, or grave, in centre of the circle, it is difficult, if not impossible, to reconstruct on paper. Its remains suggest rather a square

¹ *Vid.* Cork Archaeol. Journal, vol. xxi, p. 176.

chamber or pit than the ordinary oblong chambers of a cistvaen. Pat Daly, who remembers demolition of the pile, says it looked as if the body were interred standing upright. O'Donovan—presumably without having seen the monument—writes:—"I am sure it should be Cahergal, and that the circle is the remains of a stone fort."

St. Laurence's Well (O.M.). "Rounds" were made here chiefly on August 9th (vigil of St. Laurence).

Sliabh na Smísteach—"The Smiddys' Mountain," a sub-division containing about one hundred acres.

Móin na Ladhra—"Bog of the River Fork," another sub-division. Area somewhat indefinite.

An Faidheibín.--"The Little Green." This is an untilled space (extending to an acre and a-half) on Dineen's holding, but reaching across the road into the adjoining farm (Callaghan's). Popular reverence for the place indicates it as an ancient cemetery, though, strangely enough, it is not styled a ceall. Circuit of the enclosing fence is still faintly traceable.

An Slogaire—"The Swallow Hole," a field.

GURTEEN, Goirtín—"Little Garden." Area, 724 A.

On Muleady's farm is a single-fenced circular lios of moderate size.

S.I.D. Beanna Amúigh—"The Outside Gap," a sub-division containing approximately a hundred acres.

Móin na Ladhra—"Bog of the River Fork." Another sub-division of somewhat indefinite area: it extends into the adjoining townland of Garry-laurence (*q. v.*).

An Choill Ruadh—"The Red Wood," a glen-side.

Páirc a Chorráigh—"The Swamp Field." A *Carrach* is wetter than a *Móin*.

Páirc a Phúna—"The (cattle) Pound Field."

KNOCKY-LEAGH, Cnoc a Bhodlaigh—"Hill of the Churl." The qualifying word might also, I think, mean Hodnett's. Area, 190 A.

Three-fourths, or thereabout, of the townland area is unreclaimed mountain.

X.

TEMAIR BREG: A STUDY OF THE REMAINS AND TRADITIONS
OF TARA.

BY R. A. S. MACALISTER, LITT.D., F.S.A.

PLATES VII-X.

Read JANUARY 28, 1918. Published JANUARY 20, 1919.

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1.—INTRODUCTION

ONE of the most important publications ever issued by the Royal Irish Academy is the essay *On the History and Antiquities of Tara Hill*, by Dr. George Petrie; first drawn up for Captain Larcum's abortive Ordnance Survey scheme, read before the Academy in three instalments during April and May 1837, and published in its *Transactions*, vol. xviii, pp. 25-232.¹ This is certainly the foremost work of its distinguished author.² It still stands as a model of industry and of archaeological insight; and it is the quarry from which all later writers on the subject have drawn their materials.

Eighty years of research have passed since this monograph was presented to the Academy. Facts have come to light of which no student in Petrie's

¹ The frequent references which it will be necessary to make to Petrie's essay in the course of the present paper will cite it as *Tara*, followed by the number of the page. The place itself will throughout be referred to by its native name in the Middle-Irish orthography, *Temair*.

² It is not, however, an unfair criticism that Petrie hardly acknowledges with justice the obligations he is under to O'Donovan's assistance. Perusal of the Ordnance Survey Letters shows that the descriptions and identifications, as well as the translations of the numerous Irish texts, are all due to O'Donovan.

time could have had cognizance. Ancient texts, then hidden away in MSS. almost or entirely inaccessible, have been published. A more rigid historical criticism has been applied to the documents of which Petrie made use, and to the interpretations which he and his contemporaries put upon them. The science of Anthropology in its several branches has come into being, shedding light on corners which to Petrie and his friends were totally obscure. In short we have reached a stage where it seems profitable and desirable to review the whole subject.

The topographical part of the present paper, which occupies Section 2, is entirely corrective or supplementary to *Tara*, and no details there given accurately are repeated here, unless some special circumstance makes it necessary. I have more than once read over the descriptions in *Tara* on the site itself, and have judged of their correctness with the actual remains before me.

The views put forward in the later sections of this paper have been growing in my mind for some time. That they are at the moment "in the air" is shown by the fact that to a certain degree they have recently been anticipated in publication by my friend Dr. Josef Baudiš, in an article published in *Ériu*.¹ I am very glad that this scholar has come, quite independently, to the same conclusions as myself, as it encourages me to put forward my own suggestions with all the more confidence. Mr. A. B. Cook, in a series of articles published in *Folk-lore*,² even earlier indicated similar conclusions. I would interpret some of the facts a little differently from my predecessors; and in the following study I endeavour, so far as possible, to avoid traversing the same ground as they have done. Practically all the points which they have brought forward were familiar to me, and would have been included here had their writings on the subject not seen the light. But it would not be reasonable, especially in these times of stress, to expect the Academy to reprint matter already accessible; and accordingly where work that has already appeared still holds good, I content myself with a simple reference.

The study of the topography of the site must be based on that remarkable geographical document known as *Dind-sheanchas Éirenn*. This document, with its wild tall-tale may well seem a perilous quicksand on which to found what is intended to be a sober historical investigation. But the grotesque derivations of names and the tales of sea-monsters and other impossible atrocities with which it is so largely concerned, must not blind

¹ *On the Antiquity of the Kingship of Tara: Ériu*, vol. viii, p. 101.

² *The European Sky-God: Folk-lore*, vols. xv-xviii.

us to its practical value. Though its writer had his head filled with these frivolities, he was at least familiar with the topography of Temair. Even if we had not the evidence (such as it is) offered by the preface to the work in question, that it was actually compiled at Temair, we might have inferred this from the general accuracy of its descriptions of the several structures, and also from the fact that Temair occupies the first place among the localities of which it treats. The author wrote of Temair with Temair actually under his eyes, and, what is more important, under the eyes of his hearers, readers, and critics; and therefore, whatever we may think of his philology, there is the best of reasons for trusting his topography.

Petrie made use of the account of Temair contained in this document, as of the poems interspersed through its prose. All of these materials are printed at length and translated in *Tara*. But since his time more satisfactory editions, both of the prose and of the verse texts, have been issued—of the prose by Whitley Stokes,¹ and of the verse by Mr. Gwynn.²

In the topographical description in Section 2 of the present study, the different sites are taken in the order in which they are enumerated in the prose text. For brevity this is referred to throughout by the abbreviation PD, with the number of the paragraph in Stokes's edition (thus, PD 20). The verse texts are referred to under the symbol VD, with the number of the poem in Gwynn's edition and the number of the line of the poem; thus, VD ii 20 means line 20 of poem no. ii. Of the five poems in VD, nos. i and ii are entirely historical, and contain nothing of topographical importance; no. iii is purely topographical, and contains a full list of structures, though with very scanty details regarding them; no. iv is partly historical partly topographical, but relates to one building only (*Tech Mídeháarta*); and no. v contains nothing but a metrical list of fortresses,³ &c., which is of no service for our present purpose, and need not again be mentioned. Though I have used the printed editions for convenience of reference, I have not neglected the MSS. on which they are based. Gwynn's edition of VD gives variant readings, but Stokes's edition of PD does not profess to be more than a transcript from one MS. (that at Rennes), and only a few variants are noted. I have carefully collated the Rennes text of the Temair

¹ *The Rennes Dind-sheichas* in *Revue celtique*, xv: the portion relating to Temair will be found on pp. 277-289.

² *R. I. A. Todd Lecture Series*, vol. viii, pp. 2-45, 57-79.

³ This poem seems to have been written during the usurpation of Brian Bóroma by a supporter of the legitimate King Mael-Shechlainn: see lines 73-76. It indicates that there was still some sort of royal residence at Temair at that late date, in spite of the familiar tale of its abandonment after the curse of Ruadán. (See also *Annals of Ulster*, A.D. 1124, for the fall of a house in Temair on the king at that date.)

articles with the MSS. of *Dind-shechus Éirean* accessible in Dublin. These manuscripts are hereinafter referred to under the following abbreviations:—R for the Rennes text; H for H 3 3, in Trinity College Library; U for the Book of Ui Maine; L and B for the Books of Leinster and Ballymote respectively. For the last two MSS. I have used the R.I.A. facsimiles.

I have to thank Sir James Frazer, Mr. P. Giles (Master of Emmanuel College, Cambridge), Mr. E. J. Gwynn, and Dr. Bergin for allowing me to consult them on some questions that arose in the course of the work, and Mr. T. J. Westropp for accompanying me on two visits to the site, and for help in topographical study. I have specially to express my acknowledgments to Mr. Arthur Bernard Cook, of Cambridge, who read over the greater part of this essay in MS., and made many valuable suggestions.

2.—THE TOPOGRAPHY OF TEMAIR

1. *Nemnach*

NEMNACH, according to PD 5, "is a well (*tipra*, in L. *fi h |*pra), that is at the tumulus (*síd*) in the north-east of Temair (*and airthoctuiscert na Temrach*)." Such is the reading of R, B, U, and H; but L reads *desciort* for *tuiscert*—"south" for "north," and this must be right. For, when we read further, we find that Tech Márisend was north of Nemnach, and Ráith Loeguiri north of that again; Nemnach must therefore have been south of Ráith Loeguiri. The site of the last-named structure is fixed, being identified by its relation to the great Ráith Ríg; and no site south of Ráith Loeguiri could be described as being "north-east of Temair."

Petrie identified Nemnach with a spring that lies on the eastern slope of the hill, south of the modern village, the excellent source which supplies the modern village with water. It is just about east-north-east of the principal group of structures on the summit of the ridge.¹ His chief argument for this identification was that "it is the source of a stream which has turned a mill on the site of the ancient one to the present day"; that is, to the time when Petrie wrote. The reference is to the well-known story told in VD iii 109-120, and also in PD 5 that upon a stream flowing from Nemnach was erected the first water-mill in Ireland, made by king Cormac for the benefit of his slave-girl Ciarnait, who was unable, owing to physical weakness, to carry on the heavy labour of grinding with the hand-quern. But this spring, which is the strength of Petrie's identification is marked *Nemnach* on the Ordnance map as not south of Ráith Loeguiri; and a

¹ *Tara*, p. 149.

writer in the Ordnance Survey Letters¹ records the local tradition of the mill in a form quite different from that given by Petrie, namely, that Cormac's mill was on the river Gabhra in Blundelstown townland, "erected by a Scotchman named Hand" (!) These facts do not strengthen the case for Petrie's identification.

There is a spring, now much bemired by the trampling of cattle, at the south end of the ridge. It is marked "Well" on the twenty-five-inch map (Meath, sheet xxxi, 16). The six-inch map indicates it, but without any lettering. A streamlet flows eastward from it. The stream from Nemnach flowed eastward, according to the L text of *Dind-shenchas Éirenn (glassí bec theid [a N]emnig sair*. The word *sair* is omitted in the other Dublin MSS.). This spring would satisfy the conditions for identification with Nemnach better than the spring indicated by Petrie.

True, VD iii 103 *sqq.* says, or appears to say, that Nemnach is east of Múr Tea, and that the houses of Temair were scattered around Tech Máirisend, which was on its margin. This, so far as it goes, would seem at first sight more favourable to Petrie's identification; for his Nemnach is close to the modern village, and is about east of the site of Múr Tea. But, in the first place, it is a mere assumption that the houses of the ancient village, which doubtless stood at or near the royal dwellings, were on the site of the modern village.² In the second place, it is not certain that the passage before us really asserts that Nemnach was east of the structure called Múr Tea; rather does it intend to say that it was east of the whole site of Temair, a condition satisfied by its being on the eastern slope of the ridge. Metrical exigencies prevented the author of the poem from saying that the well was *south-east* of the settlement. The writer of PD had no such difficulties to contend with, and his version of the direction in which we are to look for the well is therefore to be preferred. Against Petrie's identification it may further be argued with fairness that, if it were sound, it would not be easy to understand why the author of PD mentioned Nemnach first in the list of notable places of Temair; while if the well were at the place now suggested.

¹ O. S. Letters, Meath, pp. 143-4.

² That there was such a village may be taken for granted: the royal establishment would need servants, caterers, and other ministers, who would have to be housed in the neighbourhood. The well-known block of red enamel from Temair, now in the Royal Irish Academy's collection (*Trans. R.I.A.*, xxx, 277; *Journal Roy. Soc. Antiq. of Ireland*, xli, p. 61), which was meant to supply material for enamel buttons to be pinned on to metal objects for their enrichment, is a proof that artificers in metal and enamel were established at Temair in the time of La Tène II, when this particular technique of enamelling prevailed.

it would naturally be mentioned first, being the first site met with in proceeding in the south-to-north direction which the author of PD follows.

Had there been any trace of a tumulus on the edge of either of the springs, the identification with one or the other would be certain: for it was by such a tumulus or *sid*-mound that the well Nennach was marked when *Díad-shenchas Éirenn* was written. But the most careful search has failed to reveal any indication of such a mound. The earth around both springs has been cultivated, as the marks of furrows clearly show: and the tumulus has been annihilated. The former existence of this *sid* is doubtless an indication that the waters of Nennach, like those of the other springs of Temair, were sacred.

The stream that flowed from Nennach bore the name Nith, according to PD 5. This must be distinguished from the better-known river of the same name, in Mag Murthoinne, on the borders of which were the winter-quarters of the revisers of the *Senchus Mor*:¹ even although that document speaks of *Nith nemnadhach*, "pearly Nith." The same combination of words occurs elsewhere. Thus, in the quatrain describing the river-bursts that took place in the reign of Sírna Soeglach, forming part of the poem beginning *Sírna Soeglach, saer in fláith*, we read—

Tomaidm Scirtige na ré,
na ré ro mebaid immach

ocus tomaidm Duailte
Nith nemnaide nemannach.

"The burst of Scirtech in his time, and the burst of Doalt:
in his day burst out Nith, brilliant and pearly" (LL 19 b 1, LLec 581 a).

This suggests that the combination of words was so familiar that the one unconsciously called the other to recollection. We find the same or a similar combination in Cormac's *Glossary*. Under the word *Neth*, "a pagan Irish god of battles," we read of his consort *Nemna*; and the next article but one in the Glossary is *nith*, "mortal wounding."

2. *Tech Márisind*

*The site of the House of Márisin (*dithreach Toigi Márisind*) is over the tumulus that is northward from Nennach, with three small stones round it. In this wise was that house established, with a lofty floor and a very low *tharsad*. Márisin was a widow who was in Temair at the same time as Cormac. Every house that is established in that manner will not be gloomy, and will not be without riches in it." So says PD 6; a paragraph that calls for most minute attention. VD iii 97 *sqq.* speaks of it as "chief for beauty

¹ *Ancient Laws of Ireland*, Rolls ed., i, 2.

² The words "in Temair" are in H only.

of Ireland; a height in the west, a great height in the north, a low level away from it eastward¹—a noble excellence.” Such are the materials that we have for the study of this interesting building, of which not a vestige now remains.

From these passages we learn—(1) that Tech Márisend was already in ruins when *Dind-shechhas Érenn* was compiled; (2) that even in its ruined state it was understood to have been of an unusual design, though the description is not so clear as we might have wished; (3) that it was considered a lucky model to follow, and that houses built after the same pattern were blessed with prosperity and happiness.

But why? Assuredly because the House of Márisiu was something more than merely the residence of an otherwise undistinguished widow. For PD records three further remarkable facts about it: (1) it was built above a tumulus; not a place, I venture to assert, where any ordinary person contemporary with Cormac would willingly dwell;² (2) it was just beside Nemnach, the holy well; (3) there were three small stones round about it.³

What were these three stones? There is not a house in Ireland, ancient or modern, in whose neighbourhood three small stones could not be found; why then are the stones round the house of Márisiu mentioned? Clearly because they had some special significance. In all probability they were the remains of a stone circle that girdled the site of the house. We need not assume that these *clocha becca* were mere insignificant pebbles; the same expression is used of the stones called Móel, Blocc, and Bluicne, which, as we shall see, must have been of some considerable size.

The name Márisiu, also written Máriseo,⁴ does not appear anywhere else, so far as I have been able to discover. We are told that the owner of the name was a widow of the time of Cormac; it is, however, evident that

¹ This seems to be the meaning of the Irish, *ard uniar, irard atáid, | ísel úd sair*. The first line might mean, as Gwynn has translated, “it was high in the west, very high in the north”; but the second line can only mean “there was a low level away from it eastward,” so that an analogous translation seems to be required for the preceding words. What this implies will be considered later.

² On the other hand, the presence of a *síd*-mound seems to have been considered an advantage for what may be called the sacred or official structures of the site. Such a mound is incorporated with the building here called Cormac’s House; the great ring of Ráith Ríg has been deflected to include another; a third forms part of Ráith na Senad, in which I am inclined to see Múr nOllomhan, the original assembly-hall of *Féis Tem-rach*; and a fourth is incorporated with the south wall of Tech Midchúarta, the later assembly-hall. See the different articles in which these structures are described.

³ This is the reading of L (*imbe*). H reads *and* (“in it”). R, B, U omit the word altogether.

⁴ The mark of prolongation over the *a* is sometimes omitted. The name appears as Muiriuse in H.

the sentence which contains this information (*Máirisiu dono, bantrebhach iac i cionne ífí Cormaic*) is no part of the original text, but a marginal gloss which has become incorporated with the passage at an early stage of the history of *Droichead-na-Éirí*. It breaks awkwardly into the sense of the passage in which it is inserted. In any case, the statement that Máirisiu was a widow of the time of Cormac is insufficient to account for the peculiarity of construction of her house, for its very singular situation in the middle of a sacred circle and beside a ghost-haunted tumulus, and for the luck said to attend houses similarly built. We are probably to see here either a confusion, or an evasion on the part of the author or of his glossator. In the former case, the writer of the sentence must have had in his mind another widow of Temair, who figures conspicuously in the legends of Cormac—namely Cainech (*after* Benmaid), the owner of the sheep which Cormac tended while exiled from his kingdom.² But it is more probable that we are to see here an evasion. The conscientious Christian who wrote the note was doubtful as to the desirability, or the legitimacy, of perpetuating unduly the beliefs of paganism. Suppose that Máirisiu was, in the ancient creed, something more than human—her innumerable choice of a dwelling-place would accord with this—the writer might well feel a hesitation in recording the heathen beliefs about her. So, instead of saying that she was a goddess, he put down the first thing that came into his head, possibly suggested by a floating recollection of the story of Cainech.³

If Máirisiu was originally a goddess, we can better understand why her house, *i. e.*, her temple, was erected over a tumulus, beside a sacred well, and within a stone circle. We can also understand the complete destruction, not merely of the house (which might have been of wood, and have perished by the ordinary processes of decay), but also of the *sid*, which would be practically indestructible without intentional violence. For the conscience of the writer of *Droichead-na-Éirí*, or of his glossator, would hardly have given vent to the worship of Máirisiu had wholly disappeared, and had become merely a matter of antiquarian interest in his time.⁴ There were

¹ *Lebor Gabála*.

² A "house of Cainech (sic) on the Road of Assa" — that is the road running westward from Temair, is called *Tach-umnaidh-Whinn*, "the house of protection of Ireland," in the *Trosc* (*Tristram*, vol. p. 2). What may be meant by "house of protection" is not quite clear. It may, perhaps, signify in the medieval sense of a place where refugees are protected from justice. There is clearly a confusion between (1) Cainech, (2) Cainech, and (3) Máirisiu in the text, and (4) the protection-house of Cainech and (5) the luck-bringing house of Máirisiu on the other. The situations of the two houses are incompatible. Possibly *Ciarrauil* and her mill are part of the entanglement.

³ This point is worth a foot-note. It is often said that it is difficult to discover the pagan beliefs of ancient Ireland from the literature, because they have been purged out

still Márisiu-worshippers in Ireland; and therefore it was at some time considered necessary by the ecclesiastical authorities to demolish the structure in which the worship centred.

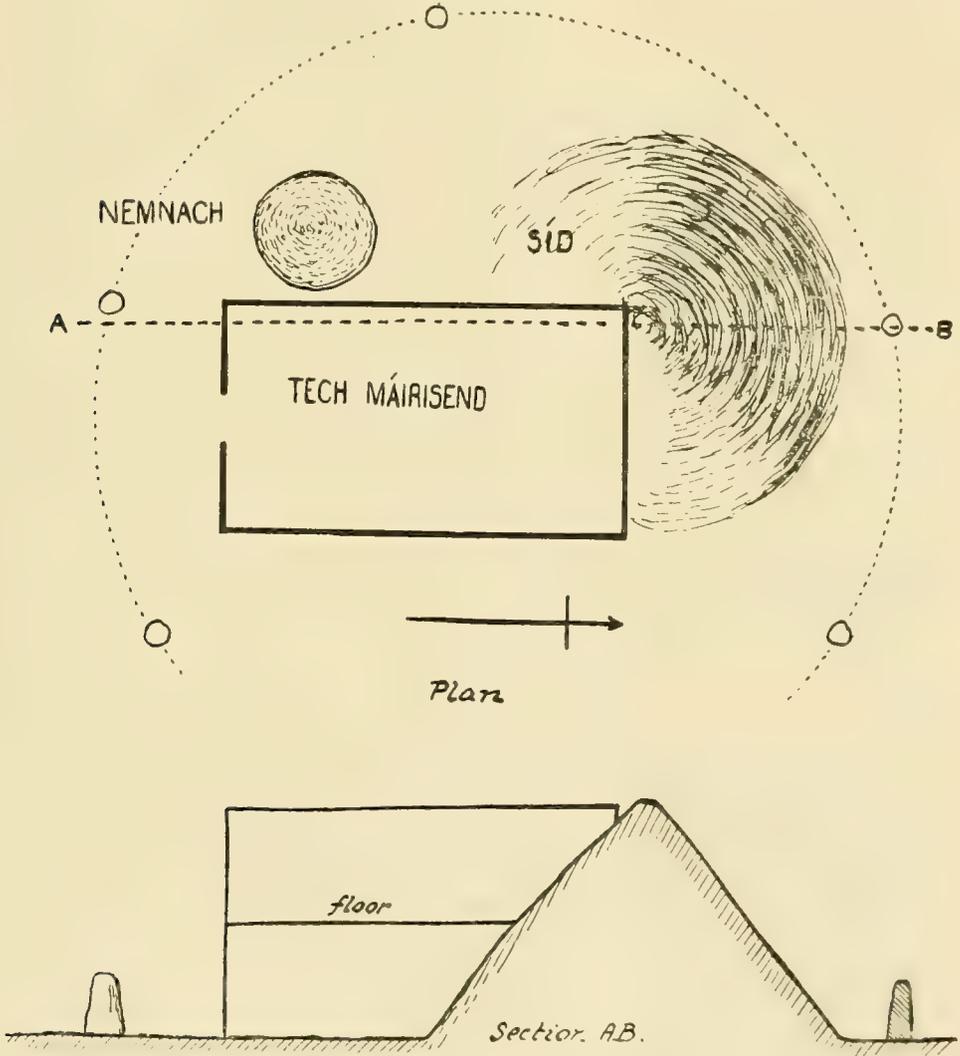


FIG. 1.—Restoration of the House of Márisiu.

The last question which presents itself with regard to the house of Márisiu is its design. The obscurity of the description in PD is not lessened

by a *succession* of scribes, by whom the documents have been transmitted to us. This is not wholly correct. The purgation took place once for all, when the literature was being written down for the first time in its present form, and while paganism was still a force to be reckoned with. The scribes would not take the trouble to eliminate *dead* gods.

by our ignorance of the meaning of the technical term *túrad*, on which all the MSS. are agreed, with slight differences of spelling.¹ It probably denotes some part of the roof. But, leaving to future discoverers to find out what the "very low (*tuad*)" of the house may have been, we note that the building had "a lofty floor" (*dlú ad*). We can guess why the floor was raised aloft with the help of the description in VD. According to this account there was a height in the west, and a great height in the north, but a low level to the east. To explain this we must remember that the house was built over or against a tumulus. The *top* of the mound (the "great height") was to the north, the *slope* of the mound to the west; east of the house was the natural level of the ground. As the slope of the mound would encroach on the ground-level of the house built against it, the floor would have to be raised in order to obtain a space of sufficient breadth. The diagram (fig. 1) is an attempt to represent the general lines of a building that would answer to the conditions. A structure thus cleverly adapted to an awkward site, might well be considered a "mason's triumph," if that could be the meaning of *áir-áir-áir*; and a person building his own house after the model of the "Temple of Mársin" might be supposed to be placing his household under her protection. Whatever may be thought of these conjectures, it can at least be claimed that they afford a not unreasonably explanation of certain statements so remarkable that some explanation is urgently called for.

3. Raith Loeghri meic Néill

This structure, which Petrie has satisfactorily identified,² had four doors ("chief doors", *primdoirsi*, in L, U, and H). It does not appear whether these doors were in the surrounding rampart or in the enclosed building; probably the latter. The rampart is too much ruined to allow us to determine the number and nature of its entrances; indeed, on the western side, almost half of the ring is totally wiped out of existence.

According to PD 7 the grave of Loeghri was "against the outer south-eastern rampart of the royal raith" (*fron ad iombhrach a-sarthar-deisceir-tóe na cteirraide*), that is, presumably, outside the rampart, and on the south-east side. Petrie cites a passage from *Lebor na h-Udú* in confirmation of this statement, but it is probably not independent of PD; the two passages seem to be drawn from a common source. VD gives a different situation for the grave. These numbers of the monument are there enu-

¹ *Tuad*. L; *tuaradh*, R. The word seems to be a *ἀπὸς λεγόμενον*.

² See Gwynn's note *ad loc.*, VD iii 100.

³ *Tara*, pp. 150, 168.

rated (VD iii 93-96): Ráith Loeguire (the inner dwelling); Les Loeguire (the enclosure surrounding the inner dwelling, with its rampart); and Lecht Loeguire, the grave, which was *for lár a lis*, "on the platform of his *less*." There is not the slightest external indication of the sepulchre; only an extensive excavation could determine its position. The rampart was double: but this does not now appear, except at one spot on the eastern side, just south of a deep gravel-pit that has been dug into the entrenchments.

It is not quite easy to see the meaning of the statement contained in the passage quoted by Petrie from *Lebor na hUidri*¹ that, at the time of Patrick's interview with king Loeguire, "Ráith Loeguire was Tech Midchúarta." Does this mean that Cormac's great building had already fallen into ruin, and that the king's ráith had been adapted as a substitute?

Though Temair was from the Bronze Age the site of a cemetery, it is noteworthy that very few of its kings were buried on the spot. The tract *Senchas na Relce* states that only three kings were there interred—Conaire, Loeguire, and a third, whose name the scribe has omitted (*Lebor na hUidri*, facs., 51 b 1).

4. *Lecht Mata Mór-glondaig*

We learn from PD 8 that the monument was beside Ráith Loeguire, to the south-east (*hi tócb rátha Loeguire anairdes*). VD makes no reference to it. There is no trace of any monument now existing in the place indicated; most likely it was a standing stone, as were the majority of the other lost monuments. This is what we might have expected: for there are few quarries in the neighbourhood, so that stone is in demand for building; and, moreover, as the stone monuments seem to have been objects of pagan worship rather than mere grave-marks, their disappearance after a change of religion is easily accounted for. On the other hand, few forms of ancient structure are more enduring than earthen mounds, when they are not destroyed with intention.

There are two versions of the story of Mata told in the mss. of *Dindsenchas Éirenn*, and there is also some uncertainty as to his name. All the Dublin mss. call him Mata²; but, according to Stokes, R reads Níata. This is probably an error: as Níata had some such meaning as "champion-like," the corruption would be easy. Whatever his name, he is said to have been a ravaging warrior (*amus bratbertach*) of the time of Cormac. "One day there were four warriors (*óclóech*) playing beside Ráith Loeguire on the south-east, and Mata pushed them all four into the ground above the narrow parts

¹ *Tara*, p. 170; see also *Revue celtique*, vi, pp. 162 sqq.

² Matta in L, Mada in U, H.

of their waists." The tale has come down to us in a condition too fragmentary for us to make much of it: but, even in its mutilated condition, it presents one or two noteworthy points. In the first place, it involves either an anachronism, or an indication that Ráith Loegniri was not originally built by the king whose name it bears. It must have been in existence some two centuries before the time of Loeguire, if the unlucky warriors contemporary with Cormac were playing a game outside its walls. In the second place, the tale bears a close family resemblance to the legend of how Conall Cernach found two youths playing with the head of Cu-Chulaind; indeed, so far as the scanty materials before us permit us to judge, we may reasonably regard the one story as a by-form of the other. As in the case of Máinisin, we may suspect here a confusion of some kind: a tale, properly belonging elsewhere, is told to account for a monument of which the true origin had been forgotten. And it need scarcely be pointed out that it does *not* account for the monument!

I. gives us a different version of the story, which is, if anything, even more corrupt and obscure. Here only one of the four seems to have been singled out as a victim and Mata cast a stone "so that the warrior died of it." This does not help us much.

So far as I am aware, the name Mata is not found elsewhere in any connexion with Cormac and his cycle. It reappears in literature, however, as that of a great monster closely connected with the Boyne valley. Among the remarkable places of Brug na Bóinne, *Dind-sienchas Éirenn* enumerates Lecht in Matae (the grave of the Mata); Glend in Matae (the valley of the Mata); Leac Bend "the stone on which the Mata was slain"; and Duma na Cúam, "the mound of the Mata's bones." In the article on Áth Cliath Caolann (Droghda), in the same compilation, we learn that the men of Ireland, after slaying the Mata on Leac Bend, threw its bones into the Boyne. The *clóph*, or skull-bone, was washed down to the sea at the Boyne estuary, whence it has its name Iubet (olptha); while the ribs were washed south to the Liffey estuary, and the "huriles," which gave its name to the ford Áth Cliath, were made from them. Opinions seem to have differed as to the appearance of the Mata. PD¹ says that it had seven score feet and seven heads, or that it was "a sort of tortoise"; but VD² while retaining the seven score feet allows it only four heads. This poem tells us that it "licked up the Boyne," and that, in some unexplained way, "the sin of Adam's wife" was responsible for its existence.

Here, then, we have a tradition of a great hydra-like monster, whose home

¹ *Revue celtique*, xv, 292.

² *Ibid.*, p. 329.

³ *Ibid.*, p. 292.

⁴ *Todd Lecture Series*, x, p. 100.

seems to have been in the valley of the Boyne: and I am inclined to suspect that the "monument of Mata" at Temair was originally in some way associated with this creature. In a more rationalistic age the story of the monster became dim, and somehow became mixed up with the tale of Conall Cernach and the youths who desecrated the head of Cu-Chulaind. Finally, Mata became a warrior, and, like most of the traditions hovering round Temair, was assigned to the time of Cormac mac Airt.

A suggestion may be hazarded as to the origin of the legend of the Mata, or, rather, as to the reason of its localization in the Boyne valley. The monster was closely associated with the great cemetery of Brug na Bóinne, the most conspicuous monument in which is the mound now called New Grange. One of the most noteworthy features of New Grange is the great stone that lies in front of the entrance, bearing an elaborate serpentine pattern of spiral scrolls. Is it too much to suggest that this sculpture helped to fix in Brug na Bóinne the tradition of a mighty dragon? The stone of Mata at Temair may possibly have borne similar sculpture. This is the more probable on account of the intimate connexion which appears to have existed between Temair and New Grange, as we hope to show in a later section.

The adjective *mór-glondach* is applied in the *Dind-shech* of Brí Léith¹ to the *síd*-prince Midir, in a story which, at least indirectly, connects that personage with Temair and with a certain *Llath*. We shall find this latter name figuring in the early legendary history of Temair. How far it is possible to see here some trace of a confusion one can hardly undertake to say; the two names, Mata and Midir, are obviously too remote from one another in form and in sound to have any radical connexion. But I confess myself unable to believe that the rules of the philologists are of the mathematical inflexibility claimed for them, when *proper names* are concerned, and when we have to deal with the folklore of illiterate or semi-literate peoples. In a folk-tale from Co. Leitrim the expression "Bull of Norroway" has become corrupted to "Bull of Oranges"—a familiar word being substituted for one unknown to the narrators.² In the face of this we may be prepared for almost any perversion of proper names.

5. *Ráith Ríg*

*Ráith Ríg*³ "is beside *Ráith Loeguirí* to the north" (PD 9). Its identification with the enormous enclosure on the summit of the ridge is beyond dispute. Only one rampart can be traced; it is possible that there was an

¹ *Revue celtique*, xvi, 78.

² *Folk-lore*, iv, pp. 193, 194.

³ Almost always written thus, without the definite article preceding *ríg*.

inner rampart of stone, which has now disappeared, as Mr. Westropp suggested to me when we visited the site together. According to PD, Ráith Ríg contained three notable things: Tech Cormaic, Láthrach in Forraid, and Múr Tea. These have now to be separately considered.

6. Tech Cormaic

The first of the "three notable things" in Ráith Ríg was the site of the House of Cormac (*láthrach* = *Taigi Chormaic*). VD makes no reference to this structure. PD says of it that it is *ind oirthir-descert na rátha illeith fri Ráith Loeguln hith*: "in the south-east of the raith, in the side towards Ráith Loeguln southward." This is very hard to understand. There is no trace of any structure in any spot that could be so described; the suspicion is aroused that there is some old and deep-seated corruption in the text at this point.

The only other guide which we have to the identification of Tech Cormaic is the further statement in the same paragraph of PD: *láthrach in Forraid hi tob láthraige Taigi Chormaic anoir*. This reading of R is followed, with a few trifling orthographical and other variations, by all the Dublin mss.; the only difference of any importance being the omission of *anoir* in U. The sentence means "the site of the Forrad is beside the site of Cormac's House eastward": *an* being the allomorphic signification of *an*, which literally means "from the east." Now there are two conspicuous monuments near the middle of Ráith Ríg, side by side, lying east and west: and if we are not misled in them, the Forrad and Cormac's House, respectively, we may abandon at once all endeavour to identify the remains of Temair with the help of the literature. Petrie has so identified them; but he has committed a strange oversight: he has reversed them, identifying the *eastern* mound with Cormac's House, and the *western* mound with the Forrad. On p. 138 of *Tara* he gives a translation of the passage in PD, rendering *an* correctly; but on p. 156 he says "the ruins of the Forrad, which were alongside the House of Cormac, and to the west"—an error subconsciously induced by his ideas as to the identification of the two structures.

The name *Forrad* is explained in O'Clery's *Glossary*, s.v. *fortha*,¹ as *ionad* = *adha* "a place or dwelling." We may compare the English expression, "the seat of Lord X," meaning his residence. The Forrad at Temair would thus have been the original royal dwelling, and would clearly be older in date than the House of Cormac. It would therefore be natural at first sight,

¹ *Irish Glossary*, iv. 324. The word is given in the plural form, *fortha*, i. *ionaid* = *adha*. O'Clery spells the word with an *r*; the mss. of *Dind-shech* = *Évran* as a rule use *two*.

to suppose that the structure which most nearly occupies the middle of the great enclosure is the Forrad, and that the earthworks to the side of it represent the later Tech Cormaic. This is what Petrie has done.

But when we examine the remains more critically we see that the judgment must be reversed. The central building is the later of the two. Each structure is surrounded by a group of circular ramparts. The ramparts of the side structure are complete. Those of the central structure are interrupted, butting against the ramparts of the side structure. (See the plan of Temair, Plate VII.) This evidently shows that the side structure existed first, and that the central structure was a later addition. The identifications made by Petrie must, therefore, be interchanged: his Tech Cormaic becomes the Forrad, and his Forrad becomes Tech Cormaic. This brings the remains into accordance with the *Dind-shechhas*. As Mr. Westropp, with whom I discussed this question on the spot, pointed out to me, the building here identified with the Forrad, though not occupying the centre of Ráith Ríg, is situated on the summit of the ridge, while the added building, here called Tech Cormaic, is on the western slope. This is an additional argument in favour of the identification. Further, it is more than probable that the great ring of Ráith Ríg is really due to Cormac, built when he added his house to the original structure. His gigantic Tech Midhúarta shows him to have been a man with a bent for grandiose architectural conceptions; and he may well have conceived the idea of the enormous fence drawn about his house. The unprecedented magnificence of Cormac's additions to the buildings of Temair are extolled in the tract *Coimpert Cormaic*.¹ If we assign the rampart of Ráith Ríg to him, the central position of his House becomes at once intelligible.²

Some time after the above paragraph had been written, I chanced to light upon a passage in *Esnada Tairgi Buchet* which I had quite forgotten,³ and which definitely ascribes the building of the great Ráith to Cormac. We are there told that when he was laying it out he encroached upon the property of one Odrán, and a curious story is related of Odrán's very natural protests, and the way in which he was compensated. I suspect that Odrán is borrowed, name and all, from *Ornan* the Jebusite,⁴ who had a somewhat analogous encounter with king David, and in any case, he can hardly be

¹ *Silva Gadelica*, i, 255; ii, 289.

² It will be observed that the ring is laid out, not in the usual circular form, but as an oval. The intention of this appears to be to include the two burial-mounds, Duma na nGiall, and, especially, Múr Tea, within the compass of the Ráith.

³ The passage will be found in the prose text, *Revue celtique*, xxv, 26, and in the verse, *Zeitsch. celt. Phil.*, viii, 264.

⁴ 1 Chronicles xxi.

historical. The story, however, testifies clearly to an early tradition ascribing the building of Ráith Ríg to Cormac.

We, therefore, here describe as Tech Cormaic the structure hitherto called the Forrad. This great flat-topped mound, which resembles the huge mound of Cruachu, doubtless served the same purpose—that is to say, it was a foundation on which the king's house was built.

7. *Forrad*

There is nothing of importance to add to Petrie's account of this structure, which he calls the House of Cormac. It may, however, be worth noting that the site of the house itself is clearly marked in the centre of the enclosure. It is about thirty feet square, which is roughly about the size specified for the house of an *Ard-ri* in *Crith Gablach*.¹ The size of the rampart, however, does not accord with the seven score feet prescribed for such structures by the same authority. In VD i 37, *Forad na ríy*, "seat of the kings," is used as a name for the whole of Temair.

8. *Múr Tea*

The third of the wonders of Ráith Ríg was Múr Tea. We must shed off our not unnatural prejudices when we approach the question of what and where was Múr Tea. The crazy structure of Anglo-Israel is built on the Tea myth, and no one who cares for Temair, and who has seen the wreckage of Rathlinc Suid, can suffer that folly gladly, or otherwise. And the preposterous derivation, Temair = Múr Tea, is enough to make us believe that Tea and her "wall" are entirely late etymological inventions.

But it must not be forgotten that the literary evidence for the existence of ~~some~~ structure, which evidently (for the sake of the derivation just quoted) our authorities called Múr Tea, is just as strong as that for the other possible "lookings" of Temair, extant or lost. The site of "Tea's Wall" is described in the same document as are the other sites, and in similar language—and we are not justified in ignoring the description in this case while we accept it in the others.

We turn back therefore to PD 9, where we read: *Múr Tea illeith fodes, comid dosam rohainniged Temair, i. Tea Múr i. in enoce becc fil eter na dá múr i leith buides, is and atá*—literally "The Rampart of Tea in the side southward, so that from it was named Temair, that is *Tea Múr*; the little hill that is between the two ramparts in the side southward, it is there it is."

¹ *Ancient Laws of Ireland*, iv, 336.

² It is fair to say that this is not much worse than *Teuch-múr*, which is given as the derivation of the name in a well-known modern work on Irish archaeology.

This is the reading of R, B, H, and U : though the last-named MS., by an accidental lipography, has dropped the first four words.¹ L inserts *cturru* "between them" after the opening words *Múr Tea*—"them" being the Forrad and Tech Cormaic, described in the sentences immediately preceding. The same MS. also interpolates an intrusive gloss, explaining who Tea was, enumerating the previous names of Temair, and stating that the site received its present name because Tea was buried *ctir láthrach ind Fóraid 7 ind Ríghthaige*, "between the site of the Forrad and of the Royal House."

In the current section we are concerned with the topography only, so that we must not at present follow up the side issues raised by this note, such as the previous names of Temair or the personality of Tea. These are subjects for later consideration. We therefore concentrate our attention on the nature and position of Múr Tea. The first thing which we notice is that the ramparts surrounding Tech Cormaic and the Forrad are actually in contact, and there is, therefore, no room for any structure between them ; it follows that there must be something wrong with L's reading *cturru*, and with the assertion based upon it in the interpolated gloss. Looking back to the other MSS., which omit *cturru*, we see that Múr Tea was a hillock (*cuoc becc*), that is, a burial tumulus, which is just what we should expect it to be from the legends associated with it. Such a structure would not naturally be described as a *múr*. We are therefore justified in concluding (as has already been suggested) that the name current in our authorities is artificial, devised in the interests of their etymology of the name Temair.² We learn further that it was situated between two ramparts, and that it was south of something—presumably at the south side of Ráith Ríg itself.

It has apparently never been noticed that in the very place indicated—at the south side of the Ráith and just inside the great rampart—there is a slight rise in the ground, which has all the appearance of being the base of a levelled mound. Its diameter is about 33 feet, and its place can be fixed by the following compass-bearings³ :—

To Trim Yellow Steeple,	278°
To a gap in a plantation of trees on a hill to the north-east,	330°
To the statue of St Patrick,	30°
To the south-east pinnacle of Tara Church Tower,	40°

¹ The scribe has, indeed, omitted the whole of the previous description of the Forrad ; his eye having wandered from *fores*, which in the text precedes that description, to the same word in the sentence quoted above.

² A more suitable, perhaps the original, name (Lecht Tea) is preserved in a line of a poem quoted in O'Clery's *Glossary*, s. v. *toinneamh*. See *Revue celtique*, v, p. 57.

³ Taken with a prismatic compass in the middle of July, 1917.

I have no doubt in my own mind that this is the trace of the tumulus called Múr Tea, and regarded as the grave of the eponymous foundress of Temair. Such a place would naturally be an especially "gentle" spot; and it is not surprising that when Cormac stood upon it alone one day he had a vision of the *síd*-folk.¹

It may be more than a mere coincidence that the traditional grave of the foundress holds roughly the same position relative to Ráith Ríg that the grave of Loeguire is said to hold with regard to the fort which bears his name.

For the topography of Múr Tea we are entirely dependent upon PD. There is some valuable traditional matter in VD to which we must return later, but nothing to throw light on the appearance of the mound. It is, however, worth passing notice that VD i 34-36 contrasts the *house* (*teoh*) of Tea, round which was a rampart, with her *grave* outside the rampart (*roadnacht ioc mór anamh*), showing that there were two sites associated with the princess. The house was presumably identical with the Forrad, the grave with the tumulus here described. The "rampart" here mentioned is of course that of the Forrad, not the later-built Ráith Ríg.

9. *Caprach Cormaic*

Caprach Cormaic was a well *fo tóibh Ráitha na Ríy anoir*, "under the side of Ráith Ríg eastward" (PD 10). According to VD iii 122, it was *i Ráith Ríy, ó Ráith Ríy sair* "in R.R., from R.R. eastward." This coincides with the position of the spring identified by Petrie with Nennach. Remembering that the name "Cabrach" still survives in the townland next to that containing Petrie's Nennach,² I suggest that Petrie's identification was wrong, and that the spring in question was really Caprach Cormaic. *Caprach* apparently means "a roofed building."³ Very likely the well was covered with some protecting structure from which it derived its name—just such a covering, in fact, as still roofs it over.

Petrie professed himself unable to discover Caprach Cormaic. He says (*Topog.* p. 166), for no very satisfactory reason, that it must have been *south* of Nennach; but on his restored map of the site he places it *to the north-east* of his Nennach!

Caprach Cormaic had three other names, as PD goes on to tell us: Liaig

¹ *Irish Texts*, iii, 193.

² The well is now in Castleboy townland; but the meaning of Cabrach comes to within 100 feet of the spring. Indeed, there is a sort of projection jutting out from the main area of Cabrach towards the spring; it looks as though Cabrach had originally been laid out to include the site of the well, but that a subsequent encroachment of Castleboy had cut it out. See the townland boundaries as indicated in the plan, Plate VII.

³ So Meyer, *Contributions to Irish Lexicography*, with a query.

(Liaig na Fíán in H), Tipra Bó Fínde, and Dere Dub. VD iii 125 gives the three names rather differently: Liaig Dáil Duib Duirb, Túath Linde, and Tipra Bó Fínde; it also speaks of the well (iii 123) as Topur Tuirme Cland, which looks like a fourth name. These names, though obscure, and perhaps corrupt (as Gwynn suggests in his note *ad loc.*), are very suggestive. Liaig, "Physician," indicates a medico-magical spring of some kind. Tipra Bó Fínde must refer to some sacred white cow. Dere Dub, "black eye," may be merely a descriptive name, applied to the dark waters; while Topur Tuirme Cland, "the well of numbering of clans," is, as we shall see, a name or expression very suggestive in the light of certain traditions regarding the foundation of Temair. I am, indeed, inclined to suspect that the sacredness of the ridge of Temair has its roots in the beautifully pure waters that flow richly from this particular spring. It is now called St Patrick's Well: is "Patrick" here a popular corruption of "Caprach"?

PD tells us that there was a proverb current, *Ní tait a laeg go liaig*, which would mean literally "its calf does not go to a healer"—Laeg being the name of another spring on the opposite slope of the ridge. The proverb evidently meant that two incompatible things do not associate together. But I suspect that the writer of PD has corrupted the saying, the jingle of *laeg* and *liaig* having proved too tempting for him; and that the original version was *ní tóit a lóeg co boin fínd*, "its calf does not go to a white cow." This emendation adds point to the proverb, and explains the otherwise meaningless little word *a* before *laeg*. Possibly the "Calf" well was supposed to be actually an outflow from the well of the "White Cow." The latter animal may be identified with *Glas Temrach*, the Grey [Cow] of Temair, which gave its name to the next site that we meet with. It may also be the same as the White Cow after which the River Boyne is named.

According to Wilde,¹ this spring was "formerly shaded by a magnificent ash-tree." May this have been the scion of an ancient sacred tree, planted by the holy well?

10. *Duma na Bó*

The "Mound of the Cow" was westward from Duma na nGiall (PD 11). VD iii 90 calls this monument *Cnoc Bó*, and says that it was "downward from Ráith Ríg (*fri R.R. anís*), which would suggest that it was outside, not inside, the rampart. It is curious that PD does not enumerate either Duma na Bó or Duma na nGiall among the *deccra* or "notable things" of Ráith Ríg.

¹ *Beauties of Boyne and Blackwater*, 2nd edn., p. 125.

The identification of Duma na Bó is a problem of some difficulty. Duma na nGiall is conspicuous enough. West of it Petrie marks on his map, and describes, a mound 6 feet high and 40 feet in diameter at the base, which he calls Duma na Bó. Notwithstanding the most careful search neither Mr. Westropp nor I could discover the slightest trace of it. I find it hard to believe in the total disappearance of so large an earthwork within the past eighty years; even treasure-diggers would have left some trace of their nefarious work. If it were not conspicuous on the old 6-in. O.S. map, I would not hesitate to assert definitely that the mound described by Petrie never existed at all, and that his record of it is due to some freak of memory, or to some confusion in his notes, or in those of O'Donovan. The rough plan drawn by the latter, bound into the Ordnance Survey Letters, shows the mound, but the accompanying description gives no particulars regarding it.

It has escaped notice that there is a mound incorporated with the north-eastern corner of the outer rampart of the structure here called Teal Cormaic. The outermost fosse has been delineated so as to avoid interfering with it (see the plan Plate VII). It seems as though this mound had existed before the building of Teal Cormaic, and it had been necessary to modify the plan of the latter earthwork in order to avoid interfering with it—doubtless, as Mr. Westropp remarked to me, because it was too sacred to be injured. There is some difficulty in reconciling the position of this mound with the directions given in PD; but unless this be Duma na Bó it is impossible to say what it might have been, and there is nothing elsewhere that can be identified with Duma na Bó.

11. *Duma na nGiall*

The "Mound of the Hedges" was north-east of the site of the Fort (PD 12), and its identification with a prominent mound roughly in that position, inside the rampart of Bally Rig, is certain. There can be little doubt that it is a burial mound, not the site of a dwelling, as Petrie supposed.

It is not obvious why Duma na nGiall should be mentioned along with Brug Maic in Ois (New Orange) and Ean Ghrádaireán on Howth as the "Three Wonders of Ireland" (in a quotation in the book of Leinster MSS. p. 164, upper margin).

12. *Fál*

Fál, or Lá Fháil as U calls it (PD 13), was beside Duma na nGiall to the north. VD does not mention it,¹ but this is probably an oversight. The

¹ Tara, p. 158.

² H says *north*, which is more nearly correct.

Fál na Temair (O 82) is not a reference to the stone; it simply means "the valley of Temair."

author of the poem apparently meant to describe it at length, for he mentions Duma na nGiall first of all the monuments of Temair, entirely out of its proper order, most likely because of its proximity to Fál. From many points of view Fál was the most noteworthy of all the monuments of Temair.

The historical and religious significance of Fál will be discussed later; at present we are concerned with its identification only. The late tradition connecting Fál with the Coronation Stone now in Westminster Abbey is not worth the expense of a drop of printer's ink.¹ Petrie's identification of Fál with the stone now erected over the "Croppies' grave," on the summit of the mound here called Tech Cormaic, derives much weight from its resemblance to other inauguration stones,² and from the fact that till 1798 it actually lay beside Duma na nGiall, the place indicated by *Dind-sheuchas Éirenn*. Certainty is impossible, but the identification is not without a considerable measure of probability. The initials of the buried rebels, with the formula R.I.P.,³ are now carved on the stone; but archaeologically it has no more business on the mound where it now stands than has the unseemly statue of St. Patrick erected beside it in recent years.

Petrie, who describes and figures this stone (*Tara*, p. 162), reports, evidently at second hand, an erroneous statement as to its dimensions. He says that it stands 6 feet above ground, and that it is 12 feet in total length. In point of fact, it stands just under 5 feet high above ground; and the late Dr. Cochrane, who saw it uncovered to its base, assured me that it is not more than 6 feet in total length.

13. *Lecht Con ocus Cethin*

Two stones, now disappeared, on the western slope, level with Ráith Ríg (*isin leitir hi comardus Rátha na Ríy star*, PD 14). VD associated the monument with Cnoc Bó (iii 89, 90). PD tells, in a not very intelligible abstract, the tale of how Cú killed Cethin, and was himself slain in revenge:

¹ A curious version of the well-known old-wives' tale which makes the Westminster stone, the Scone stone, Lia Fáil, and Jacob's pillar identical with one another is abstracted in *Revue celtique*, xxiii, 227, from *Boletín de la Real Academia de la Historia de Madrid*, vol. xl. It is not easy to make out from this review whether the Spanish story is merely a confused réchauffé of the familiar material, or is genuinely an alternative version of the legend. But this question is here of very little consequence. Skene's brochure on the *Coronation Stone* (Edinburgh, 1869) still remains the best compilation of the literary material.

² Such as that wrongly called the Stone of Dathi at Rathcroghan. Excavation has shown that the mound under this stone is merely an adapted esker, and contains no interment.

³ In spite of an imaginative article in *Proceedings R.I.A.*, ix, 539, there is no trace of any ancient carving on the stone.

an incident which formed the alleged basis of a proverb, *domgnis Cú is Cúisín*, "you have played Cú and Cúisín on me." The story is ascribed to the time of Cormac, of whom Cúisín is said to have been the table-attendant (*rondaire*).

14. *Lóg*

The "Calt" well, of which we have already spoken in connexion with Capraich Cormaic, was on the slope northward from the stone of Cúisín, and was the source of a stream that flowed westward (PD 15). It exists, as a small and insignificant source of muddy water, in the place indicated by Petrie, a modern structure of stones, resembling a small souterrain, roofs it in. It is not marked on the 25-inch Ordnance map; its place there would be a short distance south-east of the letter Q in the townland-name FODEEN, and in the same field.

15. *Cuchtair Chormaic*

The site of Cormac's Kitchen was on the slope of the hill on the brink of, and eastward from, *Lóg* (PD 16, VD iii 132). There is now no trace of this structure; it may have been of wood and unfortified.

16. *Ráith na Senad*

Near Dama n-an-tuall and northward from Fál (either the stone so called or "the vallum," i.e. *Ráith Ríg*: PD 17, VD iii 81). Correctly identified by Petrie with the ring-fort north of *Ráith Ríg*.¹ It has been almost wholly devastated by the people who were searching for the Ark of the Covenant. It is characteristic of them that they were hunting for the treasures of their patron saint Teó in a place to the *south* of the great *ráith*, though all the authorities agree in putting the grave of that lady to the *south* of it.

The legendary king Ollam Fodla is said to have built a structure called *Mú nOlloman* for the accommodation of Féis Temrach, the institution of which is traditionally ascribed to him. This building whatever it may have been, is not mentioned in *Doctúir na hÉirenn*, though other historians seem to speak of it as though it were well known. It must have been a *building*, for Ollam Fodla is said to have *died* within it, and it is unnecessary to point out that the existence of such a tradition proves the existence of the structure to which it was attached, quite independently of the question whether Ollam Fodla ever had a real existence or not. While it is unprofitable to indulge mindily in speculations that cannot be verified, I may permit myself to note here that it has occurred to me that in *Ráith na Senad* we are to see the building originally called *Mú nOlloman*. The name

¹ *Tara*, p. 171.

Ráith na Senad is obviously later than Christianity; and when Tech Midchúarta superseded the older building as the place of assembly, and when the ráith before us became associated in tradition with the three "Synods" said to have been held within it, the later name might conceivably have completely ousted the earlier. If the ráith had been an ancient assembly-place, it would be natural to choose it for the convention of the "Synods."

Had the Anglo-Israelites even done so much as to record what they actually did find, we might have partly forgiven them. But they did not even make this small compensation for their offence against science and against reason. Mr. Westropp tells me that after many inquiries he could not learn more than that a heap of bones, supposed to be a skeleton, was found, having the skull underneath; and some Roman coins, supposed to have been inserted by some practical joker. There was also a rock-cut ditch, not, apparently, coincident with the fosse of the rampart.¹ Without seeing this it would be impossible to come to any conclusion about it; it might be nothing more than a natural flaw in the surface of the underlying rock. But if it be really an artificial feature, it is very important, and would to some extent corroborate the theory put forward above—showing that some ancient structure had existed on this site, and that the earthworks represented a later restoration or alteration. If ever an attempt should be made to repair the injury done to Ráith na Senad—as I have been informed is in contemplation—it may be hoped that the opportunity will be taken to determine the real nature of this rock-cutting.

A mound or tumulus is incorporated with the ramparts of this ráith on the western side; just as a similar mound is incorporated with Tech Cormaic. Petrie records a popular name for this, current in his time, "the King's Chair."

17. *Pupall Adamnáin*

The site of Adamnán's Pavilion was inside Ráith na Senad (PD 18). Petrie identified it with the mound popularly called the "King's Chair";² and it is quite possible that this is what the writer of *Díad-shenchus Éirenn* intended. It is most probable that the real Pupall Adamnáin was merely a building of a temporary nature, which would scarcely have survived to our time. PD speaks merely of the *site* (*láthrach*) of the Pavilion, which suggests that no actual building was extant when the author wrote. Adamnán's presidency

¹ See *Journal*, Royal Society of Antiquaries of Ireland, xxx, 176; xxxv, 404. The coins are there said to have been of Constantine the Great.

² *Tara*, p. 175.

at the third of the synods which gave Ráith na Senad its name was an event of considerable historical importance: still, it is hardly sufficient to account for the occurrence of a knot of sites just at this part of the ridge, permanently bearing his name. A possible reason for this curious fact will be given presently.

18. *Cros Adamnáin*

The Cross of Adamnán, so called, was at the entrance (*arbelaibh*) of Ráith na Senad, eastward (*soir*), according to PD 18.

Just about the place indicated, though perhaps a little too far from the Ráith to make the expression *arbelaibh* strictly accurate, there is a rude pillar-stone. It is of red sandstone, 5 feet 5 inches high above ground, 2 feet broad at base, and 10 inches thick; and it stands in the graveyard, not far from the modern church, to the south-west of it. A small figure, 1 foot 5 inches high, is carved in relief on its eastern face, 8½ inches above ground. The top of the stone is fractured; and Petrie not unnaturally took this stone to be the stump of Adamnán's Cross.¹

Had the stone been a little further to the south, I should have preferred to identify it with Lecht Maine, another monument, which we have not yet mentioned. But probably it actually is the stone to which *Dind-shechhas Éirenn* refers under the name *Cros Adamnáin*. This does not amount to an admission of the historic truth of the tradition that associated it with Adamnán, or even of the idea that it is the stump of a cross. On both statements I am inclined to throw considerable doubt.

In the first place, there is a certain amount of improbability in the idea that Adamnán could have had anything to do with the erection of a massive stone cross on a site to which he seems to have paid a mere flying visit. In the second place the nature of the sculpture on the eastern face is not such as we usually find associated with Irish crosses. In the third place, the stone was in the same condition as we see it now, in the tenth or eleventh century when VD III was written, for that poem (line 835) speaks of it by the non-committal word *lacc*, "stone," and does not call it a cross. This would mean that the cross-head was then already destroyed. But such a destruction would involve no little violence, and would have been an act of sacrilege not likely at the time.

I regard this stone, like the other stones of Temair now lost, as a pagan monument. It is conceivable that Adamnán consecrated it to Christianity by erecting a wooden cross on its top as has been done in the case of the meall of Dól.² I can offer no objection to this way of saving the tradition; it would, indeed, account for the preservation of this particular stone.

¹ *Tara*, p. 175. ² See the illustration in Déchelette's *Manuel d'archéologie*, i, 440.

The sculpture carved in relief on the eastern face of the stone has been insufficiently examined by Petrie and his followers, and Petrie's drawing¹ is a very inadequate representation of it. It is, in truth, of extraordinary interest. It represents a human figure with bowed legs crossed at the feet. There are enormous projections at the sides of the head, the nature of which, owing to the weathered condition of the monument, it is impossible clearly to make out. But they have every appearance of being a pair of horns. (See Plate VIII).²

A cross-legged, horned human figure can have but one meaning when found in a Celtic region. It must represent the important deity which on one of the famous Paris altars is named CERNUNNOS.

Cernunnos has all the barbaric characteristics of a very ancient, primitive deity. He seems, indeed, to be an animal god arrested while in the very process of "anthropomorphising." Several well-known representations of him exist on the Continent, which, though differing in minor details, agree in figuring the deity in a cross-legged, Buddha-like attitude, and in decking him out with one or more massive torques. On the head are horns, usually of a stag, but sometimes of a ram. The Temair relief agrees to some extent with the Continental sculptures in the attitude, and apparently in the horns. I could not feel so sure of the torque, owing to the weathered condition of the stone. It is difficult to guard oneself against tricks of imagination in an investigation of the kind; so I will only say, with the utmost caution, that it is not impossible that the figure actually has such a collar.³ It is not a little remarkable that the two torques which are now among the chief treasures of the Royal Irish Academy Museum were found somewhere in the neighbourhood of this stone.⁴ These gigantic ornaments, too large to be used by any human being except as a girdle,⁵ may well have been votive offerings to the

¹ *Tara*, p. 176.

² The figure, owing to its bad state, is a very difficult subject for the camera. The photograph reproduced on Plate VIII is not very satisfactory, but it is the best of several attempts.

³ After the above words had been written, I put the observations which they contain to the following test:—With Mr. Westropp I conducted to Temair a party of young friends who had never been there before, had no previous knowledge of the stone in question, and had never heard of Cernunnos or of his attributes. We asked them to describe, without any assistance or hints from us, what they saw in the sculpture. After remarking on the obvious features, eyes, mouth, &c., one of them said "he has very large ears . . . or are they horns? . . ." and he seems to have something round his neck." Mr. Armstrong has called my attention to a note in Wilde's *Beauties of the Boyne and Blackwater* (2nd Edn., 1850, p. 123), where the figure is described as having "something like horns upon the head."⁴ *Tara*, p. 181.

⁵ Compare the girdle-torque worn by the figure of Nodens (Bathurst, *Lydney Park*, plate xiii).

ancient Celtic god of wealth. Possibly they decorated a colossal wooden effigy of the deity.

If this identification be admitted, some important consequences will result. In the first place, the stone will assume the great interest of being the only sculptured representation of a deity surviving from pagan times in Ireland. In the second place, it will cast some doubt on the theory that there was a Druidic prohibition of images, for which M. Salomon Reinach has argued with all his wealth of learning and persuasiveness,¹ and may perhaps rehabilitate Lucan's evidence for the use of wooden images among the pagan Celts, upon which much doubt has been thrown. In the third place, it is possible that it may show in what direction to look for the origin of those strange figures, called by the silly name *Sheelah-na-niy*, i.e., *Sile na gfeoch*, "Sheila of the Breasts." Though these are female, and have had an element of obscenity imported into them, the squatting form of Cernunnos is the basis on which they have been designed. A glance at such an example as that at White Island, Co. Sligo,² will make this clear. These figures thus seem to be survivals into Christianity of a perverted representation of one of the most important gods of Celtic pagandom.³

If this was a sacred stone erected beside some sanctuary of Cernunnos-- and it may be no mere accident that a Christian church now stands on the spot--additional proof would then be gained for the tradition reported in PD 20 and VD in 84, that close by this monument was the house that was burnt over the head of Benén (Beniat in VD), St. Patrick's follower, and the druid Lucretiúel.⁴ As the house was built of wood specially for the experiment if we may trust our authority it is useless to look for its remains: PD tells us that it was "a short distance south-east of Adamnán's Cross, a little east of the path."⁵ It is very likely that the house would be built somewhere near the sanctuary of the deity under whose protection the druids of king Eoghanite hoped to contrive the preacher of strange doctrines.

South of the Cross were the Seat and Mound of Adamnán (*síde Adamndín 7 a Dún*, PD 18). These have been effectually obliterated by generations of grave-digging. But again we ask, why were they called after Adamnán?

¹ *Cultes, Mythes, et Religions*, i, 146, et seqq.

² **Figured in *Journal, Roy. Hist. and Arch. Assoen. of Ireland*, ser. iv, vol. v, p. 283.**

³ The name of the great Cernunnos, killed by Jack the Giant-killer, is perhaps a corruption of Cernunnos, as the three-headed giant who enters into the same nursery tale appears to be a reminiscence of the tricephalous god of whom several figures exist.

⁴ See *Tara*, p. 176, where the story is given in full from Muirchu.

⁵ A conspicuous earthen mound running round the graveyard just inside the enclosing wall looks at first sight like another earthwork of the Temair series. But I cannot regard it as anything more than an old boundary of the cemetery. It is rectangular, and follows exactly the line of the outer stone wall that runs outside it.

Especially, what was he doing at Temair with a *duma*? Once more we seem to detect evidence of evasion; a re-dedication (to the Christian saint connected with an event taking place at this part of the hill) of features previously associated with the name of some pagan deity. If, as I have suggested, the so-called Cross of Adamnán was really a sacred stone originally dedicated to Cernunnos (by whatever name Cernunnos may have been called in Ireland), the "seat" and the "mound" may very well have been dedicated to the same deity.

But why should they be called after Adamnán rather than Patrick, or Ruadán, who also presided at synods held in the same ráith? Is it because of the *homunculus* sculptured on the standing stone?

It should be noticed in passing that O'Donovan identified this stone with Lia Fáil,² and records a local tradition that it marked the grave of Cormac mac Airt. He does not forget to add the obvious comment that Cormac was buried at Ros na Rígh.

19. *Lecht Maine meic Munremuir*

Lecht Maine meic Munremuir fri Ráith na Rígh anoir—"the grave of M. son of M. is towards R.R. eastward"—says PD 19 in all the mss. except L, which omits the passage. I cannot find any story connecting Maine son of Munremar with Temair. But the name occurs in that very curious list, *Tóchostul Ulad*, the persons to whom in *Táin Bó Cúalnge* the message of the Ultonians was sent.³ This catalogue is much manipulated, and, as such lists are apt to be, is corrupt. But a very brief glance is enough to show that primarily and fundamentally it is a list of *gods*. Lug, Mór-rígh, Oengus Fer Bolg, Ogma Grian-áinech, Tailtiu, Macha, are the most obvious of these. Diabul Árd and Tarothor ("Lofty Demon" and "Monster") have all the appearance of being Christian evasions for the names of unmentionable deities: and there are other names in the list whose essential divinity is at least probable. The names of heroes and of places have been interpolated, at a time when the true meaning of the list had become forgotten, or when it was considered desirable to obscure it; but to extricate the various elements would need a very long and detailed study, which would here be out of place. The appearance in the list of the name of Maine mac Munremain⁴ suggests that this is also a divine name; and coupling this monument with the stone of Mata, the stone of Fáil, and the stone of Cernunnos, which we have already seen, we conclude that Lecht Maine was not a man's grave, but a sanctuary, with a sacred stone planted upon it.

¹ See Cormac's *Glossary*, s. v. *Adamnán*.

² O. S. Letters, Meath, p. 223.

³ *Táin*, ed. Windisch, lines 4765 *et seqq.*

⁴ Bunni in L, Muindi in LLeC.

I have already said that I should prefer to identify the stone in the graveyard with Lecht Maine rather than with Cros Adamnáin. "Treasures son of Fat-neck" would not be an inappropriate name for Cernunnos, god of wealth, with his thick tongue; it might well have been the native name or (more likely) a nickname for that deity. The objection to the identification has already been hinted at: the graveyard stone is too far to the north, and could not be described as east of Ráith Ríg. But why does the compiler of PD postpone all mention of Lecht Maine until he has, as it were, passed the latitude of Ráith Ríg? He usually follows a regular order, from south to north; and Lecht Maine ought to have been described along with Capraoh Cinnáin if it were really in the place indicated. Can it be that Ráith Ríg is here a *lapsus calami* for Ráith na Senad?

20. *Móel, Blocc, ocus Bluiene*

In a sentence preserved only in L. among the Dúddiu mss., PD 21 describes Móel, Blocc, and Bluiene as "three small stones beside Ráith na Senad to the north" (*tréa clochá beag i tús Ráith na Senad thuaid*). They stood in a triangle: Móel to the east, Blocc to the south, and Bluiene to the north, or, according to L, to the north-east. U calls Blocc "Bole."

These stones are inferior in importance to Tal n-É, as I hope to show later. In the present topographical study we need only note that they have disappeared. The neighbouring stones pointed out by Iorner, of which I can find only one, cannot be the monuments in question. They are in the wrong place and will not fit in with what we are told of the stones and their functions.

Perhaps the remaining stone, which is small and rounded, may be the origin of the tradition recorded in *Lebor na hUíri* of the fate of the druid there named Leugaine. His opponent at St. Patrick was buried in the north at the ward of the apostle, so that "all the dogs that come to Tomant herold his head." The present case implies that the punishment of the druid was still

¹ *Tara*, pp. 179, 180.

² In the graveyard marked "stone" in the plan, Plate I. It stands near the so-called Cros Adamnáin, and is figured in *Tara*, p. 180.

³ See *Revue celtique*, vi, 164. The story is in some confusion; in another version in *Lebor na hUíri* (reproduced in *Topog. Life of St. Patrick*, vol. II, p. 454) the name of the druid is given as Mastan. This is evidently merely an abbreviation of the Greek *μασταν*, but is not used less probably than *Leugaine*, which is clearly a confusion with the name of the king. Perhaps in some previous version of the story the words were *Leugaine*, "the druid of Leugaine" omitted, and his story set in connection with them as "the druid Leugaine." According to the latter Irish version the druid was swallowed up by the earth, giving rise to the proverb *cuimhne Mastan*. Whatever this may mean, it is not difficult to see that the statement about the dogs has somehow been derived from it.

in progress, and therefore that the "head" was still to be seen when the story was written down; this rounded boulder might easily be taken by imaginative persons as the head of a giant turned to stone and buried in the earth up to his neck.¹ Another stone connected with the magical strife of Patrick and the druids of Temair was seen by Tírechán in the south-east of the ráith.² This has disappeared, or at least cannot be identified.

21. *Lecht in Abaic*

Lecht in Abaic, the Dwarf's Grave, was east of Móel, Blocc, and Bluiene. All the mss. of PD 22 agree in saying that it was *sairdes 7 siarbdes* ("south-east and south-west"). This is a little cryptical to begin with. We are further told that "three feet only is its measure, in its little slough below; thus is the grave, a small stone under the ground in its western end and another in its eastern" (*tri troighthi namá a tomus 'na escaid becc tís*; ³ *is amlaid atá in lige, 7 cloch becc fo talmáin ina íarthur 7 aroile ina oirthir*). This seems to indicate a cist of small size, sunk underground, which when PD was compiled had become full of mud. The cist was probably meant to receive a late bronze-age urn burial; its small size suggested to legend-framers that its occupant had been a dwarf, who is fitted with the name Sen ua Eibric in a poem quoted in *Tara*, p. 180.

Next we learn that the cist possessed the peculiar property of measuring three feet when measured at one time, three and a half another time (*fo gabtar tri troighid ind indara fecht, a tri co leith in fecht n-aile*). Such tales are not infrequently told: thus we often hear that the members of a monument (e.g. a stone circle, when counted or measured on different occasions, give different results. So they do; it is not, however, a miracle, but the result of incompetence on the part of the experimenter. It must be noted carefully that the apparent marvel of Lecht in Abaic was on a different footing from the magical properties of Fál. The voice of Fál had long been silent when PD was compiled. The writer of the tract knew of it only from tradition, and spoke of it from second, or third, or fiftieth hand.⁴ But he had only to

¹ Compare the partial burial of the companion stones of Cenn Crúaich, *Tripartite Life*, i, p. 92: also the story of Mata and the warriors, *supra*, p. 241. Petrie records a tradition current in his time that the stones were "left there by the giants of Tara."

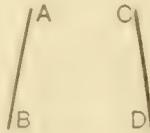
² *Tripartite Life*, vol. ii, p. 307.

³ This is the reading of B, R. Variants are—*tomus, esc becc this* (L); *a tomus indalig na escaid* (H); *an a fad* instead of *a tomus* (U).

⁴ The traditions of the properties of Lia Fáil are fairly consistent: but that they were not exempt from the tendency to exaggeration to which all orally transmitted statements are liable, is shown by the list of its wonderful properties at the end of the existing fragment of *Acallam na Senórach*.

walk across the hill of Temair—for, as we have seen, he was already on the spot—to test the properties of Lecht in Abair to his heart's content.

The clue to the marvel lies in the words *saiphs 7 síardas*. Two stones arranged as in the diagram here subjoined might be described loosely as "lying south-east and south-west" by a man standing at the point where if produced they would meet. And if A to C measures 3 feet and B to D measures $2\frac{1}{2}$ feet, all the conditions are satisfied. Look back now at PD, and it will be seen that the properties of the tomb are recorded without any expression of surprise. The author does not regard it as a marvel at all; he merely states calmly enough but intelligibly, that the dimensions of the tomb are different on the different sides.



But very soon this piece of scientific observation, if we may dignify it by such a term, became misinterpreted, which is perhaps hardly to be wondered at. The miracle-mongers fastened upon it, understanding it to mean that the stones were in the habit of shifting their relative positions. Just like the infant of Craetha Lasse, whose meaningless babblings were first taken for an invocation of the divine name, and then exaggerated into marvellous oracles as the story passed from mouth to mouth, till they earned for the baby a place among the marvels of Ireland, so we find the dwarf's classic tomb mentioned among the three wonders of Temair. The other two wonders were "a boy or sheep who begot children," and the scream of the stone of Tal.¹ The first of these may be explained either (a) as a piece of folk-lore, some sort of stone-god, who like the infant Zeus grew up to his full strength; or (b) as an exaggerated report of an actual event, or case of a disease, happily, extremely rare, in precocious maturity,² called, I understand, *projeria*. The tale of the dwarf's grave, as told among the people of Temair, is to the effect that anyone, small or great, would find that it measured exactly half of his foot. Other versions and parallels

¹ *The Irish Nevinus* (Irish Arch. Soc.), pp. 198-201.

² Compare the well-attested case of Thomas Hall (*aliter* Hale) of Willingham, Cambridgeshire, who died in 1747 at the age of five years and eleven months, but with all the signs of maturity, and even of senility (see *Phil. Trans. Royal Society*, 1745, first quarter, p. 249; Edmund Carter's *History of Cambridgeshire*, reprint of 1819, p. 209). It is very probable that some similar, anomalous, case may have happened in the case of this stone-god, similar to the old Celtic legends of the opening of the tale of Manus Oge (Campbell's *Waifs and Strays*, ii, p. 338).

are given in *Tara*, p. 180, and need not here be repeated¹: but we must not omit to mention the entirely different story told in *Acallam na Senórach* (ed. Stokes, line 7978 ff.), to the effect that the dwarf was the property of Conn Cet-chathach, and equal in height to thrice his master's fist: the best chess- and checker-player in Ireland, the best leech, and the best peace-maker. The stone was his bed, and the largest man and the smallest infant who lay thereon would find just sufficient room for himself—a sort of converse of the bed of Procrustes! All the men of Ireland, we are told in line 7979, used to resort thither for the experiment. The Triads (Todd Lect. xiii, p. 14, mention the dwarf's grave as one of the three wonders, not merely of Temair, but of all Ireland.

It is probable that the development of the tale along the lines indicated was helped by the peculiar properties, of which we have still to speak, ascribed to the stones Blocc and Bluicne.

22. *Dall ocus Dorcha*

“Blind” and “Dark,” it appears, were two beggars who fought over the division of the alms which they had collected, and killed each other; the dwarf of the previous monument rashly endeavoured to separate them, and was trampled to death by the combatants. The beggars were commemorated by two mounds north of the dwarf's grave, which still remain where Petrie records them, though in a much abraded condition. Dall was south and Dorcha north.²

It is surely obvious that this trivial story is merely a floating bit of folklore that has somehow become attached to these monuments. It is unlikely that two beggars would have been buried under special tumuli on the summit of the sacred ridge of Temair. The story of the blind beggars who trampled to death one who tried to separate them is a rough rustic *jeu d'esprit*—a folk-tale of the kind technically called a “droll.” Dall and Dorcha are names such as might have been given to blind seers: compare Dallán, the name of the druid of king Eochu Airem.

The essential point in the description (PD 23, comes at the end of the paragraph. After mentioning the graves, their names, their positions relative to Lecht in Abaic and to each other, and, after hinting at the story more

¹ To them should be added the *Tomb of Amir*, described by Nennius at the end of his list of the wonders of Britain. This had the properties ascribed to Lecht in Abaic in an even more remarkable degree.

² Adopting the reading of H. The other mss. have “west.” B has a peculiar reading which makes Dorcha west and Dall east. The relative positions of these mounds, Lecht in abaic, Móel and its companions, and Ráith na Senad, are difficult to reconstruct: the plan shows the best I can make of the indications in the *Dind-shechhas*.

fully reported in VD), the prose text adds: *7 aí fuil mír starra 7 na clocha 7 na cionn*, "and there is no rampart between them, and the stones [*i.e.*, Míal, Blac, and Blóine], and the grave [of the dwarf]." This must mean that a valid connection was recognised as existing between the three groups of monuments; otherwise there would be no point in making the statement. For the nature of the connexion we have no data on which to base a conjecture. The mounds of Dall and Docha are not marked on the 25-inch map.

23. *Mír na trí cogur*

We can say no more of the "Rampart of the Three Conspiracies" than that its history, its site, and the reason for its peculiar name are alike unknown.

It was near (or among) *Tech Mírchúarta* and between that structure and *Lacch-thopur* (FD 24, VD at 78). *Lacch-thopur*, the "Warrior-well," is not elsewhere mentioned, and its site is also unknown.¹

I have not ventured on any conjecture as to either *Mír na trí cogur* or *Lacch-thopur* on the plan.

24. *Lla na Fían*

The "stone of the warriors," like *Cros Adamnáin*, was at the entrance of *Carraigín*, an *oppidum* on *Carraigín*, *Lacch na Seana* (FD 25, VD at 89). It was therefore near *Lacch-thopur* near *Cros Adamnáin*; but there is now no trace of it, nor is anything recorded of its history.

25. *Tech Mírchúarta*

This structure, also called for some unknown reason: *Lony na mBan*, "the sleep of the women," is usually to be identified with the two long parallel mounds at the north end of the ridge.

It is an exercise of interest, and not without scientific value, to endeavour to restore or reconstruct the different buildings of *Tainin* as they appeared when they were in full "working order." Such a study, however, must be to a large degree conjectural for the materials on which it has to be based are extremely imperfect. Even for *Tech Mírchúarta* the materials are fuller and more promising than for any of the other buildings. We possess two

¹ It may all mean another name for the General-well; it recalls its alternative appellation, *Lony na Fían*. But the possibility is too slender to bear the weight of any theory of identification.

² The name is probably not to be traced with the interpretation of the General-mound of the mound in the eastern wall of the structure. For the meaning of the more usual name, *Tech Mírchúarta*, see *The Migrations of Goidel*, Henry Bradshaw, Edn., preface, p. xii.

versions of a remarkable ground-plan of this structure: the short tract *Suidingud Taiqi Midchiarta*: and some scattered references in Irish literature, all of which supplement the evidence afforded by the actual remains.

The two ancient plans will be found in the Book of Leinster (p. 29 of the facsimile), and in the Yellow Book of Lecan (facsimile, p. 418). These have been reproduced with sufficient, but not absolute, accuracy, in *Tara*:¹ as they are thus easily accessible, it is unnecessary to repeat them here. The Lecan plan is the fuller, and is much the more carefully drawn; the Leinster plan is careless, and though older in date is on the whole less likely to be accurate. Both plans show a rectangular building: no attempt is made to preserve the proportions of the actual structure, which is drawn as though nearly square. It is divided into five aisles, and the single entrance door is shown at the lower end of the central aisle. The two outer aisles are divided into a succession of what I may call "pews," each of them set apart for the use of members of the different trades, professions, or ranks of society. The names of these, with the joints of meat to which their representatives were entitled at the feasts, are written in each of the divisions. The pews are carefully marked off from each other in the Lecan plan, but not in the Leinster plan; and the scribe of the latter MS. has been careless in the spacing of his words, so that he has had to carry the two lower pews in the outer side aisles into the inner side aisles. The effect of this has been to displace the doorkeepers from their proper place beside the door; one of the obvious faults which prejudice the student against the plan in the older MS.

The inner side aisles are similarly divided. The Lecan plan shows a compartment at each side of the door, that on the left for the doorkeepers, that on the right for the buffoons. Then there comes a space where width is obtained by the omission of two pews on each side, making a Common Hall (*ceitlár cáich*). The Leinster plan omits this very probable feature. Inwards from the Common Hall the Lecan plan shows a succession of eight pews on each side, similar to those in the outer aisles, and similarly assigned, after which there is another open space, likewise obtained by omitting the last pew on each side. This open space is apportioned to the table attendants and the stewards; and as it would evidently be an advantage for these officers that they should be in an open space, for the convenient performance of their duties, we once more accept the Lecan plan, which shows this arrangement, rather than the Leinster plan, which merely writes a catalogue of trades, &c..

¹ In these reproductions the lines of the plan are drawn correctly after the model of the MSS., though with a mechanical rigidity. The conventional "print" lettering has been substituted for any attempt to reproduce the handwriting of the MSS.

with their corresponding joints, in the columns representing the inner side aisles without troubling to indicate the subordinate divisions.

The middle aisle is not encumbered with pews, and was evidently the thoroughfare through which the pews in the inner side aisles were reached. As there seems to have been no right-of-way provided from the central passage to the pews in the outer aisles, these must have been entered by external doors in the sides of the hall. The MS. plans omit these doors, but they are mentioned in the *Wind-shenchas* description. PD says "there are twelve or fourteen doors in it, namely, seven east and seven west." If we take the smaller number of these alternatives, twelve—six on each side—we get one door for every pair of pews in the outer aisle, which is the most likely arrangement.

There are a number of gaps in the mounds which now represent Tech Mídhúarta, and these were taken by Petrie as being the remains of the side doorways. At p. 186 of *Tara* he makes the naïve comment, "It may be remarked, as a curious proof of the accuracy of the prose description, that the uncertainty as to the number of doors being twelve or fourteen remains a difficulty at the present time." It cannot, however, be sustained that these gaps represent the original doorways. The remains have been mutilated by gravel-diggers and by agriculturists seeking top-dressing, and some at least of the gaps appear to be comparatively modern. In any case the number of doors mentioned by the *Wind-shenchas* account is wrong; for as there was a door at the end as well as at the sides (*testis* the ancient plan), there must have been an *odd* number of doorways in the original structure. The *Wind-shenchas* writer does not aim at meticulous accuracy; he merely says "there were twelve or fourteen doors in it" as a careless approximation, such as any of us may throw out in conversation at any hour of the day; and we cannot assume as Petrie tacitly does, that the remains were in the same ruinous state when he wrote as they now are.

A more serious difficulty is raised by the presence of the doorkeepers at the end doorway. These would seem futile if there were six unprotected doors in each side of the building. But according to VD iv 37, 38, the whole hall was surrounded by nine ramparts; these are perhaps to be equated to Múr na trí cogur. Even if this unheard-of number of fences is an exaggeration there very likely was some sort of thicket fence surrounding the whole hall; there is no existing trace of such a fortification, so that we cannot think of earthen mounds. Unauthorized intruders would be stopped at the doorway of this outer protection, so that the porters¹ would be needed in the house itself only to guard the Common Hall from disturbance.

¹ What was "Mol, doorkeeper of Temair," of whom we read in Cormac's *Glossary* (s. v. Milgum). From the way in which the word is there used it would appear to be rather a technical term for the office than the proper name of some person who held it.

The Leinster plan shows in the central aisle of the building the following, in order from the end door inwards: a *lóchet*, which may be either a light or a fire,¹ more probably the former; a *les* or haunch, which a *daul* (waiter) is carving—the childish sketch of the waiter is not without interest for the study of costume; a *bir bruinne*s or cooking-spit of Gargantuan dimensions, a *lassar* or fire, and at the inner end the *dabach* (cauldron), beside which are the *dailemain* or stewards. The Lecan plan is, as usual, more business-like. It shows in order from the door inwards a *locarn* (lantern), *cainnel* (candelabra), *dabach* (cauldron), and three hearths, marked *tenc*, one after the other. Behind the third hearth is the open space for the table attendants.

We may here recall Keating's interesting account of the banqueting halls.² He describes them as being long and narrow, with tables along the side walls, and hooks on the walls above the tables. A marshal (*boltsaire*) took the shields of those who were to partake of the feast, and under the direction of what we may call a recorder (*sencha*) he hung each on the hook above the owner's proper place. The feasters were then admitted, and each found his own seat, marked with his shield. If it be objected that this smacks too much of mediæval chivalry, with its heraldic shields, we may fairly call to mind the Gaulish shields wrought with distinctive figures of animals (Diodorus Siculus, v, 30), comparing the famous Witham shield now in the British Museum, which has had the figure of a boar riveted on to it. Keating's statement may well rest upon ancient authority.

It now becomes our task to fit this plan to the actual remains on the ground. For this purpose it has to be re-drawn in proper proportion. The result will be seen on Plate IX. For reasons that have now been sufficiently set forth, the Lecan plan is adopted as the basis of the drawing. The names of the several professions are placed in the pews belonging to them in English; for the Irish names and for the joints belonging to them, reference may be made to *Tara*, p. 205 *et seqq.*

On looking at this plan, the first thing that strikes us is the position of the king's pew. We might have expected it to be in some more conspicuous place—say at the very head of the hall, or in the exact middle. It occurred to me that this offered a very good test of the trustworthiness of the plan. If the fourth pew was suitable for the king, there ought to be some traceable reason for this suitability. Accordingly, I took an opportunity of visiting Temair to examine this question on the spot. The first point to settle was the orientation of the plan. The modern convention of placing the north at the top of the plan or a map did not bind mediæval cartographers. It would

¹ *Loichet* i. *cainnell* no *sutrall* no *lasair*—O'Davoren.

² *History*, I. T. S. edition, ii, p. 250.

be more likely that the bottom of the ancient plan (where the door is shown) would represent the north end of the hall, which, owing to the fall of the ground, is much lower than the south end. Moreover, all or most of the old roads appear to enter Temair from the north end, so that it is more probable that the doorway of the hall would be placed to the north, so as to be convenient to visitors. Otherwise when entering the hall they would have had to intrude unduly on the royal dwellings.

This being assumed it follows that the king held the fourth pew from the south end, on the western side. We must make the further assumption, which is quite reasonable, that the pews were of approximately the same size. The king's pew must, therefore, be between three-twelfths and four-twelfths of the whole length of the hall from the southern end. It was with no small satisfaction that I found on determining the place by measurement, that the site thus indicated stands exactly on the edge of a sudden fall in the ground, which makes the whole of the upper part of the hall to the end of the first four pews on each side a sort of natural dais. From this part of the structure the king would be able to command the whole hall in a way impossible at any other spot. The photograph, Plate X fig. 1, shows the ridge. A person (indicated by the arrow) is sitting in the spot where the king's seat was placed.

We can only conjecture how the pews were divided from one another; I suppose by dwarf wooden screens, probably carved with La Tene ornament, and enriched with metal-work.

The plan being thus fixed, we proceed to consider the design of the superstructure. The early stone churches of Ireland which are modelled on the better-class timber-hall houses of their time enable us to form a general idea of the manner of construction of the latter buildings. We can picture to ourselves (1) four massive upright corner-posts, represented by the corner seats of the churches supporting (2) a truss, probably a king-post truss, at each gable-end, and (3) a heavy horizontal beam or wall-plate running along the tops of the side walls. The ends of these beams are translated, so to speak, into stone, in the projecting corner-brackets such as are found in some of the early churches of Glendalough and elsewhere. The principals of the end-trusses cross at the top, giving rise to the winged finials of the churches; and in the Y-angle of the cross rests the ridge-pole. The vertical walls between the corner-posts consist of wattles covered with baked earth. In a building of such exceptional length as Teah-Machairna—(it was about twice the length and half the width of St. Patrick's Cathedral), the largest church

¹ See my book, *Monasticism, A Study of Monasticism*, pp. 25-29, where these analogies are worked out in detail.

in Ireland—there must have been a number of intermediate roof-trusses. These I assume to have been at the place where the side doors were pierced in the wall: and pillars are suggested in the restoration, rising from the intersections of the pew-screens. The roof, as in all early Irish buildings, must have been high-pitched: and it was possible by running a floor across the building at the level of the top of the wall to make an upper storey. We find this upper storey, translated into stone, at St Columba's House, Kells, and at St Kevin's "Kitchen" in Glendaloch. No staircase was provided to give access to this loft; a ladder would be necessary.

In applying these principles to Tech Midchúarta, we derive valuable help from the opening paragraphs of the tale called *Fled Bricrend*. Bricriu Venontongue made a feast for the Ultonians, and built a house especially for their accommodation. This house, we are told, was designed after the model of Tech Midchúarta. The naïve anachronism need not trouble us; the writer has forgotten that constant tradition ascribed the building of Tech Midchúarta to Cormac mac Airt, whose *flourit* is some three centuries later than the alleged date of the Ultonian braves. If we assume a date somewhere in the middle of the ninth century for the origin of *Fled Bricrend* in its present form—it is doubtless founded on still older materials—even then we are brought back to a time when traditional knowledge as to the general appearance of Tech Midchúarta was still living and accurate. There was doubtless a great deal more known about Tech Midchúarta and its arrangements in the ninth century than there was when the Leinster and the Lecan plans were copied into their respective manuscripts. If then a writer of the ninth century says that a certain building was built after the model of Tech Midchúarta, while we need not believe a word of the story he is telling unless we have a mind to do so, we may very fairly conclude that in the description of the building of his tale he is actually giving us some sort of description of Tech Midchúarta, as he pictured it in his imagination.

Bricriu's house, like Tech Midchúarta, was divided into pews, separated with screens of bronze enriched with a garnishing of gold. At one end was the couch of King Conchobar, raised high above the floor of the house: and level with the couch was a *grannán* or sollar which Bricriu made for himself, with windows through which he could watch the strife stirred up by his devices. For Bricriu knew that the Ultonians would not allow him to come in among them owing to his numerous objectionable qualities.¹ From this description we derive the conception of a rectangular building (not necessarily of the same proportions as Tech Midchúarta) with a lofty royal couch at one

¹ *Fled Bricrend* (Irish Texts Society, vol. ii), *ad init.*

end, and an upper storey at the other, *not extending along the whole length of the Hall*. Figure 2 shows, in outline, the only design which will satisfy all the conditions of the story. The upper loft was the sollar of Bricriu; it terminated in a party wall with windows or spy-holes, through which the ill-conditioned master of the house could gloat over the proceedings below. Between this party wall and the opposite end, where the couch *imda* of Conchobar stood, the roof was open. It may be objected to this restoration that the royal couch is inconveniently and impossibly high. The objection can be met by supposing that the author of *Fled Bricrenn* pictured the ground as falling away in Bricriu's house, as it does in Tech Midchúarta.

Two considerations indicate that the same design was followed in Tech Midchúarta as is here indicated for Tech Bricrenn—a long hall, with the

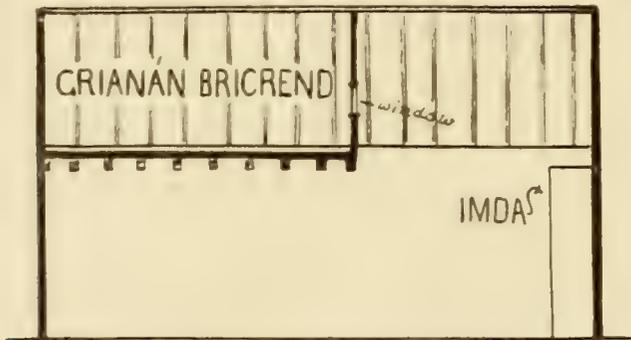


FIG. 2.—Vertical Section of the House of Bricriu.

roof trusses open at one end and masked by an upper storey at the other. In the first place, the ground falls away considerably towards the north, so that there is a much greater height at the north than at the south—thus giving greater head-room for such an upper loft. In the second place, it will be noticed that the *Leam* plan shows the three hearths all concentrated at the southern end. This would be inexplicable, except on the hypothesis that there was an upper storey at the northern end, which would prevent the escape of the smoke. In the restored elevation on Plate IX, I have inserted dormer windows merely as a convenient indication of the probable extent of the upper storey, but without the intention of suggesting that this was actually the way in which the loft was lighted—a point on which we have no information. The three chimney openings show that there is no obstruction for the smoke at the southern end. To these arguments for an upper storey we may perhaps add the testimony of VD that there were bed-chambers in Tech Midchúarta. The floor being wholly occupied with the arrangements for the feasts and the assemblies, we must suppose that the dormitories were elsewhere in the building.

This northern upper storey further gives us the *raison d'être* for the Common Hall. Some free space was needed for the foot of the ladder leading up to the loft. And a special doorkeeper would be needed here to prevent unauthorized persons from entering the upper storey, which would doubtless be reserved for people of importance.

The poem VD iv is almost entirely devoted to this structure. For our present purpose it is rather disappointing. Most of it consists of rapturous eulogies of king Cormac, the founder of the Hall, and of enumerations of the various functionaries connected with it. The only facts about the construction of the Hall which we gather from the poem are (A) its length, 700 feet, which agrees tolerably with the actual measurement of the remains; (B) its height, 30 cubits (*sé cóic cubat*), which may or may not be accurate; as Mr. Gwynn points out on p. 71 of his notes, it is suspiciously like an echo of the corresponding measurements in Solomon's Temple. The word *cubat* alone is enough to inspire such doubts.¹ (C) The nine ramparts, already referred to; (D) its doors, here given as fourteen in number. It is curious that the plans mark the end door but ignore the side doors, while the descriptions enumerate the side doors but make no reference to the end door.²

The prose tract called *Suidiugud Taiyi Midchúarta*³ does not carry us much further. But it seems to explain a discrepancy that would otherwise be puzzling between the 700 feet, given as the length of the building in VD, and the 300 feet in PD. It seems that the greater length is attributed to Cormac mac Airt, the lesser to Loeguire mac Néill; as though Loeguire had for some reason cut short the enormous length of the original hall. We have already (p. 241) noticed a passage which seems to imply that the hall had fallen into ruin in Loeguire's time, though it suggests that the king provided a different substitute. The rest of the tract is occupied with lists of furniture, beds, &c., in the house, which give us no help in studying its internal arrangements.

26. *Duma na mBan-amus*

The "Mound of the She-mercenaries," otherwise *Duma na mBan*, the "Mound of the Women" (VD iii 61), was of small size, and in the south-east,⁴ at the southern end of Tech Midchúarta (PD 27). This is probably to be identified with a small mound, close to the eastern wall of that building,

Other parallels between the descriptions of the two buildings have not escaped Mr. Gwynn's notice; reference may be made to his remarks, *loc. cit.*

The evidence of the early churches tends to show that the narrow end of a rectangular building was the normal place for a door.

³ See *Tara*, p. 197.

⁴ Stokes by a slip translates "south-west." All the MSS. read *anairdless*.

and 31 feet from its southern end. The diameter of the mound at the base is 60 feet. Petrie placed Duma na mBan-amus on his map in the same position by conjecture; but, strange to say, he was unable to find any trace of the monument on the site.¹ It is, however, fairly conspicuous.

Unless the "women" were those slaughtered by Dunlaing, king of Leixhen, in or about 222 A.D., we have no information as to the history of this mound. VD refers obscurely to the "betrayal" of the women after whom the mound is named, but gives no particulars.

27. *Comfot Caelehu ocus a Arad*

The grave (*lit.* "equal length") of Caelehu and his "ladder" were "level with the northern end of Tech Midehúarta" (PD 28). The grave was apparently a cairn: it is said in VD iii 143 to be *fo chochma cloch*, an obscure expression (see Gwynn's note *ad loc.*): These monuments have disappeared; Petrie's identification of the "Fort of Caelehu" is wrong, the structure which he thus names being certainly Ráith Gráinde. Indeed, it is most probable that there never was a fort so named at Temair at all. *Árad* means "a ladder." It reads *a ead[u]* instead of *árad*, on which the other MSS. are agreed; and, as usual, the *lectio difficilior* is to be preferred. The "ladder of Caelehu" might have been some structure of stones—an allée couverte, for example—standing close beside the cairn, and wrongly supposed to belong to it. Mr. Westropp calls my attention to the "steps" at Duntrileague, Co. Limerick—an allée couverte in which the successive capstones rise stair-wise. There is a large block of conglomerate in the fence on the eastern side of the road not far from the indicated spot: this may possibly be a relic of the monument.

28. *Treduma Neisi*

This was at and level with the north-east end (*sin*) of Tech Midehúarta (PD 29). The word *treduma* might mean either a triple ring-fort, or a group of three burial mounds; the latter seems the more likely; but VD iii 47 describes the structure as a *with*.² Petrie found no trace of it; but Mr. Westropp and I noticed what may be the remains of it in a corner of a field close to the northern end of Tech Midehúarta and on the opposite side of the neighbouring road. We observed a quadrant of a circle, the sides measuring 51 yards along the road fence and 65 yards along the adjoining field fence,

¹ *Tara*, p. 215.

² *Chochma* means some kind of vessel, possibly a comparison is intended between a heap of stones and a cooking-vat or some such utensil, turned upside-down.

³ See the drawing in Borlase, *Dolmens of Ireland*, i, 50.

⁴ Compare also the notice of Dinn Tradúí, s.v. *Mug-éime*, in Cormac's *Glossary*.

enclosing one small mound, much abraded. The rest of the structure has been destroyed by tillage in the adjoining field, and by the laying-out of the road; but a faint rise can be detected in the road, as well as its continuation into the field containing Tech Midchúarta, where there is a second small mound.

29. *Ráith Conchobuir*

This was beside and to the north of Treduma Neisi. It had a door facing the east, level with Corus Cind Chon-Chulaind PD 30, VD iii 49. It was not found by Petrie, but seems to be represented by a deep gravel-pit in the next field but one to the north of that containing the remains mentioned in the last article.

30. *Sciath Con-Chulaind*

The "Site of the Buckler of Cu-Chulaind" was level with the "Neck of Cu-Chulaind" (*Méde Con-Chulaind*), to the north-east. It evidently was an earthen ring, representing the outline of the shield, with a mound (*tul*) in the centre, suggesting the umbo. It is, in fact, described in exactly these terms in PD 31. It was more probably a sepulchral rather than residential—a grave-mound within an enclosure, like the dolmen at the Giant's Ring, near Belfast, or the cist at Longstone Fort, near Naas; and, like these, was presumably a bronze-age monument, the "dedication" to Cu-Chulaind having been imposed upon it when its original owner was forgotten. No trace of this mound can now be discovered.

31. *Corus Cind ocus Méde Chon-Chulaind*

The "Measure of the Head and Neck of Cu-Chulaind" is not mentioned in PD except as a guide to the identification of *Ráith Conchobuir* and *Sciath Con-Chulaind*. It was to the north-east of the former, according to VD iii 50, and doubtless was near *Sciath Con-Chulaind*. In this collection of mounds, one called the head, the other the shield, of an ancient hero, we see an old example of the common idea of the "Giant's Grave," a name still current for megalithic monuments in the country. The names are at least as old as the story of the death of Cu-Chulaind, as it appears in the Book of Leinster, for the mounds are there alluded to in the following terms:—*Otharlige a chind 7 a láime dói 7 lán lainne a scith di úir*, "the sick-bed of his head and of his right hand, and the full of the cover of his shield of earth."¹ As in the case of *Sciath Con-Chulaind*, we are probably to regard this as a bronze-age monument, re-named at a later time. It has now completely disappeared, probably owing to tillage.

¹ LL, facsimile, p. 121 b 40.

The monument was probably a round tumulus with a neck-like projection attached to it. Mr. Westropp has sent me a sketch of a mound of similar design in the cemetery of Cenn Febrat.

32. *Sescead Temrach*

"The little dirty marsh," which, with the partial exception of the springs, is the only *natural* feature of Temair mentioned in *Dind-shechhas Éirenn*, was level with Tech Midchúarta on the north-west. It was still remembered in Petrie's time, though it had even then been drained.¹ It was south of Carn na Maeradae (PD 32) and east of Ráith Gráinde (VD iii 45); Ráith Neisi and Ráith Conchobuir were east of it (VD iii 47).

O'Donovan's account of the Sescead may here be quoted²: "This spot, extending from the ash-tree under which there was a well called Tober Fin [sic] southwards [sic: 'read' northwards"] to the road was *spewy land* in the memory of Mr. Mac Mádhon, a farmer, who holds the adjacent land and who fought on the hill in '98 with all the vigor of his ancestor Colla Da Chrioch. Shortly before 1798 the proprietor of the land, to reclaim this 'spewy spot' stopped up Tober Fin with *poore* and *—'sá*; and to carry off its fountain he sunk a drain of remarkable depth for a short distance to the west of the well northwards to the road where the land ^{inclines} _{slopes} [sic]. The ash-tree and the well can still be seen the latter marked by an irregular depression in the ground.

33. *Ráith Gráinde*

In the identification of Ráith Gráinde and its companion Fothad Ráitha Gráinde, Petrie had erred grossly. The ramparts which he calls by these names are certainly the Cloenfertai. Petrie's identification³ leaves no room on the hill for the Cloenfertai, which were to the west of Ráith Gráinde; and even the relative positions of the two structures are given erroneously for Petrie makes the Fothad south of the Ráith, whereas the authorities which we have to follow make it the northern of the two. Taking these two sites as the Cloenfertai, we must look for Ráith Gráinde to the east of them; and we find it at once, in a shapely ring-fort which Petrie has called Ráith Chobhain. Even if there were evidence that such a structure as the *fort* of Chobhain existed at Temair at all—and, as we have seen, there is no such evidence—the fort called by that name in Petrie's work is too far from the site of Tech Midchúarta to accord with the indica-

¹ *Tara*, p. 151.

² O. S. Letters, Meath, p. 234.

³ *Tara*, p. 216.

tions in PD, to the effect that “Comfot Caelchon is level with the northern end” of that building (PD 28). On the other hand, it appears to agree in position with that assigned to Ráith Gráinde—“westward from the Marsh of Temair on the summit of the mound” (*ó Sciscend Temrach antar for forard na telea*). I suggest, therefore, that the structure hitherto called Ráith Caelchon on Petrie’s authority should be named Ráith Gráinde.

According to *Trans. R.I.A.* xxx, 279, the lump of red enamel mentioned above (p. 238) was found “on the inner slope of the northern portion of the ditch” surrounding this ráith. This would tend to show that the ráith was a little older than the time of Gráinde, daughter of Cormac, but not much. It is right to mention that there is another story, to the effect that the object was found at Kilmessan (*loc. cit.*). But the localization in Ráith Grainne seems very circumstantial.

34. *Fothad Rátha Gráinde*

This structure was to the north, under Fán na gCarbat, and level with the northern Cloenfert (PD 24). Neither it nor Ráith Gráinde is mentioned in VD. There is no separate structure now to be seen in the place indicated. But there is a small mound attached to the external rampart of the mound here called Ráith Gráinde, on the north side; and this may be the structure intended.

The question turns on the meaning to be assigned to the word *Fothad*. O’Donovan, in the O.S. Letters, confesses his inability to deal with it. Stokes, in his edition of the Rennes *Dind-shenchas*, translates it “foundation,” which is not altogether satisfactory, for it implies that the fort was in one place, and its foundation in another! The sense given to *fothugad* in O’Clery’s Glossary—*cundach no tinnsynamh*—suggests the sense which we can best attach to this word: the “founding” or “beginning”; the “original” Ráith Gráinde; the “building which developed into Ráith Gráinde”—such seems to be the meaning which we are to understand. It does not necessarily follow that this is what actually happened; all that we are to infer is that when *Dind-shenchas Érenn* was compiled, or rather when the name *Fothad Rátha Gráinde* became attached to the mound, it was supposed to have been the original ráith. It looks more like a burial-mound: and once again we see a case of the incorporation of such a mound with a ráith. This, however, is less likely to have happened in the case of a *residential* ráith.

35. *Cloenfertai*

The Cloenfertai were west of Ráith Gráinde; and both this indication, and the appropriateness of the name “sloping trenches”, help us to identify

them with the pair of conspicuous ramparts on the steep north-western slope of the hill. Petrie seems to have supposed that they were merely a sort of wall or ditch, running down the hillside; but the fact that historical or quasi-historical events are said to have taken place within them—the slaughter of the princesses by Dunlaing in the southern Cloenfert, and the *gu-bretha* or wrong judgments of the usurping king Lugaid in the northern—is enough to show that they were *breithings* of some kind. Indeed, the statement *táid fá' é all táb' don tóg' a' cionn' na g'hu' b'ithé* "half the house where the wrong judgment was given slipped down the slope", grotesque though it be, gives an accurate idea of the curious site of this structure; half of it being on the flat top of the ridge and half on the steep slope of its side.³ This is evidently the basis of the version of the story of the desertion of Temair told in the Norse *Speculum Regale*.⁴

The southern Cloenfert goes also by the name *Fert na n-Ingen*: see Hogan's *Onomasticon*, s.v.

36. Carnn Macraide Laigen

The stone-heap of the Leinster youths was beside and to the north of the Seseenn (PD 36). Like most of the stone monuments, and nearly all the structures at the north of the hill, it has disappeared.

37. Cros Fergusa Noeb-Ailithir

The Cross of the Holy Pilgrim Fergus, of whom we would like to know more, was *á Carráic Clumán Arísach Carráic na Macraide* "in Carráic Clumán beside Carráic na Macraide" (PD 37). The cross has disappeared. The place name Carráic Clumán (Clám in L) does not appear elsewhere, nor is there any prominent rock anywhere about, so far as I can see, to which it would be likely to belong, and Carráic na Macraide exists no longer. Petrie gives no reference for the "Irish tradition" that he reports,⁵ to the effect that "Fergus, the pilgrim of Carráic Clumán, saw in a vision that a cross would be erected in honour of himself near Fan na Carput, on the hill of Tara"; and I have failed to trace out his authority.

³ *Silva Gadelica*, i, 255; ii, 288.

⁴ See Mr. Westropp's photograph, reproduced in Plate X, fig. 2, where the sloping site is well shown.

⁵ *Ériu*, iv, 10. But *Senchas Mór* (*Ancient Laws*, i, 6), and *Betha Colmáin* (Todd *lett.*, xvii, p. 62) have a reference to a legend ascribing the "tilt" to the prayers of St. Patrick, when evaded an earthquake: the original legend doubtless attached to the Cloenfert, as stated in *Betha Colmáin*, where the structure is called *Clannráth Temrach*. In *Senchas Mór* it is made to apply to the whole of Temair.

⁶ *Tara*, p. 144, note 9.

38. *Deisel Temrach*

Deisel Temrach was situated between the two stone-heaps of the youths, that is, between the southern heap and the northern heap (PD 38). According to VD iii 137 it was between the two cairns, and *tes Crinna*—"south of Crinna"—a mere cheville. More important is the further statement that it was

fót co rath ria ndul ar cel a sóitís dáine deisel,

"a sod with luck before dying, where men used to turn sunwise".

This passage obviously refers to some religious rite, probably observed before going into battle, in order to secure good fortune for the warriors. There can be little question that Deisel Temrach was a stone circle; and the passage, to which we must return later, is of importance in giving us some notion as to the traditional purpose and use of such monuments. The structure has now entirely disappeared.

39. *Carnn Macraide Ua Néill*

We know nothing about the stone-heap of the youths of Ui Néill, except that it was beside and to the north of Deisel Temrach (PD 38). There is no record of the history of the Leinster and the Ui Néill youths who owned the two cairns named after them respectively. The two names occur together in the Annals of Ulster (A.D. 779), where we read of a "convention of the synods of the Ui Néill and the Leinstermen" which met in "*opido*" *Temro* under the presidency of Dublitter the anchorite.

40. *Ráith Colmáin meic Faolchon*

This fort was north-east of Carnn Macraide Ua Néill (PD 40). The owner of the fort is called son of Faolchu in R, of Aeelchu in B, and of Caelchu in L, U, H. It may possibly be traced in some obscure irregularities in the ground, connected with a gravel-pit, in the southern corner of a large field next to the west of that containing the remains here identified with Ráith Chonchobuir.

41. *Duma ind Luchduinn*

This mound was west of Ráith Colmáin (PD 41). It is not mentioned in VD; it can no longer be found; nor is anything known of its history. The word *Luchdunn* (spelt variously in MSS.) occurs twice in *Fled Bricrend* as an epithet of the Ultonian hero Loeguire Buadaich; but this does not help us much, except, indeed, on the theory already set forth, that the monuments at the north end of the ridge were the remains of a bronze-age burial-place, which in popular tradition had become transferred wholesale to the braves of

the Ultonian cycle, Conchobar, Cu-Chulaind, and the rest. Elsewhere the *luch donn* appears as a monstrous [wolf?]: see *Todd Lectures*, xiv, p. 28. There is a pile of stones in the north-east corner of the field containing the remains here called Ráith Chonchobair. This would about fit in with the place indicated for Duma ind Tachduinn.

42. *Adlaic ocus Di-adlaic*

These were two springs on the side of the slope, level with Ráith Colmáin on the north-east (*hi conchobair R.C. sairtúaid*, i. *hi tóeb léitrech frisín ráith anair-túaid*: PD 42). The directions are not very easily followed: according to VD iii 135, two streams flowed from them down to Carn na Macraide; therefore they must have been on the slope above the Carn, that is, to the south of it. But according to PD 42 they were north-east (*saír-túaid*) from Ráith Cholmáin, and the latter was north-east from Carn Macraide Ua Néill, which was the more northerly of the two stone heaps. As we have already said, when PD and VD are thus irreconcilable, the former is to be preferred in topographical questions. But it is not very clear what PD means by saying, "They are two springs. Adlaic is one of them and Di-adlaic the other, but there is no difference between them" (*dí típraid indsin, Adlaic indara n-dí 7 Dindshenchas, aithní atáil dochair d'arra*). Taken in connexion with the names, which appear to mean "desirable" and "non-desirable" respectively, this perhaps implies that the two wells are really one, and that under certain mysterious circumstances it changed its character—being on some occasions salutary, on others hurtful. Magic of this sort is familiar in folklore; we may compare the well of Shab nGiam.¹ To the east of the pile of stones mentioned above in the notice of Duma ind Tachduinn, is a deep cow-pond. If this be a spring it may represent either or both of these water-sources.

43. *Icc Mail ocus Midna*

The stone commemorating the youths who were found playing hurley with the head of Cu-Chulaind, and were killed in punishment for the sacrilege, was somewhere near Corus Cind Chon-Chulaind (VD iii 53), but there is no indication of its position relative to that monument. I have therefore omitted it from the plan.

Some other sites in or near Temair are mentioned in *Acallam na Senórach*, and may be here enumerated, though no attempt at an identification of any of them can be made. These are *Fel na nDruid*, the Grave of the Druids,

¹ *Metrical Dindshenchas* (Todd Lect., vol. x), p. 436.

north-west of Temair (361)¹: *Locc na nDruad*, the Stone of the Druids—perhaps the same place, though this is said to have been north-east of Temair (7957): *Cnoc na nonbur*, “the hill of the nine men,” which, whatever we may think of the story told of it (7901), was probably a burial tumulus²; it was west of Temair: and *Ard na Tened* (1731), the height of the fire, which was probably the site of a sacred fire, notwithstanding the marvellous tale which the *Acallam* tells to account for the name.

In *Cathreim Conghail Cláiringhaigh*³ part of the scene is laid in Temair, and there are some topographical notes. The text is late, and the description anachronistic; but it ought to correspond generally with the *Dind-shechhas* topography. The curious statement is made (p. 10) that every pentarch had buildings and land at Temair. If this be so, it need not have been on the ridge itself, but may have been in the surrounding plain. The expedition of Conghal came to Temair and arrived first at *Ráith Uadth*, the Ráith of the Ulidians, “which is now called *Ráith na nDoirseorach*, the Ráith of the Doorkeepers.” There is no such ráith recorded in the *Dind-shechhas* description, nor do I find it mentioned elsewhere; it is not entered in the *Onomasticon*. As the text goes on to say in effect that the travellers, coming from Ulaid to Temair, stopped first at this ráith in order to prepare themselves, and to deposit their travelling equipment in their own houses, it was most likely some outpost not on the hill itself. On three sides there are such outposts; Ráith Meidbe at the south end of the Ridge, Ringleston Ráith by the side of the road from Kilmessan on the west, and Ráith Miles, otherwise (according to the Ordnance Survey Letters) Ráith Lughá on the north. The last-named may have been the doorkeepers’ fort. At p. 20 of the same text we read that on the following morning the king rose before sunrise, as by one of the *gessa* attached to his office he was obliged to do,⁴ and went to perform his ablutions in *Tiobruid na Laochraidhí*, after which he came to *Dana na Rionraidhe* beside *Muillem Chiarnaidhe*, “for it is there that kings were wont to sit.” Muillem Chiarnaidhe is, of course, the mill on the stream Nith. The only *duma* near this is the *súl* mound that was over Nemnach, and it may be that there was some religious duty which the king had to perform there in the early morning. *Tiobruid na Laochraide* is presumably the same as the unknown *Laech-*

¹ To be distinguished from Fert in Druad (7726), which was in Connacht. In line 5270 *Fert na ndruid* is said to be *ar fáithche na Temra*—on the lawn of Temair: so that possibly the Móel, Blocc, and Blucine group of monuments is intended. The numbers in brackets refer to the lines in Stokes’s edition of *Acallam na Senórach*.

² Compare the inscription *Ilad in Dechenboir*, “the Grave of the Ten Men,” on Inis Cealtra.

³ Irish Texts Society, vol. v. The references are to the pages in this edition.

⁴ See post, p. 363.

thopur, of which we have heard in connexion with Múr na trí cogur. The various sleeping-buts that are referred to in the text were probably temporary structures. At p. 24 we hear of *Lios na Ríogaidhe*, "now called *Lios Tórna Éccis*," where was the house of Cairbre Cromm, king of Breg and of Mide. A lios called after the chief poet Tórna Écces was perhaps that otherwise called Múr nOllamban. We have already suggested an identification of this structure with Ráith na Senad, and this may well have been the ráith used by Cairbre as a sleeping-place.

3.—THE ORIGIN OF TEMAIR

Cuin robo Temair Temair? When did Temair become Temair? This is the question which the poet of VD i invokes the legendary sages of Ireland to answer; and it is the question which we must now consider.

The material for the study that is now to occupy our attention is twofold: archaeological and literary. The archaeological evidence has been marshalled in the preceding section; the literary evidence consists of a number of very remarkable traditions. We begin with the archaeological material.

It is impossible to date rude earthen mounds by inspection only. The most expert archaeologist in the world could not classify the majority of the remains of Temair chronologically without assistance from some external source. Excavation, by revealing datable objects, might conceivably give a clue, but this is by no means certain. Indeed, so far as can be judged from observation on the surface the prospects of a successful "dig" in the mounds of Temair are not very bright. Petrie found people cutting top-dressing from the mounds, and this process may have been going on for more than a century before his time. Further I am inclined to suspect that there was a certain amount of surreptitious digging after the discovery of the great golden hoques early in the last century. We have no information as to the state of the mounds before that time, as no survey earlier than Petrie's exists, and it is on some such hypothesis that the partial destruction or total disappearance of many of what might have been the most promising mounds for excavation can best be explained. In any case, excavation on a site of the outstanding importance which Temair possesses should not be carried out except with the most extreme caution; and the excavator would be in duty bound to expend as much money in restoring the mounds to the exact condition in which he found them as in making the necessary trenches. It is to be hoped that we may never know what, if anything, lies buried beneath the surface at Temair, if the excavation is to be carried out after the model put before us in recent years at Ráith na Senad.

Moreover, it is not certain that even a successful excavation would illuminate the problem of *origines Temoriae*. Datable objects might tell us at what time a building containing them was occupied, but would not necessarily tell us anything as to when and for what purpose it was first built.

In the absence of any archaeological clue to the dating of the different sites at Temair, we must fall back on the legends contained in *Dind-shechhas Éreinn*. When that book was compiled, these legends were by a thousand years fresher, and were by so much nearer to the events which they professed to record, than we are; and they belonged to a time when such legends were the chief mental *pabulum* of the people of the country. Thus, foolish though many of them admittedly are, they are all the more likely to contain some germs of real historical truth, though these may be thickly overlaid with the irresponsible imaginings of the generations of story-tellers through whose mouths they had passed. And, fortunately for us, *Dind-shechhas Éreinn* is remarkably full in the information which it gives us about the legends of Temair.

The first step of the investigation must be to classify the various sites according to the date assigned to them by the *Dind-shechhas* traditions. Taking the reign of Cormac mac Airt as an era, we can draw up this classification as follows:—

A. LATER than *Cormac mac Airt*—¹

- Ráith Loeguirí meic Néill.
- Ráith na Senad.
- Pupall, Cros, Suide, 7 Duma Adamnáin.
- Cros Fergusa.
- Carnn Macraide Ua Néill.
- Carnn Macraide Laigen (probably).

B. CONTEMPORARY with *Cormac mac Airt*—²

- Tech Máirisend.
- Lecht Mata Mór-glondaig.

¹ Except Cros Fergusa, which must be Christian, and Carnn Macraide Ua Néill, which must be later than the establishment of the sept of Niall, the late date assigned to the sites named in this list is perhaps open to question. As has already been shown (p. 242), the Mata story is inconsistent with a late date for Ráith Loeguirí. Ráith na Senad is named here simply because there is no earlier mention of it under that name. The sites connected with the name of Adamnáin may be much earlier, as has been shown in the articles dealing with them in the previous section.

² Of the sites in this list, the first, second, fifth, sixth (?) and twelfth are most likely of an origin earlier than Cormac; see the articles dealing with them in the preceding section.

Tech Cormaic.
 Ráith Ríg.
 Caprach Cormaic.
 Duma na nGiall.
 Cuchtair Cormaic.
 Lia na bFían (?)
 Tech Midehúarta.
 Ráith Gráinde.
 Fothad Rátha Gráinde.
 Comfot Caelchon.
 Ráith Colmáin meic Faelchon.

C. OLDER than *Cormac mac Airt*—

Forrad.
 Múr Tea.
 Fál.
 Lecht Maine meic Munremuir.
 Móel, Blocc, 7 Blucne.
 Treduma Neisi.
 Ráith Conchobuir.
 Sciath Con-Chulaind.
 Corus Cind 7 Méde Chon-Chulaind.
 Cloenfertai.
 Deisel Temrach.
 Lecc Mail 7 Midna.
 Múr n-Olloman.

D. *Of uncertain date, but probably older than Cormac*—

Nemnach.
 Duma na Bó.
 Lóg.
 Lecht in Abaic.
 Dall 7 Dorcha.
 Múr na trí cogur.
 Duma na mBanamus.
 Sescend Temrach.
 Árad Caelchon.
 Duma ind Luchduinn.
 Adlaic 7 Di-adlaic.

Careful study of the confused mass of Irish historical material leads us to the conclusion that it was Cormac mac Airt who established at least the nominal suzerainty of the kings of Temair over the whole or the greater part of Ireland. Previous to his time the "High-kingship" had no real existence; politically the kings of Temair were merely the local chieftains of the province in which the Ridge is situated. That the standing army organized by Cormac, the memory of which survives in the traditions of the *flana* of Finn, was an innovation modelled on the Roman legions, may be taken for granted. A man of energy and bold initiative, such as Cormac is consistently represented as being, had opportunities for studying the machinery of empire in the Roman operations witnessed by his generation in Britain. Doubtless it was the example thus put before him that showed him the way to extend his provincial sovereignty over as much of the island of Ireland as he could manage to conquer. The traditions that assign so many important monuments to Cormac cannot be altogether baseless, though they may be doubted in some individual cases. Tech Midchúarta has all the appearance of having been modelled after the pattern of a Roman basilica; and the traditions which make Cormac the master of a standing army, a patron of letters, an administrator of laws—even that strange story which credits him with some kind of Christianity—all fit in with the portrait of the man who planned his life and his actions on the models afforded him by Roman Britain. There may be a considerable element of truth in the theory, which is at least as old as Pinkerton, that the *flana* of Cormac were first organized to guard the coast from a possible Roman invasion. Cormac, indeed, is the first real personality in Irish history. Doubtless some of his predecessors in the pages of the Annals had a real human existence. I see no reason to deny this to such people as Tuathal Techtmar, Conchobar mac Nessa, Cu-Chulaind, Medb, and many others; but these have become so completely wrapped up in a fog of legend that it is impossible to be certain of the historical truth of any of the actions attributed to them; while Cormac, though the legend-makers have not altogether left him alone, stands out clearly before us as an innovator, a conqueror, and a law-giver.

In the present essay we do not propose to dwell on the doings of Cormac and his successors. Our special purpose is the origin of Temair, and the nature and early history of its kingship. The later historical developments, inaugurated by the conquests of Cormac, do not specially concern us here, except in so far as they may throw some light on the problems before us. We therefore exclude from our consideration the buildings attributed to Cormac and his successors. The next step, then, will be to re-classify the older buildings, including a few that seem to be attributed in error to

Cormac's time, according to their purpose. This classification will be as follows:—

A. SANCTUARIES—

Tech Máirisend (?).
The Cernunnos sites (?).
Deisel Temrach.

B. HOLY WELLS—

Nemnach.
Caprach Cormaic (Típra Bó Finne).
Lóeg.
Adlaic 7 Di-adlaic.

C. STANDING STONES, MARKING GRAVES OR OTHERWISE—

Lecht Mata Mór-glondaig.
Fál.
Lecht Maine meic Munremuir.
Cros Adamnáin (?).
Móel, Blocc, 7 Bluicne.
Lecc Mail 7 Midna.

D. MONUMENTS OF SACRED ANIMALS—

Duma na Bó.
Duma in Luchduinn ?).

E. GRAVES AND GRAVE-MOUNDS—

Múr Tea.
Lecht in Abaic.
Dall 7 Dorcha.
Duma na mBanamus.
Treduma Neisi.
Sciath Con-Chulaind.
Corus Cind 7 Méde Chon-Chulaind.
Árad Caelchon.

F. RESIDENCES—

Forrad.¹
Cloenfertai (?).¹

The order of place in this list will show how enormously the religious interest of Ireland preponderated over its political or its military importance

¹ Originally, perhaps, the men's and women's quarters respectively.

in the pre-Cormac stages of its history. It is as a sanctuary, or rather as a group of sanctuaries, that it calls for attention; and, as we hope to show, its king was primarily a religious rather than a civil functionary. It is not for nothing that the *Tripartite Life of St. Patrick* calls Temair *cead állachta óus drúidechta na hÉirenn*¹—"head of the idolatry and druidry of Ireland."

A further classification may now be indicated, in which the different monuments are grouped by constructional types. It is scarcely necessary to set forth this classification at length; we may content ourselves with indicating the headings. Primarily we may divide the monuments of Temair into (i) stone and (ii) earthen structures. The former may be grouped as—

- (1) standing stones;
- (2) stone circles (round Tech Máirisend, and Deisel Temrach);
- (3) cists and dolmens (Lecht in Abaic and Árad Caelchon).

The latter may be divided into

- (4) earthen rings;
- (5) earthen mounds;
- (6) earthen mounds (tumuli) within rings.

Of these, class (1) may belong to any pre-Christian date, and cannot be assigned, without external aid, to any definite period. The same is true of (4) and of (5). On the other hand, classes (2) and (3) are essentially bronze-age monuments.² The same is perhaps true, as a rule, of no. (6), if the analogies presented by the Giant's Ring and Longstone Fort hold good. But even if we have to assign certain ringed tumuli to the Iron Age,³ there is sufficient evidence in this classification of the monuments that the history of Temair begins in the Age of Bronze. It is especially to be noted that the *burial* monuments are for the greater part at the north end of the ridge: and it is not improbable that this was due to the existence here of the stone circle called Deisel Temrach. Just as Stonehenge stands surrounded by the grave-mounds of those who desired to be buried near the sanctuary, so the "sword that brought luck before dying" was regarded as a suitable centre for burial. The history of Temair, therefore, seems to begin, at least partly, as the history of a cemetery; but other elements, as we shall see, entered into its sanctity from the first. Even *Dind-shechus Éirenn* has not ignored

¹ Ed. Stokes, vol. i, p. 40.

² Dolmens are usually to be assigned to the Stone Age, but cists (such as Lecht in Abaic seems to have been) and allées couvertes (to which class Árad Caelchon may have belonged) are more probably bronze-age.

³ Such as the small mound at Grannagh, Co. Galway; see Proceedings R.I.A., vol. xxxiii, Sect. C, p. 508.

the cardinal fact of its early connexion with the dead: for it expressly says that Tea chose the place especially to be a *grave* for herself. The bronze-age, pre-Celtic heroes, after whom the mounds were originally named, have been displaced in tradition by the heroes of the dominant Celtic, or, more accurately, the Celtic-speaking people, after these had taken possession of the country and introduced the Iron-Age culture. The forgotten warriors of the Age of Bronze have yielded their place in popular legend to Cu-Chulaind, Conchobar, and their attendant braves.

Such, in abstract, are the conclusions at which an archaeologist would arrive, who visited the site and examined it with the descriptive portions of the *Dead-sheathas* texts in his hand. But *Dind-sheathas Éirenn* has something further to add about the early history of the site, in the shape of certain stories, contained in a preface to PD, and in the first two poems of VD. To these we have not yet referred, and we must now analyze them.

The poem VD i calls on the ancient sages of Ireland to tell the history of the site, and then proceeds to reply to the invitation, in the name of Finnian, the antediluvian invader of the country, to whose survival through the centuries the preservation of ancient memories was naïvely attributed. We need not, however, linger over the "machinery" of the composition, nor turn aside to discuss the Finnian myth, which would occupy an essay in itself. Stripping the poem of its verbiage, and of its metrical devices, we can reduce its contents to the following summary:—

(1) The hill was originally a hazel-thicket, in the days of "the son of Olleáin." This thicket was cleared by Liath son of Laigne Lethan-glas, who turned it into a corn-land (*is árdán is árdán na tí, "its corn was rich corn"*). This Liath called the ridge after his own name, *Druim Liath*, that is "Liath's Ridge."

(2) The ridge afterwards passed into the possession of Cáin son of Fiachu Coráindán, from whom it received its second name, *Druim Cáin*, "Cáin's Ridge." It now became a military station (*is tabaich a teipéis máir, "the hill to which chiefs used to go"*).

(3) Coráind daughter of Allod then comes on the scene, and from her the site was called *Cathair Coráind*, "C's fortress," in the days of the Tuatha Dé Danann. A palace has therefore now been built on the ridge.

(4) Coráind was succeeded by Tea daughter of Lugaid, the wife of Eremón, who built a rampart round her house, outside which she was buried; and from her the site was called *Tea Múr*.

The nominative of this name is probably Olle[h]ann, not Olleáin; compare Cáin in the following stanza.

The purpose of the poet is not so much to give a history of the site, as to account for a series of names by which, according to tradition, it was successively known: Fordruim (apparently the original name before the clearance of the hazel-thicket), Druim Léith, Druim Cáin, Cathair Chroífind, and Tea Múr (*sic*). The course of events by which he endeavours to account for these names is clearly very natural; unusually so, indeed, for a *Dind-shenchas* history! The change of the name of a place with its owner is a common occurrence in Ireland down to modern times; Flanagan's Rock, Fort, Hotel, or what-not, becomes O'Connor's in name as well as in legal title, to the frequent confusion of topographers. So the theory that explained these changes of name by changes of ownership is just what would naturally occur to a commentator. And the transformations of the hill as pictured in the poem before us are what any intelligent person might evolve out of his inner consciousness. We see in turn the unreclaimed thicket; the site turned to a corn-land; the elevation of the hill to a military station, when its strategic advantages became evident; the establishment of a royal house; the foundation of a royal dynasty. Nothing could be more obviously true; nothing could be farther from the real truth.

The only historical value that the poem possesses is its testimony that the hill was known by different names. We need not accept the chronological succession of these names; they may have been used indiscriminately, perhaps in different parts of the country. Other names, not mentioned in the poem, are recorded elsewhere: O'Clery's *Glossary* gives us *Connalt*, i. tech Cuinn i. Temair Breg¹; also *Ros*, i. Temair, to which the lexicographer Peter O'Connell adds "an old name of Tara."² PD records another name, *Druim nDéscend*, but without comment. The name Ros Temrach is also vouched for in *Acallam na Senórach* (ed. Stokes, line 1475).

The ninth stanza of VD i would seem to imply that there were structures at Temair associated with Tea—a house and a grave. "A rampart was built round her house by Tea the great, daughter of Lugaid; she was buried behind the wall without, so that 'Temair' comes from her." Possibly the Forrad was supposed to have been originally Tea's house.

Another important point must be marked for future reference before we pass from this poem. The foundation of the *cathair* is ascribed to a woman.

VD ii is a poem of great obscurity. The author assumes on the part of his readers knowledge which is no longer accessible; his allusions are therefore difficult, if not impossible, to understand. The text of the poem will be

¹ *Revue celtique*, iv, 390.

² *Ibid.*, v, 38.

found in Gwynn's edition: it is not necessary to give here more than an abstract of its contents. The numbers in brackets refer to the stanzas—

1) Temair was founded by a woman: it was obtained as a possession by [Tea] daughter of Lugaid. (2) [Tea] wife of Gáide, desired it from her husband as a dower. (3) It was to be a fortress, and afterwards Tea's burial-place. (4) Eremón had his wife in imprisonment—a reference, probably, to some otherwise lost saga. He gave her what she asked. (5) The palace took its name from Tea, who was buried here.

At this stage we pause to note that the same formula is used in the story of the *Bóth of Cúmbro* to account for the name of the palace of Almu; or, rather, it is one of different alternative explanations which the romancer offers of the name. Almu was the wife of Naim, the druid of king Cathaer Mór; and she begged her husband that her name should be on the hill where she was buried.

In the stanzas analysed above, the sudden change of the name of Tea's husband from Gáide to Eremón, is embarrassing enough; but now the *domestic possession* change abruptly and completely, and we are plunged into the middle of what at first sight seems to be a totally different story—

(6) Ois Tephí daughter of Forand comes on the scene, who built a stronghold, "fashioning it with her steel and with her brooch." (7) The fortress was called Mór Tephí after Tephí, the king's wife. (8) Mór Tephí in the east, which though a sacred place (*gráid*) is not hallowed, became the centre of the graves of many queens. (9) The house of Tephí was sixty feet square. (10) [Tephí] was a relative of Basile son of Eusech (*prince Basileusius Isidris*), a native of Spain, and was abducted by one Cansón. (11) Tephí and Cansón built the Raíth mentioned in the sixth stanza, *the mound*, to conceal her. (12) "The king of Britain" did not carry off Tephí, "though there was strife between him and Cansón." (13) Cansón pledged his god Eithern, that he would restore Tephí (alive or dead). (14) Tephí died, and Cansón sent her body in a ship [home to Spain]. (15) reports (14) in *other words*, adding that the grave of Tephí was called *Tephí-ón*. (16) Temair was built in imitation of Tephí's grave. (17) All places that are lofty and conspicuous are called Temair after this site. (18, 19) A collection of tales and miracles, of *no importance*, but containing an allusion to the final destruction of Temair.

The prologue to the account of Temair in PD gives us some help to an understanding of this incomprehensible melody. Temair we are there informed is the name or wall of Tea daughter of Lugaid son of Ith, the wife of Gáide Ollgethán. Or it is Tepe-mór, the name or wall of Tephí, daughter of Basile, King of Spain, she lived with Cansón (*prince*) son of Cathmaín king of Britain. Eithern, the god of the Britons, had been given as security for her return to Spain alive or dead. She was buried in Spain, and the rampart

built around her was called Teipe-múr. It was seen by Tea wife of Eremón (*sic*), and when she came to Ireland with her husband from Spain she followed it as a model in building her own fortification; and she erected a rampart like that of Tephí, on every hill that she chose as a fortress.

No one could blame any impatient reader who would protest, at this point, that it is utterly impossible to extract any sense or reason out of all this farrago. Certain sciolists, he might very justly say, wished to find by hook or by crook an etymology for the name of Temair, and to do so they invented a story of quite unusual silliness. But we are not entitled to brush aside the legend in so cavalier a manner. In the first place, we note that if the tale had been invented merely for the purpose of explaining the origin of the name of Temair, the inventors would have rested content with the, for them, brilliant inspiration of *Tea Múr*, and would not have embarrassed themselves with Tephí at all. It is quite clear that the *Dind-sheanchas* writers, both prose and verse, were more interested in the etymology than in the romance: and it is also obvious that Tephí was very much in their way: she was in the story, but they did not know what to do with her. The whole Tephí fatuity, as it appears to be at first sight, is really one of the best arguments against the story being merely a philological invention, and for the etymologies being an adaptation of something that was already in existence. In the second place, the story exists in several versions, and, indeed, we can trace two versions combined together in the *Dind-sheanchas* tale, which made Tea the wife, in the one version of Eremón, and in the other of Géide. An inventor would not have introduced this unnecessary complication. *Lebor Gabála* gives a different form of the story, which will be found (*inter alia*) in LL 13 *b*. According to this, Tea was the daughter of Lugaid mac Itha, and was wife of Eremón, the mother of his youngest son Iriél; Eremón had deserted his previous wife Odba in Spain, in order to attach himself to Tea. Odba, however, came in a ship to Ireland, with Muinne, Luigne, and Laigne, the three sons that she had borne to Eremón: and she was in Ireland till she died and was buried in the hill of Odba, near Navan. Meanwhile, Tea had begged of Eremón a heritage and a burial-place, and he had given her Druim Cáin, as it was then called. Seemingly Odba here takes the place of Tephí, and the Camsón incident is ignored. Cormac the glossator knew the story, and refers to it (s. v. *Temair*).

It is to be noted that Tephí is said to have laid out her stronghold with the aid of her staff and her brooch. The same expression is used in speaking of the foundation of Emain Macha by queen Macha: and it is there adapted by the etymologizers to give some sort of derivation for the word *Emania* (LL 20 *b* 50). The story of the brooch has no etymological point in the story

before us, and its presence here seems to show that it existed as a folk-lore element independently of the use made of it in explaining the name of the Ultonian palace.¹ This illustrates the contention here made, that the *Dind-sheanchas* tales existed in folk-legend independently of the etymologies founded upon them. We may throw overboard the philological *fatras* of *Dind-sheanchas Éireann* and similar works, but we cannot thereby evade the duty of trying to make what we can of the stories on which it is based.

In these legends of the origin of Temair, analysis shows seven elements that call for consideration which we now proceed to examine. These are as follows:—

A. *The Tephí Legend.*

- (i) The personality of Tephí.
- (ii) Her father Forann.
- (iii) Bachtir and Camsón.
- (iv) The god Étherún.

B. *The Tea Legend*

- (v) The personality of Tea.
- (vi) The attribution of the foundation of Temair to Tea.
- (vii) Who was the husband of Tea?

A. TEPHÍ.

(i) The attentive reader of the Tephí stanzas in VD ii cannot fail to be struck by the nonsense which they display on the word *run*. The writer's mind is obsessed, perhaps unconsciously, with the idea of a "mystery" while he is dealing with this lady, and finally he tells us that the grave of the dead princess was called "Tephí-rún," which means, if it means anything, "the Tephí-mystery." A *grain* is doubtless a dark and mysterious place; nevertheless this is not a satisfactory name for a grave, and the author's statements do not satisfactorily explain the word. Nor could anyone, even an ardent Irish etymologist, be content with "Tephí-rún" as an interpretation of "Tea"; even if he had not had before him the evidently much better etymology *Tea Mór*. Surely this implies that the word *Tephí-rún* whatever its meaning existed in some form before anyone thought of extorting the derivation of the name of Temair out of it. It reminds us not a little of the *αἰὲς ἡ ἀόρατος* *ἀρα*, with which the seer of visions in the Apocalypse introduces

¹ A modern example of the same etymological myth will be found in the story called *Fionn mac Cumhaill 7 a mháthair* (Seosamh Laoide, *Sq'alaíthe Óirghiall*, p. 38).

² The word is evidently cast into this form by the poet to give a rhyme for *Étherún*, as reference to VD ii 60 will show.

his famous cryptogram commonly called the Number of the Beast. The word seems to say to us: "Here is a mystery; what is 'Tephi'?"

Before we try to solve the enigma, we must first ask ourselves, why should there be a mystery at all? And we have little difficulty in finding an answer to this question.

The struggle between Christianity and Paganism in these islands is a subject that has hardly as yet been systematically studied. It has been too readily assumed, for example, that because there is little or no record of martyrdom in Ireland the triumph of the Cross must here have been easy and immediate. It should not be forgotten, in criticizing these and similar assumptions, that all the records which we possess are comparatively late; they have come down to us from the hands of adherents of the religion that ultimately conquered, and from a time when that religion had gained complete ascendancy. To get at the full truth, so far as it is at all possible to do so, we must read between the lines. When we do so, we find that Christianity had in reality a hard struggle to establish itself in the hearts of the inhabitants of this country. We shall hear several echoes of the strife as we proceed in our present study; and it is not irrelevant to observe that we must be prepared for three phenomena—syncretism, spite, and secrecy.

(a) Syncretism implies that the people while accepting the new teaching do not relinquish the old; they merely add Christ to their pantheon. The parents who, according to a frequently repeated story, left the right arms of their infants unbaptized, in order that they might be strong to strike the crueller blows on their enemies, were good examples of this religious phenomenon. But the most remarkable illustration of syncretism afforded by the antiquities of these islands is the sculpture on the monumental stones found in the land of the Scottish Picts. It is well known that these monuments fall into three groups. In the first and oldest, we find no crosses, but a rich and very obscure system of pictorial symbolism—animals, crescents, circles, and other signs, some forty in number. The symbols are incised, and there are no other devices on the stones. In the second group we find the same symbols, *in relief*, accompanied with elaborate crosses. The interlacings and other ornamental motives associated with Celtic Christian art appear for the first time in Scotland on the stones of the second group, and it is important to observe that the extremely delicate minuteness of this decoration is a proof that the Scottish sculptors here followed the models set them by *manuscripts*, not the traditions enshrined in other sculptured stones. In fact we see clear evidence in these stones of the influence of the foreign missionary, with his illuminated gospels and service-books. In the third group the symbols wholly disappear, but the crosses and allied patterns survive. The

subject will be found elaborately worked out, artistically, topographically, and chronologically, in Romilly Allen's *Early Christian Monuments of Scotland*; but the author of that magnificent book makes no attempt to explain the symbols—of which, indeed, no satisfactory explanation has as yet been offered.

I have devoted some attention to this problem, taking into account the fact that the symbols are also used in the decoration of metal objects, and sometimes in graffiti. I have considered the symbols in turn as marks of tribe or of trade, as Christian emblems, and even as the characters of some hieroglyphic system or syllabic writing. In every case I have found insuperable objections to the interpretation attempted. I find myself at last forced to adopt the conclusion that they are not Christian symbols at all, but Pagan; that they are probably marks associated in the minds of those who made use of them with different deities, surviving and flourishing side by side with a newly introduced Christianity. They are in fact invocations of the various pagan gods, just as we may see invocations of Odin or of Thor on pagan Runic inscriptions. When Christianity was first introduced among the Picts, they did not see their way to abandon their ancient gods all at once. For a time they tried to set themselves right with the deities of their fathers and with the new Faith; they carried on their monuments the symbols of the old and the Cross of the new. The first group of stones, then, are on this theory Pagan monuments; the second transitional, erected before the missionaries could fully enforce that exclusion of all other gods which is a cardinal principle of Christianity; the third group belong to a time when the old gods were dead, and when the Cross had triumphed.

Some of the Scottish stones bear Ogham inscriptions, which have taxed in vain the last resources of our most accomplished philologists—as well as some of the others—an interpretum. Most of these inscriptions are grave-formulae in the Pictish language, and as that language is dead and forgotten, and its very place in the classification of languages is unknown, we can have very little hope of ever completely understanding them. But others look like something else; and I suggest that they are invocations of the *names* of pagan Pictish gods. This is not so far-fetched an interpretation as it may appear to be, for on one stone at least—that at Papa Stronsay in the Orkneys—the fashion is carried into Christianity, and the only inscription on the stone is an invocation of the Christian God. We may compare the "ejaculation" DNE,

¹The famous Orkney rent, which bears a sculptured figure of Thor incongruously associated with Christian symbols, offers an exact parallel. See Professor George Stephens' brochure, *Pagan and Thor in Orkney* (London: Williams & Norgate, 1878).

carved on the cross-slab of Reisk and on the alphabet-stone of Kilmalkedar, in Co. Kerry.

All this is not so remote from the subject before us as the reader will naturally be tempted to suppose. As we shall presently see, the sculptured stones of the Picts, the representatives of the pre-Celtic bronze-age people who founded Temair, have some light to throw on the problems of its early history; and it is important to understand clearly how it is here proposed to interpret them.

(b) The *odium theologicum* between adherents of rival religions takes the form (1) of profane nicknames used by the supporters of one faith for the gods and holy places of the other; (ii) of improper stories told of the opposition deities; (iii) of miscellaneous forms of mockery. We have examples of all three in Irish literature. Of the first, we may take as an example the nickname *Cromm Crúaich*, of which we must speak later. There is no satisfactory evidence that this was ever the real name of a deity. We may compare also Diabul Ard and Tarothor (*lege* Torathor), already mentioned on p. 257, and the names given in Cormac's Glossary to the wife of The Dagda. The worshippers of the gods thus scornfully designated, retaliated by calling the Sacred Figure on the Crucifix *An Crochaire Tarrnochtuiithe*, a name still current in folk-tales told by good Christians, who are blissfully ignorant of its true meaning.¹ Of the second form of religious spite we may take as an illustration, from the Christian side, such a tale as *The Second Battle of Moytura*,² where the deity known as The Dagda is placed in a number of ridiculous and, to speak mildly, undignified situations. On the pagan side we may instance the story called *Aided Diarmada*,³ in which the half-heathen king Diarmait and Saint Ruadán of Lorrha fling preposterous curses at one another, those of the king being effective and those of the saint, at least in what we may presume to have been the original version of the story, power-

¹ The meaning is obscured by translating it "The Naked Hangman." The word *crochaire*, though now used principally in the sense "hangman," also means "a hanged person," and is sometimes applied to the Figure on the Cross; cf. *cret in dealbh croiche ut 7 in Crochaire innti*, Book of Lismore 69 b 1.

² *Revue celtique*, xii, 52. The reference in the text is to the story in its present literary form, which is an uncouth exhibition of Rabelaisian humour. It is doubtless founded on much earlier traditional materials.

³ *Silva Gadelica*, i, 72. This tale, at first a piece of rough humour, was later taken seriously by writers unable to believe that the saint's curses could possibly be impotent; and they based upon it the legend of the destruction of Temair in or shortly after 563 A.D. But, as Professor MacNeill has pointed out, this alleged desertion of Temair is altogether inconsistent with the later history. On the other hand, the Prologue of *Féilire Gengusso*, line 165, shows that Temair was of small importance in the ninth century, when that poem was written.

less. Of the third form of spite it will suffice to quote here the unedifying wrangling of Oisín and Patrick in the so-called Ossianic poems.

(c) Secrecy, on the part of the adherents of a weaker faith, is necessary to avert persecution. While the Christian faith was struggling for existence, its followers made use of secret signs and passwords whereby they could recognize one another. Contrariwise, the *mysteries* were the last stronghold of Paganism when the Cross had triumphed.¹ And so, to return to the point from which we set out on this digression, I think we may take it that "the mystery of Tephi" is some such secret. It was a private way of referring to a divine being, invented when Christianity had reduced the rival faiths to impotence. At least, let us for the moment assume this to be the case, and let us now inquire what divine being might be supposed to lie hidden under the personality of Tephi.

Tephi is called "daughter of Forann." This is the same word as the Irish equivalent of Pharaoh, the title of the king of Egypt; Tephi therefore is spoken of and was doubtless understood by the writer of VD ii as being the daughter of the king of Egypt. He was not troubled by the improbability of such a princess being at the same time a relative of "Bachtir of Spain," and we need not feel any more uneasiness on the subject than he did.

Two other daughters of Forann make their appearance in the legends of Irish *antiquaries*. These women were both called Scota; and though by the annalists they are separated from one another by a number of generations, they are clearly doublets of one another. This "Scota daughter of Pharaoh" is the prime cause of the devious wanderings of the children of Míl over the face of the earth, before finding a permanent home in Ireland. The children of Míl were called "Scots"; one school of etymologists derived this ethnic name from *Scythia*, and so the tribe had to be brought on its wild journey to Scythia in order that it might pick up the name. But another school of etymologists favoured an eponymous ancestress, "Scota daughter of Forann" understood as being the daughter of Pharaoh. To secure this ancestress, the tribe had to make its way to Egypt. Finally, when the redactors attempted to make one story out of all the scattered tales that lay before them, they found that different accounts were given of the husband whom Scota married and of the children whom she bore. In order to work these all in the lady had to be duplicated thus necessitating two different voyages to Egypt in different generations. Such is the evolution of the story of the wanderings of the children of Míl, helped out by tags borrowed from the wanderings of the Israelites and from other sources.

Here again, as in the case of Tea, the fact that the historians were

¹ See Farnell, *Cults of the Greek States*, iii, 127.

embarrassed by a variety of mutually contradictory legends is sufficient to show that the story of *Scota* is no mere invention, devised to give some sort of etymology for the ethnic name of the "Scots." Essentially the story of *Scota* is a popular tale of a divine ancestress; though the *name* of the ancestress may have been artificially modified, by the men of learning who systematized the stories into the form in which we have them, in order to improve the analogy between the two words compared. If we could have recovered the tale of this ancestress *from the lips of the common people*, we would not necessarily find that "*Scota*" was the exact form in which they would have given her name to us, or that the idea of the derivation of the ethnic was at all uppermost or even present in their minds. Such artificial modifications of proper names, in the interests of etymology, are not unknown in Irish historical literature; we may instance the constant habit of spelling the name *Finnachta* with an interpolated *shn*, as though it were *Finn-shnechta*, "white snow," or *Fín-shnechta*, "wine-snow."

The story of *Scota's* parentage leads us to a further inference; namely, that not only are the two "*Scotas*" to be treated as one and the same legendary personality, of whom different stories were told; but that *Tephi* also is to be regarded as identical with them. Herein lies "the mystery of *Tephi*."

But, it will fairly be asked, what possible connexion can there be between the names of *Scota* and *Tephi*? One method of linking these words may be suggested. Suppose we write the name *Scota* in Ogham letters on a circular stem-line (fig. 3 *a*), and then manipulate its letters symmetrically, making the first three strokes of the S, and the last three strokes of the C, into vowel-scores (fig. 3 *b*). Then, regrouping the vowels, and beginning to read at the T (fig. 3 *c*), we obtain *TEBHI*. According to the principles of Ogham orthography, H is not here the sign of lenition, so that the word would be pronounced *teb-hi*, not *tevi*. To preserve so far as possible this pronunciation, the unlenited *b* is written *p* (as it usually is after vowels in Old Irish), when the Ogham is transliterated.

For purposes of comparison, a facsimile of an actual "wheel" of the kind imagined is added to fig. 3 (fig. 3 *d*). It occurs on the stone at Logie Elphinstone, Aberdeenshire, in association with certain of the Pictish symbols, to which reference has been made on a previous page. These scores are certainly cryptographic, but the key to their decipherment has not yet been discovered. The puerile cryptograms on the great Runic stone at Rök, Sweden, are of the same character.¹

Reams of nonsense have been written, trying to make cryptograms out of the straightforward memorial inscriptions in Ogham; this way of interpretation

has proved an absolute *cul de sac*, and is now universally discredited. But that the Ogham character was on occasion used for cryptical purposes may be taken as certain. The series of Ogham alphabets in the Book of Ballymote is no mere vacuous pastime of the scribe of that compilation: it is a treatise on cryptography, a collection of the variants of the Ogham alphabet invented and used from time to time by ingenious *literati* for purposes of secrecy. Besides the Logie "wheel," we possess two cryptographic inscriptions in Ogham—the formula LMOPW on the Glenfahan stone, and the similar formula LMOTM on the bead-amulet from Ennis. I have not succeeded in hitting upon the solution of these riddles, but I am inclined to believe that the name of a pagan god, or perhaps the initials of a number of names of gods,

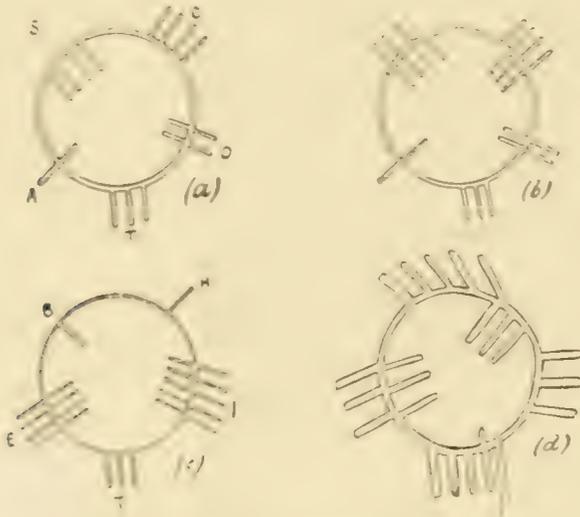


FIG. 3.—The "Wheel-ogham" Cypher.

may be concealed under these strings of consonants. If this interpretation of these inscriptions be correct, the Glenfahan stone would be of especial importance in this connection. It would be a valuable monument of the syncretism which we have already endeavored to trace in the Pictish sculptured stones. The setter-up of the monument was at a loss to choose between the old faith and the new. He tried to make his peace with both by carving an elaborate cross on the face of the stone, and by invoking the old gods in his cypher on the edge. It is not difficult to understand why the inscription should be a cypher, for the maker of the monument well knew what would happen if he had written the god's name without concealment.

¹ See Sophus Bugge, *Der Runenstein von Rök* (Stockholm, 1910).

I think that I was the first to point out that in Ogham inscriptions couched in the formula *A maqi mucoi B*, in which the descent of the deceased is traced not from his father but from a remote eponymous ancestor, the second name, that of the ancestor, is very frequently broken off while the rest of the inscription is left intact; and this almost always seems to be a work of intentional violence. I completely missed the true interpretation, however, which is certainly that given by Professor MacNeill¹; namely, that the ancestral name is that of a divinity, which would naturally be destroyed when some enthusiastic Christian iconoclast came across it.

I therefore suggest that *Scota* was an eponymous ancestress of the Scotie people, to whom divine honours were paid, and that *Tephi* was a cryptographic way of referring to her, devised at the time when Christianity had become the strongest faith in the country.

(ii) The next question that arises in connexion with *Tephi* is the interpretation to be put upon the statement that she was a daughter of *Forann*. It is not to be understood that she was originally supposed to have been a daughter of the king of Egypt, though this explanation, doubtless, became current in later times. We are to see in *Forann* a native name, which later historians misunderstood.

Sir John Rhys long ago suggested a comparison between this name and that of *Feron*, mentioned in the legends of Irish *origines*.² According to one story, preserved by Keating,³ *Partholón*, the first post-diluvian invader of Ireland, had four sons, named *Er*, *Orba*, *Feron*, and *Fergna*. Another tradition made these four the sons of *Eber*, brother of *Eremón*, the first king of the Milesians, and assigned to them a reign of half a year in joint rule, some little time after the establishment of the Milesian kingdom.⁴

There is, on the whole, a general similarity between the legends of *Partholón*, *Nemed*, and the *Fir Bolg*, close enough to justify us in regarding them as variants of one and the same group of tales—namely, the tales that the aboriginal pre-Celtic people of the country told about their own beginnings. This being premised, it may be considered as at least probable that the four leaders of the expedition whereby these *autochthones* were said to have been settled in a previously desert Ireland, were the ancestral deities of the pre-Celtic tribes. Accordingly, we find the same quartette appearing in another guise, as those of the sons of *Nemed*, the second post-diluvian invader of the country. As there given, they are *Starn*, *Iarbonel*, *Fergus*, *Ainnind*.⁵ The

¹ Proceedings R.I.A., vol. xxvii, section C, p. 334.

² *Rhind Lectures in Scottish Review*, October, 1890, p. 252.

³ *Forus Feasa ar Eirinn* (I.T.S. edition), vol. i, p. 170.

⁴ *Ibid.*, ii, 116.

⁵ *Ibid.*, i, 174.

similarity of three out of each of these quaternities of names, which may be displayed as follows—

ER	ORBA	FERGna
stARn	iARBOnel	FERGus

—may not be very striking when the names are considered separately; but when they are considered in a group the analogies almost amount to a demonstration that the first list is a broken-down form of the second, probably derived from some half-illegible record. That Feron does not bear any resemblance to Ainnid I explain on the theory that the group was at first a triplicity, as such god-groups usually are, and that the fourth was a variously-named later addition.

With all possible reserve I venture to record an idea which has occurred to me: that we have an invocation of this triplicity on a very remarkable stone in Pictland. This is the well-known monument at St Vigean's, Forfarshire, which will be found well illustrated in Allen's book (cited above), p. 236. On one face of the stone is an ornamented cross, the upper part of which is now broken away; on the other face are some of the "Pictish" symbols, with one of the enigmatical hunting scenes so common on the Pictish stones. Low down on one edge of the stone is a small panel bearing the words

DROSTEN
IPEUORET
ETTFOR
CUS

I well remember the surprise I felt when I saw this stone many years ago, at the ~~background~~ background of this inscription: it is, as it were, thrust out of sight, as though the writer were half-ashamed of it. It is not more prominent than the names which monumental masons cut on modern tombstones to advertise themselves. This would scarcely be intelligible if the purpose of the inscription had been to perpetuate the name and parentage of the owner of the monument. But if it were the memorial of a syncretism, in which the pagan faiths were "recessive" and the Christian "dominant," we might understand a pagan inscription being put in the background in this way. Not one of numerous attempts that have been made to interpret this inscription can be said to carry conviction. There is therefore room for another suggestion, though I can scarcely hope to have succeeded where so many have failed. But it is undeniable that there exists at least a superficial resemblance between the words on the stone and the names of the triplicity set forth above; DROSTEN suggests STORP, IPEUORET corresponds to *Iarbanol*, and FORCUS

to *Fergus*. The interpolated ETT would then be simply the Latin *et*, learnt, with the forms of the letters in which the inscription is cut, and the accompanying cross with its ornamentation, from the missionaries. On this hypothesis, the St Vigean's inscription would give us the original pre-Celtic forms of these names, those in the Celtic documents being corruptions.¹ I may remind the reader of the illustration I have used in a previous paper²—the transformation of the names of *Eudus* and *Mael-Oinac*, heads of Clonmacnois, into *Eogán* and *Mael-Tuile* in all the Annals—which shows that there is scarcely any limit to the possibilities of corruption in proper names, even when these are familiar. The change of *Ipeuoret* to *Iarboael*, which is perhaps the most violent of those suggested, will not seem so difficult when we remember the similarity of þ to R, R to n, and τ to L, in the so-called "Irish" capitals, especially if these are not very carefully written.³

It is not difficult to recognize the same quaternity once more in the names of the four persons recorded as having escaped the universal deluge, Finntan Feron, Fors, and Andoid.⁴ Here Feron and his double Ainmind (Andoid) appear together, while Finntan and Fors take the place of the others.

The name Feron appears to occur in a similar invocation on the Newton stone. The beginning of this inscription is AIDDARRNNN VORRENN. Reason will presently be given for seeing in the first of these words the name of a god; and the analogies already suggested perhaps make it at least admissible that Vorrenn is to be similarly treated. Feron would thus be an artificial corruption of the name of a very ancient deity, made by interchanging the vowels.

We have thus reduced the mysterious Tephí daughter of Pharaoh to a Celtic divine ancestress *Scota*, considered as the daughter of a pre-Celtic deity called *Forenn*. But why should this Celtic ancestress be made the daughter of a pre-Celtic divinity? To this question, at first sight difficult, a simple and convincing answer is at hand. It is a device of the Celtic invaders, who came in at the beginning of the iron-age culture, to establish their claim to the possession of the land. Baudiš⁵ has ingeniously explained the songs of Amergin as hymns designed to propitiate the unknown deities of a country

¹ There seems to be a contamination with another triplicity, namely, the three "gods of the Tuatha Dé Danann," called Brian, Iuchar, Iucharba. The names Iuch-AR, Iuch-ARBA, are reminiscent of the first two names of the Partholón triplicity.

² Proc. R.I.A., xxxiii, C, p. 106.

³ That ghost-words produced thus, by misreadings of manuscripts, can attain to vitality is shown by such examples as *Hebrides*, *Ioua*, *cell* (chisel), and *uncwail*, derived from misreadings of *Ebudae*, *Ioua*, *caelo*, and *initiales*.

⁴ Keating's *History*, I.T.S. edition, i, 184.

⁵ *Ériu*, viii, p. 102.

which the singers are invading. One of the most familiar devices for establishing a treaty with the gods of a conquered country is to affiliate them to the gods of the conquerors. Much of the Greek *Theogonia* has its roots in this custom, and we can very reasonably trace it here. The Celtic-speaking people, coming into the country with their *Scota*, declared that she was the offspring of the aboriginal *Foenn*, and thereby put forward the strongest claim they could make to the possession of the country. Some further suggestions as to *Scota's* personality must for the present be postponed.

(iii) The saga which connected *Tephi-Scota* with *Bachtir* and with *Camsón* is lost except in the allusions of the poem before us, and there is no light from any other source to throw on these obscure names.¹ The "king of Breogan," with whom *Camsón* was at enmity, can hardly be dissociated from *Breogan*, the grandfather of *Mil*, traditional ancestor of the Milesian or Celtic invaders. *Camsón*, the son of the king of Britain, would thus be a non-Celt, and we now begin to see indicated a legend told to account for the invasion of the Milesians. The orthodox story is to the effect that the expedition was first undertaken to avenge on the *Tuatha Dé Danann* the murder of *Ith* son of *Breogan*; but that other tales were current before the historians formulated the "official" history of the country can hardly be doubted. Probably, according to this story *Camsón* abducted *Scota-Tephi* from Spain, and the expedition was set in motion to avenge the outrage. But this does not altogether exhaust the possibilities of reconstruction as we shall presently see.

(iv). *Camsón* had a god *Etherún*, on which a word or two must be said. *Petrie*, not uncharacteristically, compared this name to that of *Taranis*, the Gaulish deity named in an oft-quoted passage of *Lucan*. The vowels, however, seem irreconcilable with this identification, and moreover we do not appear to have any very clear evidence of *Taranis*-worship in these islands. I at one time thought that in *Etherún* we were to see a scribal error for *Echevún* treating this as some sort of corruption of the name *Cernunnos*. This however assumes the unDemonstrable hypothesis that *Cernunnos* was known in Ireland under the same name as on the Continent; and as *Camsón*, on the theory here advanced, was a pre-Celtic personage, he must have had a pre-Celtic god. We must therefore look elsewhere for *Etherún*, and once more *Pictland* comes to our assistance.

Two of the Scottish Ogham stones—that from *Scoonie*, *Fifeshire*, now in *Edinburgh Museum* and that at *Brodie Park* in *Elginshire*—bear a word *EDDARINOLAN*. On the former stone it constitutes the entire inscription; on the latter it is the only word now legible in what appears to have been

¹ With the exception of one solitary ray on *Camsón*, to be mentioned later.

Tea is called daughter of Lugaid mac Itha. This Lugaid was said to be cousin of the tribal ancestor Míl, Ith being the brother of his (Míl's) father. Scota, according to one of the stories about her, was wife of Míl, and mother of his numerous family of sons, chief though not eldest of whom was Eremón, who according to one of the traditions married Tea. Tea thus works out as daughter-in-law of Scota, and second cousin of Eremón.

The details of importance in this genealogy are the heroine's descent from *Ith*, "corn," and her marriage to *Eremón*, the "ploughman." Tea thus is an impersonation of the spirit of vegetation. We shall see abundant evidence that the rites which centred in the ridge of Temair were associated with agricultural festivals; and that the corn-spirit should have been regarded as the cause of the foundation of the worship of the site is thus all the more probable.

When in the light of this identification we look back at the scanty and confused record of the story of Tea and Tephí, we begin to wonder whether their rôles have not somehow become reversed. For the story of the abduction of Tephí by Camsón has one very peculiar feature in it. This is the promise made by Camsón *to return Tephí, alive or dead*. Such promises are not usually made under such circumstances in folk-tales—except in one group, namely that of which the deathless story of Demeter and Kore is the crown and type. Here, too, we have a rape with a promise of a return. The winter-time gives place to the spring, and Pluto gives back Persephone, the corn-spirit. In the very fragmentary condition of the Irish legend, it is impossible to develop the analogies thus suggested in detail. But it is clear that if Tea be the corn-spirit and Tephí the tribal ancestress, the story of the abduction would be more likely to have the former for heroine than the latter. I suspect that in the original version this was so; and perhaps that Tephí (Scota) the mother (not mother-in-law) of Tea played the part of Demeter. But the tale has become confused in the telling, and has not been improved by the dry-as-dusts who were interested in it only as a source for an etymology. In the poem on Temair, *Lacelua* in Kerry, contained in *Deirdre's Éreann*, Tea is again mentioned, but no additional facts are recorded of her except that she came from *Tír fé Thuílan*, that is, from Elysium in one of its many manifestations.

(vii). In all the welter of confused traditions and etymologies with which we have been hitherto concerned in the present section, one fact of very great importance stands out prominently: the indication that Temair was believed to owe its origin to a woman. Had this been an isolated case it would have been injudicious to attach much importance to it; but we know that it was actually the rule. All the important *seanch* and palace sites in Ireland are alleged to have been founded by women, who gave them names to the places

where they were established. Tlachtga, Emain Macha, Tailtiu, Carman, occur to the mind at once in this connexion, and form a body of cumulative evidence that cannot be rejected on the ground that the tales, as they have reached us, show marks of late manipulation for philological purposes. Taken in connexion with the matrilinear law of succession among the Picts, well attested by Bede and by other writers, as well as by the Pictish list of kings, these tales must mean that the founders of the monarchies, or the establishers of the rites, at the places referred to, did so by right of their wives or of their mothers: in other words, that descent was reckoned in the female line. Such a system did not exist in Ireland after the establishment of the Celtic *régime*, at the beginning of the Iron Age; the traditions must therefore in their essence reach back to the Bronze Age, and therefore fall into line with the archaeological evidence for a bronze-age origin for Temair, which we have already found.

A different story is told in VD i, assigning the foundation of Temair to one Crofind, daughter of Allod. For the present we content ourselves with noting that this story also speaks of a *foundress*. Allod is a divine name; its owner, indeed, was the brother of The Dagda, and he appears as a tribal ancestor on several Ogham stones. As we shall see later, this mention of Crofind is of great importance: but meanwhile we must look a little more closely at the princess Tea from another point of view.

(vii). The author of VD ii has endeavoured vainly to slur over an inconsistency in Tea's matrimonial connexions: in one place she is called the wife of Eremón, the leader of the Milesian, i.e. the Celtic expedition to Ireland; in another place she appears as the wife of a certain Géide Oll-gothach. If we take the chronology of the Four Masters, which will serve as well as any other, we learn that Eremón with his braves landed in Ireland *Anno Mundi* 3500, and that he died in 3516; while Géide Oll-gothach reigned from 3960 to 3971, about four and a-half centuries later. How are we to explain this inconsistency?

To answer this question we must first inquire as briefly as possible into the origin of what for convenience I may call the "official history," i.e. the history of Ireland enshrined in the Books of Annals, Lebor Gabála, Keating, and other writings, from which the dates just given and others like them are to be extracted. That the "official history" is an artificial compilation, based on Scriptural and Classical synchronisms, is obvious. But of what elements is the compilation made up?

Prof. MacNeill, in his paper on Ogham inscriptions, published in vol. xxvii of the *Proceedings* of the Royal Irish Academy, has shown clearly that these inscriptions represent a totally different orthographical tradition from the

Irish of the MSS. ; and that while the Irish of the MSS. represents a Christian tradition, dating from the earliest ages of Christianity in the country, the Ogham inscriptions represent a pagan tradition. It follows beyond the possibility of question that there must necessarily have been a certain amount of literary culture in the country for at least a century or two before the coming of the Christian missionaries. As I have said in a paper already published by the Academy,¹ "the ground-work of this literary culture was, no doubt, the poems which according to Caesar were committed to memory by the pupils in the druidic schools²—most likely Veda-like sacred and semi-magical hymns and formulæ of various kinds." The analogy with the Vedas suggested in the above quotation is exact, and explains several otherwise inexplicable phenomena in Irish literature. These traditional hymns, like the Vedas at the beginning of their existence, were never written down, as Caesar goes on to tell us: it follows that they would preserve in memory an archaic form of language, just as the Vedas preserve Old Sanskrit, and as the ritual of the *Frater Arcales* enshrines an archaic form of Latin. After this we are not surprised to learn that the study of these poems occupied no less than twenty years, at the end of which time the *literati* would be so steeped in the sacred language that they would naturally use it as the basis of literary composition. To the large illiterate majority this archaic language would be totally unintelligible—as much so as Latin would be to an illiterate Frenchman or Italian.

When the Christian missionaries arrived in Ireland, they found much the same condition of things prevailing as modern missionaries have found in China. The current language of daily intercourse was a colloquial, which was never written; while the language used for writing, by those few who possessed the art, was an archaic form of speech, familiar to the "mandarins," but incomprehensible to the unlearned. To instruct those whom they had come to teach, the missionaries in ancient Ireland solved the problem thus presented to them as the missionaries in modern China have solved it. They elevated the colloquial speech to the level of a literary language, writing it after a newly devised phonetic system; and they created a literature by translating into it such of the ancient traditions as moral or religious expediency permitted them to translate. It need hardly be said that no archaic, pre-Christian literature in vellum MSS. is to be postulated³; tablets of wood,

¹ *Proceedings*, vol. xxxii, section C, p. 231.

² *De Bello Gallico*, VI, xiv, 3.

³ Though possibly the books of Longard were written in this archaic dialect. They survived till the time of the writing of the annotations to *Peirele Oenepasso* (Bradshaw edn., p. 198); but were unintelligible, owing, tradition said, to a curse uttered by Colum Cille.

with or without a covering of wax, were doubtless the materials on which the documents were written. In criticizing the contents of Irish historical documents, we must always be prepared to look back from the writings as we have them to the archaic records from which, on this hypothesis, they have been translated. In this, and in no other way, can the following phenomena be explained:—

(a) The use of an archaic language in the Ogham inscriptions. These cannot possibly be so old as the time when, for instance, the natural way of expressing the genitive of the word for "son" was *magi*. There was, doubtless, once such a stage of the spoken language; nothing but a carefully treasured and meticulously studied body of traditional literature could have preserved the memory of such ancient forms down to the time when they began to be written in Ogham.

(b) The archaeological accuracy of romances like *Táin Bó Cúalnge*; which though written in their present form in or about the seventh or eighth century A.D., reproduce the life of the first or second century B.C. Something more than mere oral tradition must have existed, to preserve the memory of the details of La Tène civilization which Professor Ridgeway has detected and set forth in his well-known monograph *On the Date of the first Shaping of the Cuchullainn Saga*.¹

(c) The non-metrical character of certain early poems; such as the concluding lines of Amergin's *Am goth immuir*,² which may, perhaps, be actually a translation of a hymn of one of the Druidic "Vedas." These may be presumed to have been regularly metrical in their archaic form, but to have lost their metre through translation, just as would an ode of Horace if it were to be translated literally, line for line, into Italian.

(d) The streams of nonsense, dignified by the name of "retorice," occasionally introduced into the prose romances. These, at first at least, were nothing but the bungling of an incompetent translator: though in the later imitative literature they became an artificial pose.³ Such a text as *Briatharachath Ban nUlad* must have been almost Homeric in its original form, with its stately roll of inflexions; the version which we possess is on the level of a sixpenny "crib" to the *Iliad*.

On such materials, then, the "official history" is ultimately based. The tales were told by the professional story-tellers and historians, at first enshrined in their memories; afterwards, when they became acquainted with

¹ *Proceedings of the British Academy*, vol. ii.

² The translator has been able to cast the first part of this rhapsody into a metrical form, owing to its regular structure.

³ As in *Aided Conchobuir* (Todd Lectures, xiv, 10).

the nature and use of the Roman alphabet, written down on waxed tablets in the archaic language; and after a time translated under Christian influence, not always satisfactorily, into the colloquial tongue which we know as Old Irish. The work of the succession of historians, who hammered the "official history" into shape, consisted in selecting, synchronising, and arranging, on principles not always easy to discover, the Orphic fragments which the change of religion had permitted to survive. In the discrepancy as to the matrimonial relations of Tea we have a very welcome peep behind the scenes. We see at once that Tea is no mere etymological figment, for otherwise there would be no such discrepancy. Our historians must often have come across the contradictions and inconsistencies familiar to all folk-lorists who study popular legends told of ancient historical characters. When the synthesis of scraps which we have here called the "official history" was finally evolved, and became a regular subject of instruction in the schools, fragments not consistent with it had but a small chance of surviving; it is only by good luck that now and then one of these perials of Irish tradition succeeds in worming its way into literature. One of these happy chances is now before us. Some historian found two narratives, which made Tea wife, the one of Eremón, the other of Géide. He might have deduced two "Teas," as a brother historian had deduced two "Seotas" out of a similar discrepancy. But he preferred to reject one of them; and as a date had somehow been fixed for Géide which was later than the time of the first appearance of Temair on the stage, he had to reject the Géide version. Hence in the "official history" Tea appears as the wife of Eremón, and Géide is ignored. True, on one of the lines of development of this history, the difficulty is surmounted by identifying Géide with Eremón;¹ but the Keating-Four Masters tradition takes no notice of this way out of the difficulty.

We cannot congratulate ourselves too heartily on the chance that the Géide version of the marriage of Tea was known to, and was simmering in the mind of, the author of VD ii when he was writing his "poem"; for it is nothing less than the "Open Sesame" to an understanding of the early history of Temair.

Let us look, first, at the place which Géide holds in the "official" history. This document gives us a long roll of the kings of all Ireland, beginning with Slánge, first king of the Fir Bolg. We may note the accession-dates of this and the other monarchs with which we shall have to deal, merely as a convenient way of indicating into which pigeon-hole the historians fitted them. For this purpose the dates (*Anna Munda*) in the *Annals of the Four Masters*

¹ See *Cóir Anmann* (in *Irische Texte*, iii, 324).

will serve as well as any other, and will be used throughout. Slainge is said to have begun his reign in *Anno Mundi* 3266 (= B.C. 1933).

The royal succession, as conceived of by the historians, is rarely one of immediate heredity. It is based on the theory of an eternal blood-feud, carried on through the centuries. Say there are three successive kings, X, Y, and Z. Y reigns after killing X, the latter having ascended the throne after killing some relation of Y, who had reigned previously; and Y remains king until in his turn he is killed by Z, a relative of X. We have to return to the subject of this alleged blood-feud in a later section, so that we need not discuss it further at the moment. But we must note that in one place, in the course of the roll of kings, it is interrupted by a short intrusive dynasty, which runs as follows:—

A.M.

- i. 3883 Eochu, surnamed Ollom Fodla, son of Fiachu Findscothach.
- ii. 3923 Elim, surnamed Finnachta, son of (i).
- iii. 3943 Slánoll, son of (i).
- iv. 3960 Géide Ollgothach, son of (i).
- v. 3972 Fiachu Findoilches, son of (ii).
- vi. 3992 Berngal, son of (iv).
- vii. 4004 Oilill, son of (iii).

For convenience of reference we may call this the "Ulidian" dynasty. It is said to belong to the province of Ulaid; and indeed *Lebor Gabála* gravely tells us that that province derived its name from *Oll-flaith*, "Big Prince," with reference to Eochu Ollom Fodla. This evidently means, though we are not told so in so many words, that *Oll-flaith* was a by-name or a nickname of the monarch in question. Otherwise there would have been no point in dragging the etymology in.

We learn further from the same authority that Ollom Fodla was chosen by the men of Ireland to reign over them, for his wisdom. To him is ascribed the establishment of the periodical *féis* of Temair, and the building of the structure known as Múr nOlloman. His son and successor Elim derived his by-name Finnachta, explained as *fln-shnechta*, "wine-snow," from the remarkable fact that "snow with the taste of wine fell in his time." Slánoll was so called ("*slán-oll*, "healthy-great") because "everyone was healthy in his time." We further learn that he himself was found dead in Temair of an unknown disease, "but the colour of his body changed not, neither did it decay, for forty years afterwards it was exhumed and found in perfect condition." Géide was called *Oll-gothach*, "Big-voiced," for the inadequate

¹ Compare what we are told of the body of Cianán of Daimliag, in *Féilire Oenqusso*, annotations, 24 November.

reason that "everyone thought the voice of his fellow sweet as the strings of a lute, for the abundance of peace in his time." As a description of a time of peace this is expressive enough, and when we read the same phrase in an account of the golden age of the reign of king Conaire¹ we accept it with satisfaction. But when we find it given as an explanation of how a king came to be called "Big-voiced," it seems extremely foolish. It must have been a stork expression; and some wiseacre laid hold of it to account for a nickname which he was unable to understand.

Of Fiacra we are told a number of interesting facts. Every calf born in his reign had a white head. He invented cistern-digging. He founded Cenannus,² and for some reason nowhere stated, so far as I am aware, "Cenannus was the name of every place where he set his habitation." And such was the prosperity when he was king, "the stalk could scarce sustain its corn in his reign."

Notwithstanding the close relationship of the kings of the Ulidian dynasty, the last four were slain by their successors, according to the usual rule.

Let us now turn to the *Pictish Chronicle*.³ From this compilation we learn that Gede Oll-guthach was a personage of considerably greater importance than the Irish historians would permit us to suppose. We are here told that Cruidne son of Uing, the eponym of the Picts, reigned for 100 years, and that he was succeeded by his seven sons in turn, who between them held the throne for 224 years. After them came Gede Oll-guthach⁴ who reigned, not too insignificant twelve years to which the Irish annalists limit him, but a space of no less than eighty years. Indeed this Gede next to the eponymous Cruidne, is evidently regarded as the founder of the Pictish monarchy; for the seven sons of Cruidne are obviously late interpolations dating from a time when the Pictish law of matrilineal succession had become obsolete. By this law a son could not succeed his father; and the seven are clearly nothing more than eponyms of different provinces of Scotland. We therefore delete the seven sons of Cruidne, and thus the reason Gede Oll-guthach is left to be head and founder of the Pictish monarchy;—Lernmon is the traditional head and founder of the Irish Celtic monarchy; it ceases therefore to be surprising

¹ *Revue celtique*, xxii. 27, 28.

² Kells, Co. Meath—the mensal lands of the kings of Temair, as we learn from a gloss printed in Todd Lect., xiii. 36.

³ Printed in Skene's *Chronicles of the Picts and Scots*, pp. 4, 5.

⁴ In another list of Pictish kings, quoted by Skene from a MS. in the Phillips library (p. 28), Gede, with a reign of 100 years to his credit, stands at the head of the dynasty, without any predecessors, eponyms or other wise. This is, however, a different personage (?) who appears to belong to the Pictish Chronicle after the thirty Brudes.

that the legends should waver between Géide and Eremón as the husband of Tea, the traditional foundress of Temair.

In the *Pictish Chronicle* Géide is followed by Denbecan or Oenbecan, who reigns 100 years, and he by Olfinechta, who reigns eighty years. The latter looks like a compound of the names of Géide's two predecessors in the Ulidian list, [Slán]oll and Finnachta. But there is a different version of the roll of early Pictish kings to be found in Rawl. B 506 (Bodleian Library) and in the Book of Lecan at p. 285.¹ This list follows closely the Ulidian dynasty; but it appears to duplicate the personality of Fiachu Findoilches, and while one of his "components" keeps the place before Berngal, the other takes the place of Slánoll, who is shifted to the place following Géide. The names of the components are Findoll Cisirne (before Géide) and Bagag² Ollfiacha (before Berngal). To the first are assigned the white cows, and it is easy to see the enigmatical by-name *Findoilches* buried in his name, as well as Fiachu's "cisterns." To the second is assigned the "beginning of wars in Ireland" which became so bad that in the time of his successor Berngal "all the corn in the country was destroyed except a sack and a half." The number of seven kings is preserved by the omission of Oilill. For reference we may set out the Pictish version of the Ulidian dynasty, as it appears in the Book of Lecan, thus:—

Ollamh.
 hEilim Ollfinsnechta.
 Findoll Cisirne.
 Geithe Ollgothach.
 Slanoll.
 Bagag (Inbadach) Ollfiacha.
 Bearngal.

All these kings are said to have reigned thirty years—a round number for a generation.

Let us now compare with the Ulidian dynasty the list of kings of the Fir Bolg, as it is contained in the "official history." This list stands as follows:—

- A.M.
 i. 3267 Slainge, son of Dela.
 ii. 3268 Rudraige, son of Dela.

¹ Printed in Skene, *op. cit.*, p. 318. There is another copy of this list in the *Book of Ui Maine*, fo. 15 a 1, line 32. I have collated this, but find no variant readings of importance, except that it calls Elim "Ollamh." I have also collated the Lecan copy, which displays slight orthographical variations from Skene's text: Skene follows Rawl., which I have not had an opportunity of examining. The Lecan version calls Elim "Ailill."

² Inbadach in the *Book of Ui Maine*.

- iii. 3270 Gann and Genann, sons of Dela, in joint rule.
- iv. 3274 Sen-gann, son of Dela.
- v. 3279 Fiachu Cend-findan, son of Starn, son of (ii).
- vi. 3284 Rinnal, son of Genann.
- vii. 3290 Foidbgen, son of (iv).
- viii. 3294 Eochu mac Eirc, son of (vi).

Except Fiachu, the names are all different.¹ But we notice at once that Fiachu occupies the fifth place in each list, and what is yet more suggestive) we are told the same tale about both these kings, that "the cows in their reign were white-headed." This leads to the inference that the two dynasties are essentially one, notwithstanding the incompatibility of the names. Comparison of the meagre genealogical and other particulars confirms us in this opinion. The first four names in each list are bound together by close ties (counting Gann and Genann, for the moment, as one). In the first list we have a father and three sons, in the second four (five) brothers. In each list the kings after the third met their death at the hands of their successors. The penultimate name in each list is that of a descendant of the fourth, and the ultimate that of a descendant of the third. That there are eight names in one list, seven in the other, need not trouble us seriously, for the Pictish list shows the possibility of one of the kings having a multiple personality.

The name Eochu appears in both lists, but in different places. I suggest that there has been a contamination of tradition, and that Slainge occupies the place properly held by Eochu mac Eirc—a name that seems to mean something like "divine horseman," or "horseman son of heaven." And it is not difficult to discover the source of the contamination which has produced this shift of names.

The name Slainge can hardly be dissociated from the river Slainge, anglicized "Slaney." That Slainge was regarded as the leader of the Fir Bóg in their expedition to Ireland is only another way of saying that in some way the god of that river was responsible for their settlement in the country. This would mean that there was at least a tradition that the first settlement had been made at or near the mouth of the river in question, and that the colonists had penetrated up its valley into the interior of the country.

Now the Milesians were said to have been led to the settlement of Ireland by a certain Donn, though his untimely death prevented him from actually enjoying sovereignty in the country. A very ancient way of referring respect-

¹ Though *Rinnal* and *Genann* have sufficient resemblance to suggest that the one may be a corruption of the other, or both corruptions of some third form.

fully to divine or sacred personages is to prefix the possessive pronoun *mo* to their names. Donn, thus referred to, would be called Mo-Donn. When we turn to the *Geography* of Ptolemy, we find that he knew the Slaney under the name *Modonnos*: from which we infer that there was also a Milesian tradition that the god of this river led the invaders.

It is unlikely that both the aborigines and the Celtic invaders should have ascribed their conquests to the same leader. That is to say, one or other version is the original story, the alternative story being imitated from it. On a later page of this paper I hope to set forth some other, quite independent, reasons for believing that it was the Celtic incomers who landed at the Slaney estuary. It follows, then, that the Fir Bolg story is merely a corruption, the Slaney being put at the head of the Fir Bolg list because the same river, under another name, occupies a corresponding position in the Milesian list. Slainge is therefore to be expunged, and it may well be that Eóchu mac Eirc should replace him. This would bring the two lists into yet closer correspondence.

But, even without any such manipulation, the links are strong enough to bind the lists together. Notwithstanding the difference of names, we have before us two different versions of the story of one dynasty. The difference of names, at first sight difficult to account for, is really a very simple matter. Personal names are the most fluid of all folk-lore elements, and one and the same story told throughout a country will be fitted to a John in one shire, to a James in another, and to a Thomas in a third. The story of the dynasty before us was enshrined in a folk-tale. Different narrators in different parts of the country, while preserving the incidents, were troubled with lapses of memory where the names were concerned. The tales were then collected by the investigators (if we may so call them) on whose work the "official history" was based. Unfortunately those dreary people had no interest in anything but the skeleton of history—the names and the dates. They extracted these from the tales before them, not troubling to notice that the different versions of the history were not independent of one another.¹

The suggestion may further be made that the folk-tale was a popular version of a lost epic. Such a composition, being written in the obscure archaic language of the druidic poems, would in its literary form be the exclusive property of the men of learning; only its general contents would be known to the people at large.

¹ It is only fair to add, that they were very probably influenced by their desire to maintain Christian faith and morals unalloyed. It is quite possible that the folk-tale was offensive from this point of view, and that the only "safe" parts of it were the names and dates. The curious details about Slánoll's burial were perhaps in the original story; the other recorded "facts" are clearly etymological adaptations.

There is yet a third list of kings which seems to be based upon the same foundation. This is the dynasty of the Tuatha Dé Danann. It consists of seven entries, to which an eighth is added by way of appendix in *Lebor Gabála*. They run as follows :—

A.M.

- i. 3304 Bres son of Elada.
- ii. 3311 Nuada Airgetlám son of Eochu mac Eirc.
- iii. 3331 Lug Lámfhala fostered by Tailtiu daughter of Eochu mac Eirc.
- iv. 3371 Eochu Oll-athair, surnamed In Dagdae, son of Elada.
- v. 3451 Delbaeth son of Ogma.
- vi. 3460 Fiachu son of (v).
- vii. 3471 Three kings, variously named, in joint rule.
- viii. (did not reign) Manannán mac Lir.

This list begins with a "son of learning," just as the Ulidian list begins with the "sage of Ealla." The connexion of the next two with Eochu mac Eirc is inconsistent with the latter being one of the rival Fir Bolg; we have here a further suggestion of an original form of a tradition in which the "heavenly horseman" stood at the head of a genealogy. Eochu Oll-athair, again, is closely cognate in form and meaning with Eochu Oll-flaith: we can hardly avoid the conclusion that the two names refer to the same personage. *In Dagdae* is not a name, but an appellation, as we gather from its always having the definite article prefixed. *Géi-de*, the name which started us on this line of investigation, is of similar formation, and holds a corresponding place in the Ulidian list. The element *Géi-* occurs again in the name of the *Géi-sons*, an obscure Gaulish tribe mentioned by Caesar. This name is interpreted as meaning "stormy, impetuous"; if this etymology be sound, we must have in *Géi-de Oll-geithach* literally a "Big-voiced Storm-god."

The other links connecting the Tuatha Dé Danann dynasty with the Ulidian dynasty are fewer in number than are those which we have traced between the Ulidian and the Fir Bolg lists: but they are not weaker. Fiachu reappears, though not exactly in the same place, and, apparently, without any legend about white cattle attaching to him. Delbaeth recalls the *Deibhsean* or *Deibhsean* of the first Pictish list—perhaps these two forms are scribal errors for the first.

Fiachu himself had some connexion with Temair. According to VD i it was in the days of Fiachu Cenélmlán that Liath son of Laigne Lethan-

¹ See Holder's *Altceltischer Sprachschatz*, sub voce.

glas cut down the hazel-thicket of Temair; and we may now turn aside to follow up this thread in the tangle.

The name Fiachu occurs several times in the roll of the kings of Ireland. Besides the two of whom we have already heard, we find the following in the more legendary period:—

A.M.

- i. 3728 Fiachu Labruinne father of Oengus Oll-mucach.
- ii. 3848 Fiachu Find-scothach, father of Eochu Ollom Fodla.
- iii. 4395 Fiachu Tolgrach.
- iv. (did not reign) Fiachu Fer-mara, son of Oengus Tuirmech Temrach.
- v. A.D. 56 Fiachu Find-íolach.

Of these, Fiachu Tolgrach seems to be independent of the rest, and need not again be referred to. Fiachu Find-íolach and his successor Elim are evidently borrowed from the Ulidian dynasty as padding, inserted before the doubtless historical king Tuathal Techtmar. *Cóir Anmann*¹ tells the same story of his connexion with white cattle, which is enough to settle his identity with the other kings of the same name. Fiachu Find-scothach, father of Ollom Fodla, is a doublet of Elim Finnachta, son of Ollom Fodla; for the same peculiar story is told of him—that snow (in his case flowers) with the taste of wine appeared in his reign. This is important, as it shows that doublets can reverse their genealogical connexions; that is to say, if we have pairs of doublets, A, A', and B, B', we may find in one story that A is a *son* of B, though in the other story A' may be the *father* of B'. The point of this observation appears when we consider the two remaining names of the list. Fiachu Labrainne is the father of an Oengus; Fiachu Fer-mara is the son of another Oengus, who is called by the suggestive name *Tuirmech Temrach*, which seems to mean “the reckoner” or “the apportioner” of Temair—a fitting name for someone who had to do with the foundation of a sanctuary. We are reminded of the name given in VD iii 123 to the holy well called Caprach Cormaic—*Topur Tuirme Cland*, “the well of numbering of clans”; and we must not forget that this well also bore the name of *Tipra Bó Finde*, “the well of the white cow,” which recalls to our minds the peculiarity of the cows in the reign of Fiachu.

Of Fiachu Fer-mara we are told that he was begotten by his father Oengus on his own daughter, when drunken; and that Oengus was so much ashamed of what he had done that he put the infant adrift on the sea, with a purple royal robe and a gold pin upon him. The child was rescued by fishermen, who gave him the name Fer-mara, “man of the sea,” in com-

¹ *Irish Texts*, iii, 332.

memoration of the event. An almost identical tale is told of Cummíne Fota in the glosses to *Féilire Oengusáil*; showing that (as is so often the case) the explanation offered for the name is not a mere etymological invention, but an adaptation of a fragment of folk-lore previously existing. This is the reason why the "explanations" are almost always so pitifully inadequate! The name Fer-mara is clearly theophorous, meaning "Man of the sea (-god)," just as Fer-Loga means "Man of (the god) Lug."

But how did such a story of a father-and-daughter union come to be told? It is not a solitary case: another instance is the case of Oengus Nic anocht (another Oengus?), son of the Leinster king Cathaéir Mór by his daughter Muchna.² In fact we read several times of such occurrences, always explained by intoxication. This explanation is probably an attempt on the part of a Christian historian with a recollection of the story of Lot and his daughters in his mind,³ to tone down an offensive incident. But the true explanation of this type of tale is very different. In an exogamous society founded on mother-right the father and the daughter belong to separate clans, and marriage between them is not necessarily a thing forbidden. Unless the tribe has evolved the complex organization of the Australian aborigines, in which by a further subdivision of the clans into exogamous phratries and totem-groups such unions are excluded automatically, there is nothing to prevent them. In the original version of this and similar tales the union of father and daughter was most likely treated as a matter of course, to the very natural scandal of their Christian editors. There is no use trying to worry our ingenious expositors of the evidence that marriages in early Britain and Ireland were regulated by laws very different from those now in force. Much ill-illumination has been aroused by Caeser's assertion that the British tribes practised a form of polyandry in which the husbands were father and sons.⁴ Even if it were a *libel*, it might surely be taken with philosophic calm after two thousand years; but it is not a *libel*—it has not apparently been noticed that we have the record of just such a *ménage* in the *Lismore Life of St. Columba*⁵ which introduces us to one Donnán, brother's son of Senán *who had the same mother as Senán*.

The other Oengus son of Froche Ladruinne, is known by the surname *Oll-mucach*, "great quencher"—not an unnatural name to give a warrior. It remains us now a little of the surname *Oll-goibhach* given to Geide. It is

¹ Bradshaw Edition, pp. 242, 243.

² *Tionnna Chathaéir Mhóir in Leathar na gCart*, ed. O'Donovan, pp. 198, 199.

³ Genesis xix. 30-38.

⁴ *De Bello Gallico* V. xiv.

⁵ *Lismore Lives*, ed. Stokes, line 4362.

tempting to treat Oll-mueach as a variation of Oll-gothach, derived from a misreading of a note written in Ogham. As will be found by experiment, the scores by which these two words would be so denoted are almost identical. But the temptation must be suppressed. The names would not be written in Ogham characters *in their modern orthography*, with lenition expressed by means of *h*, except as a *jeu d'esprit*; and this would not happen till after they had both established a separate existence in literature.

The foregoing arguments give us the following equation:—

Géide Oll-gothach = Eochu Oll-athair = In Dagdae = Sen-gann

—and this leads to the further conclusion that the appellation *In Dagdae* is a euphemism, “the good god” instead of “the storm god.” But why, it will be asked, is this Celtic storm-god claimed as the head and founder of the Pictish monarchy? The answer to this question must be, that we have here a variety of syncretism in which the new gods are not *added* to the old pantheon, but are identified with them individually—just such a syncretism as we see existing in literature between the gods of Greece and of Rome, where Iuppiter and Zeus, Minerva and Athene, Diana and Artemis, are treated as identical personalities. The incoming Celts have identified their storm-god with some god or deified man, who was supposed to have founded the kingdom of the aboriginal Picts.

In that case, someone will object, the name of Géide ought to have come *first* in the dynasty which we have isolated. Instead of this it occupies the fourth place. This difficulty arises however we are to interpret the documents; but an explanation is not hard to find. It is this—Géide, or rather the person whose place in the original tradition Géide holds, was the first *human* king in the list. The three names which precede his are the names of gods. If the hypothesis on which we are working is as correct as it seems reasonable—that the dynastic lists before us are extracted from the several versions of a folk-story, which was itself a popular paraphrase of an epic—it follows that the epic narrated a history which began in Olympus, and half way through descended to a newly-fashioned earth. It was, in other words, an epic of cosmogony.

Of this view the Fir Bolg list affords some confirmation. The names of the two personages in joint rule, Gann and Genann, are clearly variants of one another. In fact, they belong to a triplicity of which the third member is their successor Sen-Gann, “Old Gann.” Now, why does not “Old Gann” reign *before* his presumably younger colleagues? Doubtless because he is “old” from a different point of view. He is the “Old Gann” of the earth-dwellers; probably he is conceived of as a sort of heaven-descended *mortal* creator.

exactly like the Unkulunkulu, the "old old one" of the Zulus.¹ Sen-gann is, in short, the last god and the first man of the cosmogonic epic; and it is thus quite natural that he should have become identified with the founder of their human monarchy of Temair, while retaining sufficient divinity to make it possible for him to be a storm-god.

But another objection may now be raised. We have already suggested the equation of Eochu Oll-athair with Eochu Oll-flaith, who holds a different place in the Ulidian dynasty. To Eochu Oll-flaith is ascribed the institution of the *fiéis* of Temair, and therefore the personage so called, who stands *first* (not fourth) in the Ulidian list, must be regarded as the head of the established monarchy. How can this be reconciled with the ascription of the same function to Géide, the fourth in the same list? Only on the hypothesis that Géide and Eochu were originally one, and originally held the fourth place in the list. Some uncomprehending historian, who could not understand the *factes ante Aquimencasat*, has transferred to Ollom Fodla, the divine source of all knowledge and wisdom, the head of the god-kings, the actions which really belong to Géide, or whatever name we call the fourth personage, the connecting link between gods and men, the head of the man-kings. This is the more easy to understand when we see reason afforded us by the Tuatha list to believe that both these personages were called Eochu. The Tuatha list therefore comes nearest to the original form. The Ulidian list, which has divorced the foundation of Temair from the fourth king, represents a corruption, and the Fir Bolg list, which has displaced the divine Eochu in favour of the river-god Slange, under the influence of a different story, shows a further contamination.

This theory, of a popular tale based upon an ancient epic, derives support from an exact parallel which I am able to quote. In the Hebrew Scriptures there is to be found a sublime philosophical poem, based upon a slight thread of incident. I refer to the Book of Job. Whether the author of this poem invented the story, or whether he adapted a folk-tale previously existing, cannot be determined with certainty: the latter is the more probable. But I was able to recover from an illiterate Arab of Southern Palestine a folk-tale, certainly based upon the poem. All the philosophy was, of course, excised, and the tale was told as a child might tell it—with the importation of extraneous elements, derived from the common stock of folk-belief. The relation between the poem and my folk-tale is identical with the relation which I

¹ Or like Adna, son of Bith, "Ancient, son of Cosmos," who, according to a tradition preserved by Keating, was the first visitor to Ireland after the deluge (Keating's History, I.T.S. ed., i, p. 154).

here presume to exist between the epic and the stories on which the "official historians" founded their catalogues of kings.¹ The Ogham inscriptions teach us that even proper names appeared in the epic language in a form quite different from their form in current speech—far greater is the difference, indeed, than that between the way in which Homer pronounced the names of his heroes, and the barbarous way in which English schoolboys are taught to pronounce them, though that is saying much—so that it is not surprising that the popular narrators gradually substituted for these unfamiliar forms names with which they were better acquainted. So, in the story of Job and similar modern Arab versions of Hebrew narratives, all extra-biblical personages introduced are fitted with familiar Arabic names.

We have seen that the Tuatha list comes nearest to the original form. The Ulidian and the Fir Bolg lists are closer to one another (*e.g.* in the relationships alleged to exist between the kings), but farther from the original form. I take it that the Ulidian version is not derived from the Tuatha version, but represents an independent line of tradition, and that the Fir Bolg version is a derivative from the Ulidian; probably developed in south-east Leinster, owing to the prominence given to the deity of the Slaney river.

We can now, I think, make some way towards reconstructing a skeleton of the original epic. The number of names in the lists oscillates between seven and eight. On the whole, the probability is in favour of seven as being the original number. It is the number of Tuatha kings, and it is also the number of Fir Bolg kings when we displace Slainge and restore Eochu mac Eirc to his proper place at the head.

In the Tuatha list the first three kings are well-known gods—Bres, Nuadu, Lug. The fourth is also a god. The other three, Delbaeth, Fiachu, and the triplicity with which the list ends, are not gods—at least, there is nothing about them which we can point to as divine. It is a mistake to suppose that the Tuatha Dé Danann are a pantheon of gods pure and simple; the mere fact that we are told of the gods which they worshipped—Brian, Iuchar, and Iucharba—shows that this easy solution of the Tuatha problem is only partially successful. And the final triplicity of kings are so far human, that almost the only thing that we are told about them is the nature of the gods

¹ A translation of the version which I learnt will be found in the *Quarterly Statement of the Palestine Exploration Fund*, 1908, p. 315. It is instructive to notice that another version of the story, so different as to be an almost independent paraphrase, will be found in the Rev. J. R. Hanauer's *Folk-lore of the Holy Land*, p. 17. This, as illustrating the different versions of the "epic" tale, makes the parallel even more illuminating. In Dr. Walter Leaf's *Homer and History* other parallels will be found, in chapter viii, headed "The Achaian Epos."

which they worshipped—one the hazel, the second the sun, and the third the ploughshare. If this means anything, it implies rather that they were culture-heroes, who taught certain forms of religion to their people. The connexion of Fiachu with cattle is also suggestive of a pastoral culture-hero.

The Fir Bolg and the Tuatha lists both end in a catastrophe called the Battle of Mag Tuired. Our historians, taking these records as literal history about literal persons and places, sought and found a different site for each battle. This is, of course, only late euhemerism, acquiring plausibility from the existence of megalithic monuments on the sites chosen. Or, perhaps preferably, we are to see here a false identification. The epic narrative ended in a tale of disaster. There were current, independently of the epic, stories of great battles in the places called Mag Tuired, suggested by the megalithic remains. The epic disaster became popularly associated with these battles. We do not find any such definite story of catastrophe in the Ulidian narrative though in its Pictish version there is more than a hint of it, in the battles which destroyed the crops in the reign of the last king.

To sum up, an epic in four books is adumbrated:—

BOOK I: *The Story of the Gods.*

i. Divine Wisdom (*Ollom Fodha*, *Mac Elathann*) impersonate in a mighty (*bers*) divine horseman (*Eochu mac Ene*). Perhaps we should rather say a divine horse-man: the deity may have been hippomorphic, or hippanthropomorphic.

ii. Nuadu.

iii. Lug. These are the more ordinary names of the gods, who appear under other names in the other lists. It is noteworthy that although others of the Tuatha Dé Danann were certainly gods (such as Ogma, Dian Cécht etc.) yet they have no place among the "kings." This fact is suggestive, as indicating artificial selection and manipulation.

BOOK II: *The Story of a Creating Demi-god.*

iv. Eochu (a different being from E. mac Ene), a storm deity (*Géid*), but also a "good god" (*Boogda*). He is closely akin to the three preceding, as the genealogies in the Fir Bolg and Ulidian lists show, but on a lower plane. He is killed by his successor in the kingdom—the meaning of this custom, and the special significance of its beginning at this stage in the narrative, will appear in the following section. He descends to earth, and is the "Old Gann" of the earth dwellers; and is a great prince (*Oll-riocht*) and universal Father (*Oll-athair*). We may further suggest that this epic married Tea to the creating demi-god, and that the latter, after his death, became lord among the dead. This would account for Caesar's story that the Gauls reckoned their

descent from Dis Pater¹; it would also bring the Tea story yet further into line with the model of the myth of Kore.

BOOK III: *The Story of the Heroes.*

v, vi, vii. Three heroes, or groups of heroes, who teach the several arts of life and religion to the people. They are variously named, except Fiachu, who appears in all the lists. We may very fairly note the curious coincidence that the Tuatha list ends with three culture heroes, as does the ancient Hebrew tradition, which after the story of Creation gives us a genealogy, culminating in three culture-heroes, Jubal, Jabal, and Tubal.

BOOK IV: *The Story of the Final Catastrophe.*

Possibly a flood-legend: the tale of Cesair is certainly a native flood-legend, synchronized by the historians with the flood of Noah. A reminiscence of a flood-story may have become incorporated with a wholly different saga, that of the fight between the sons of Nemed and the Fomorraig, when the combatants were drowned by the rising tide which, in the heat of battle, they did not perceive. It is also suggested by the frequent legends of lake-bursts. But on the whole it is more probable that the Final Catastrophe took the form of an annihilating war, as in *Volo-spá*. Indeed, that glorious poem is not unlike the epic which we are reconstructing, and may even be based upon it. The Druidic name or equivalent for the Teutonic Ragna-rök, the Doom of the Gods, appears to have been *Erdathe*,² a mysterious word still awaiting explanation.

It is evident that such a symmetrical arrangement as this—three gods, a demi-god, and then three heroes—must be due to conscious literary manipulation on the part of some individual author. Moreover, such an author must have had a mind stored with ideas of religion above the common folklore; no ordinary man would have begun his scheme of creation with the abstract conception of Divine Wisdom, even though he impersonated it in the crude form of a horse-god. This might be taken as an objection to the theory here set forward; but it need not necessarily be so. We are only beginning to realize how much movement there was between peoples and tribes even so far back as the European Bronze Age. I see no extravagance in imagining a medicine-man of Central Europe fired with a longing for wisdom, and seeking it even so far away as the Vedic schools of India. Such a man, returning to his own people, and trying to systematize their crude beliefs on the basis of

¹ *De Bello Gallico*, vi, xviii. 1. If those are correct who would see the Gaulish Dis Pater in Cernunnos, the presence of Cernunnos shrines on the hill of Tea would become yet more suggestive.

² Tirechán, in *Vit. Trip. Pat.*, vol. ii, p. 308.

the modicum of philosophy which he has thus acquired, would produce a literary composition not unlike that outlined above.¹

But we have not yet finished with these lists and their syncretisms. One of the commonest ways of identifying gods together is by affiliation, making the one the son of the other. To In Dagdae was affiliated in this way one of the greatest of the gods of Pagan Ireland, Oengus in Broga.

Constant tradition associated Oengus in Broga with the colossal monument now called New Grange, the chief sepulchre of the Boyne valley. And there is every reason to suppose that tradition is here correct. The very existence of the mound proves the historicity of the owner, just as absolutely as any of the Egyptian pyramids would prove the existence of the king who built it, even if no other record of him survived. The tomb must have been a sanctuary almost from the first and the dedication of Oengus established and fixed his name in tradition, just as the names of river-gods have been fixed in tradition. We find Oengus worshipped in Ireland down to the seventh century A.D., in *Irish Genealogies Leachdan* we read that the jester² of king Cináel put his horse under the protection of Oengus while his Christian master put his horse under the protection of St. Colmán, with the natural result that the heathen's horse was stolen, while the king's remained safe—another of the stories used as ammunition in the war of creeds.

Now there is another tradition as to the parentage of Oengus which has never been explained, ascribed in his full name *Oengus mac an Óc*, "Oengus son of the Two Youths." A first clue as to the meaning of this name is afforded us by the *For Buid* list. The name there corresponding to In Dagdae (= Oengus) is *Seingann*, "Old Gann"; this name is immediately preceded by two other names, denominated slightly as *Gann* and *Genann*, who may be tentatively described as the two "Young Ganns," by contrast.³

But we may pursue this road still further, and find at the end a striking confirmation of the views put forward in the foregoing pages, as well as a welcome glimpse into the early traditions on which the epic was based.

In Dr. Rendel Harris's suggestive series of volumes on the Dioscuri especially

¹ Since writing the above words I have re-read, for a different purpose, M. Salomon-Rennel's famous essay *Le druidisme celtique*. Under its influence I am inclined to wonder whether it is necessary to send an epic writer to India (whether, indeed, the inspiration did so travel by a contrary direction). But into the mazes of speculation which such a question would open up I dare not venture, and I allow the text to stand as originally written.

² Todd Lectures edition, p. 87.

³ Doubtless meaning *foetal*: the Christian historians were not above taking advantage of the similarity between the words *druth* and *druí*.

⁴ In passing we may note a tradition that made Gann and Genann two Fomorian leaders: see Keating's *History* (ed. I.T.S. i, p. 178).

in that entitled *Boanerges*, it is established that in primitive Aryan belief, and also in other primitive systems of belief that in our present knowledge we must consider remote from Aryan, thunder is regarded as being produced by a bird, which is usually the woodpecker. This thunder-bird in time becomes a thunder-god, the ornithomorph developing with advancing civilization into an anthropomorph—though the bird is not often wholly forgotten. The thunder-god becomes the parent of one or both of a pair of twins—Castor and Pollux is the best known of a long series of such pairs, of which Dr. Harris has collected the particulars. These twins are habitually clothed in red, or by some other association with the colour red betray the secret of their fiery origin. Dr. Harris has been able to bring forward quite a striking number of examples of this sequence.

The Fir Bolg list gives us a new example of the same sequence, *in the reverse order*. It is one more indication that Slainge is to be treated as an interpolation, that the sequence begins with and explains the otherwise obscure name Rudraige, where we see a recollection of the *red* of the twins' robes (ruad = "red"). Next come the twins themselves, Gann and Genann, with assonantal names, as is usual. Then comes the parent of the twins, Sen-gann, whom we have on quite independent grounds already identified with the thunder-god. We next come to Fiachu. It is impossible that the name Fiachu (< *veikos, should represent *Picus* directly, nor does Fiachu mean "woodpecker." In fact, I can find no Celtic word for the woodpecker cognate with *picus*. But *fiach* means "raven"; and this suggests that the myth embodying the {woodpecker—thunder-god—twins—red colour} sequence is not Celtic tradition, of native growth, but imported from without; and that for the unfamiliar name of the woodpecker the name of another bird resembling it in sound has been substituted, in the course of the transference.

Be that as it may, we have the thunder-god associated with a raven on the well-known Sarrebourg altar.¹ This monument represents a god with his attendant goddess, called respectively, in the associated inscription, Sucellos and Nantosvelta. Beneath their figures is the bas-relief of a raven. That Sucellos is a thunder-god is indicated by the great mallet which he is carrying.²

¹ See Reinach, *Cultes, Mythes, et Religions*, i, p. 217 ff.

² The well-known and curious passage in Pseudo-Plutarch (which M. Reinach duly quotes), informing us that "*Lougos* is the Celtic for a raven," is probably an ignorant confusion between (a) the sun-god, (b) the thunder-god, and (c) the ornithomorphic representation of the latter. It is no more worthy of credence than the stories which well-meaning but ill-informed journalists have recently been setting before us, regarding the significance attached by the Syrians to the name of General Allenby. The worst Arabic ever written has appeared in some of these ingenuous concoctions.

The reversal of the sequence in the story before us cannot be explained except on the theory of literary craftsmanship. Once more we trace the hand of the unknown Celtic Hesiod, who wove his *Theogonia* out of previously existing materials. For the connexion of the woodpecker with pastoral pursuits (as Fiachu is associated with cattle) it will suffice to refer the reader to the numerous examples collected by Dr. Harris, especially in his thirty-seventh chapter. Perhaps it is too much to see in a following king, Foidbgen, said to have derived his name from the fact that "knots" (*fuilb*) first appeared in trees in his time, for before his time the trees were smooth, a reminiscence of the more ordinary activities of the woodpecker.

Reversals of like nature are not unknown in the literary manipulation of folk-lore. For, as Dr. Harris has shown, in many of the cases where Ovid in his *Metamorphoses* speaks of a man or woman having been transformed into a tree, or a bird, or what-not he is re-telling a savage legend in which a phyllo-morph or a thermo-morph has been turned into an anthropomorph; that is, he is reversing the actual sequence of events in the original tale. In consequence of this reversal, it follows that Oengus, or, rather, the being to whom Oengus was equated, was not originally *son* of the two youths, but *father* of the two youths; and he thus falls into line with other storm-gods as the parent of Dioscuri.

Oengus himself, we may feel confident, was primarily a historical character. He appears under several disguises in the roll of kings. *Oll-macoll*, "great pencil," is a good name for the despot who caused the huge monument on the Boyne to be built in his honour. *Tairneach Temrach* is another of his avatars. This name the "official historians" explain by one of their usual fables; but it would be quite suitable for the personage who established the sanctuary on the ridge on which there is a sacred well bearing a similar name.

We now gather together the threads which we have endeavoured to disentangle, and set before the reader an attempt to trace the chronological development of the myth.

The raw materials were as follows:—

AMONG THE PRE-CELTS

(In Ireland)

1. The sanctuary of Temair.
2. The tradition of Oengus or Egan, great a great warrior, who had established the sanctuary, and who was

AMONG THE CELTS

(On the Continent)

1. The woodpecker myth.
2. The story of Scota and Tea (a version of the Demeter and Kore formula).

buried (and worshipped) at New Grange. N.B.—The traditions regarding Oengus were coloured by the matriarchal organization of pre-Celtic society.

3. Certain gods, including Etherún, and a triplicity or quaternity among which was Feron.

3. Certain gods.

4. Certain cosmogonic myths.

The steps in the development were as follows:—

1. An epic was composed, at some unknown time before the arrival of the Celts in Ireland, based upon the Celtic material set forth above.

2. This epic was taught as a text-book in the druidic schools, and garbled paraphrases of it became current in the form of folk-stories.

3. The Celts landed in Ireland about 400 B.C.—at the beginning of the Iron Age in the country—at the mouth of the Slaney, and adopted the god of that river as their leader in the invasion. It is likely that the prime purpose of the invasion was to acquire a mastery of the Wicklow gold-fields, so that it was natural that the invasion should attack the country at the south-east, where a large river offered a water-way through that part of the island.

4. They asserted a claim to the country by affiliating or otherwise identifying their gods with the gods of the aborigines. The chief identifications were that of the demi-god of their epic with the pre-Celtic Ungust or Oengus; and the affiliation of Scota to Feron.¹

5. The story of the abduction of Tephí (originally of Tea) was afterwards adapted as a reason for their coming to the country. This story is told in two versions—either as an abduction, as we find it in VD, or as the murder of Ith, that is of “corn.” There is not a very serious difference between the abduction of the corn-spirit and the murder of corn, so that the two stories may well have been more similar to one another than might have been expected at first sight. As we have not got the full tale of the abduction of Tea, it is impossible to compare them.

6. After the establishment (i) of the suzerainty of Temair over most of Ireland and (ii) of Christianity, the native scholars turned their attention to the collecting and systematizing of the historical traditions current in the country. Having fixed a framework of chronology on the basis of Scriptural

¹ In Leaf's *Homer and History*, chap. vii, a remarkable parallel to this process of affiliation is described: the absorption of the Pelasgian corn-spirits and similar beings by the pantheon of the intruding Achæans.

and Classical synchronisms, they fitted their materials thereto artificially. These materials were threefold, namely,

- A. Folk-lore collected from oral tradition,
- B. Folk-lore written down at an earlier time,
- C. Historical record written down at an earlier time,

—the earlier writings being in the obscure archaic language mentioned on a previous page, which the historians probably knew very imperfectly. Of class A we have a good example in the dynasty-record that we have in this chapter been analysing; the last relic of the ancient cosmogonic epic. Of class B we have an illustration in such romances as *Táin Bó Cuailnge*, which in their present literary form preserve the record of modes of life older than the time when they were written down. Of the presentation of early *historical* record, class C, I can give no better example than the list of chieftains of the district now known as the Deeps of Waterford, whose historicity is attested by their Ogham-written monuments, but who are woven into the roll of the kings of Temair.¹ The historians believed that Temair had always held the central place that it enjoyed in Irish politics in their own time, and they framed their history in this belief; thus they supposed that the numerous names of kings which they found in their authorities, were all High Kings of Ireland. In point of fact, some of them were gods, others mere creations of folk-lore, others actual human chieftains who had reigned in one part or another in Ireland. Many of them were duplicates derived from different authorities, but really referring to the same historical or legendary character. The theory of the central position of Temair was pushed back into the pre-Celtic period, so that pre-Celtic rulers of Temair had become rulers of Ireland. Thus Ungust, originally the local hero of the Boyne valley, equated to the storm-god Gáide, and in his time "humanized" into a hero, became the founder of the whole Pictish monarchy.²

It is worth the almost casual mention of the obscure Gáide of the Great Waste as founder of Temair, which has led us by these devious ways to the conclusion that the traditional founder of Temair, and the personage in whose honour the great mound of New Grange was erected, were one and the same.

¹ I called attention to the remarkable correspondences between these Ogham records and the genealogy of Temair kings in 1908 (Proc. Roy. Soc. of Ant. of Ireland, xxxviii, 1). The paper referred to contains a number of mistakes, now obvious to no one more than myself; but the identity of these correspondences still holds in most, though not in all, of the cases brought forward.

² He appears to have been known later in the list of Pictish kings; for "Grest Curite," (Proc. Roy. Soc., p. 100), is obviously merely a corruption of "Ungust of the Brug" or palace.

It was suggested on a previous page that the name *Scota* had possibly been modified artificially in the interests of the etymology of the ethnic name *Scuit*. We may for a moment return to this subject. With all reserve I suggest that the name of the ancestress was originally *Scáthach*, and that she is none other than the amazon instructress of *Cu-Chulaind*. The following analogies seem to be worth pointing out:—

Scáthach is called "*Scáthach Buanann* daughter of *Ardgéimm* king of *Scythia*" in a passage which will be found printed in *Ériu* iv 30.¹ Now *Buanann*, according to an entry in *Cormac's Glossary*, was an important mother-goddess; *Ana*, he says, was mother of the gods, and *Buanann* of the heroes. This just fits in with what *Scota* is said to have been—the eponym of the Scotie tribes. Again, *daughter of Ard-géimm* and *wife of Oll-gothach* are closely analogous expressions. (It will be remembered that we have indicated some reason for thinking that *Tea* and *Tephi* have been confused and interchanged in the corrupt version of their story, which is all that we have of it.) And finally *king of Scythia* and *Pharaoh king of Egypt* are not far removed from one another in Irish tradition. In another passage we have a different version of *Scáthach's* parentage.² She is there called *ingen Búanuinne, ríy na Scithia*, "daughter of *Buanainn* king of *Scythia*." Now we remember that *Scota* was daughter of *Forann*; that *Forann* seems to be an adaptation of *Feronn*; and that in another list *Ainnind* occupies the place of *Feronn*. *Ainnind* looks like a corruption of [*Bu*]anainn.

The syncretistic affiliation of the incoming mother-goddess to an aboriginal Pictish deity would almost inevitably result in the home of the goddess becoming localized in Pictland. This is what we find in the case of *Scáthach*; she is always conceived of as living in the North. There seems to be a reminiscence of the same order of ideas, and also of the "epic" dynasty, in the personage called *Senoll mac Ongai*, to whom *Brian*, the brother of *Niall* of the Nine Hostages, was sent in the north of *Alba*, to learn the art of war:

4.—THE KINGSHIP OF TEMAIR.

We have already seen that, previously to the conquests of *Cormac mac Airt*, *Temair* was of much greater importance as a religious sanctuary than as a political centre; and we must now consider the religious rites of which the Ridge was the scene. The first question which meets us will be the nature of the kingship of *Temair*.

¹ I am indebted to Dr. Bergin for directing my attention to this passage, but he has no responsibility for the use that I am making of it.

² *Revue celtique*, xxix, 114.

³ *Revue celtique*, xxiv, 177.

The king of Temair was a god incarnate on earth. 'This is the all-important fact which results from the study of the traditions of the early kingship that have come down to us, confused and misunderstood though these certainly are by the ancient historians who have recorded them. When a good king was on the throne, the gods condescended to take up their abode within him; when the king was illegitimate, they withdrew themselves. In the former case the crops were plentiful; in the latter case there was misery and famine. Contrast these two characterizations, from *Lebor Gabála*—

Good was that king Eochu mac Eirc; there was no rain in his time, but only dew; there was no year without its harvest, falsehood was expelled from Ireland in his time.

In evil case was Ireland in the time of that Coirpre, for the earth did not yield her fruit, because there was but one grain in the ear, one acorn on the oak, one nut on the hazel; the creeks were unproductive, the cattle were dry, so that there was an intolerable famine throughout Ireland for the five years in which Coirpre was king.

We have seen in the last section that Eochu mac Eirc was the great impersonation of Divine Wisdom, at the head of the "epic" pantheon; and though the historians have made him into a king, he retains sufficient godhead to secure the blessings named for his people. Coirpre, on the other hand, surnamed Cenn-Chait, was the leader of the revolt of the serfs, that is, of the enslaved aborigines. He was alien in race, religion,¹ and probably in speech, from the ruling classes. Naturally the gods would not condescend to take up their abode in a creature so despicable, and naturally the country suffered from their absence. The same idea appears elsewhere in Celtdom. Livy has a reference to it in his priceless abstract of the saga of king Ambigatus.² As Dr. Baulís points out, this idea is also at the basis of the prohibition of the rule of a blemished king.³ Evidently a chief function of the king was to offer his body as a receptacle for the divinity whose presence secured the boon of plentiful harvests; and the body must be worthy of its divine

¹ *Cler. General*, a tract which tries to do for biography what *Dindsenchas Éirenn* does for geography, accounts for Coirpre's nickname "cat-head" in a singular way. It says, *fóthall réidhí pécáda*, "his god had the shape of a cat." Obviously this does not explain why a person should be called "cat-headed." We must therefore see once more an adaptation to etymological needs of a sentence already in existence. It is not difficult to see in it a contemptuous reference to some form of animal worship among the aborigines, an early manifestation of *idolium theologian*, this time between the creeds of rival pagan races in the country.

² Livy, v. 34.

³ This rule was not universal. From the story of Arthur we learn that the Cornician king Guare had but one eye, which did not interfere with his reigning.

occupant. A Christianized version of the divinity of the king appears in the story of the Battle of Mag Mucrimne,¹ in which angels hovered over the head of king Art in the battle, "because he was a true prince."

It is extremely important to notice indications that, in the case of the king of Temair, the *marriage* of the king was essential to secure the boon which he was supposed to bring his people. This is probably the reason why the nobles of Ériu refused to countenance the unwedded king Eochu Airem and boycotted his assembly;² and in the story edited by Mr. Best, under the title of *The Adventures of Art son of Conn*,³ the men of Ireland enjoy three harvests of corn annually so long as Conn is wedded to his fitting spouse Eithne Taebfota; but when she dies and he marries in her stead the disreputable Bécuma, there "is neither corn nor milk in Ireland." The exercise by the king of his marital functions acts sympathetically on the fertility of the land and of the cattle. It is to be noted in passing that when Eithne died she was buried in Tailltiu; was this the normal cemetery of the *queens* of Ireland? If so, the fact is of some importance.

The point is, that Bécuma had been banished from among the Tuatha Dé Danann for her misdeeds. She was therefore not any more acceptable to the gods than was the foreigner Coirpre Cat-head. Probably we are to understand that the feminine principle of fertility refused to acknowledge her, as the masculine principle refused to acknowledge Coirpre. To avert the curse that had in consequence fallen upon the land, it had to be re-quickened *with the blood of the son of a sinless couple*. How such a youth was found, how he was condemned to be slain and was redeemed with the blood of a cow, and how Bécuma was finally expelled from Temair, will be found in the original story, which is one of the most valuable, from the point of view of folk-lore, that we possess. Just as an elaborate ritual had to be gone through, as we shall see in a moment, in order to restore the continuity of the kingship when it had been broken by what we should call the *natural* death of the king, so the blood of a youth of miraculous birth had to be shed on the ground outraged by the king's marriage with a person forbidden.

In Christian times the saints appear to have entered on the heritage of the kings as earnesters for the goodness of the crops. Thus St. Patrick, prophesying of St. Senán, promises this boon so long as the people shall be obedient to the saint.⁴ We might explain this as a reminiscence of some

¹ *Revue celtique*, xiii, 456.

² *Irische Texte*, i, 118. It is evidently wrong to explain this, with Nutt, as a fear of the excessive use of the *droit du seigneur* (*Voyage of Bran*, ii, 51). The marriage of the king would not necessarily interfere with such a practice, which in any case is mythical: see the discussion in Frazer, *Folk-lore in the Old Testament*, vol. i, p. 485 ff.

³ *Ériu*, iii, 149.

⁴ *Lismore Life of St. Senan*, ed. Stokes, line 1855

thing that had been said of the fertilizing river-god, if we had not something analogous in the life of St. Finian. We there read that a barren patch of land was made fruitful by sprinkling it with water in which a eulogy of the saint had been steeped.¹

The divine king has been studied fully by Sir James Frazer in his monumental work *The Golden Bough*. This study is based on the remarkable institution of the *Rex Nemorensis*, the priest-king of the sacred grove of Aricia at Nemi. It is not for nothing that *Rex Temorensis* differs by a single letter only from *Rex Nemorensis*: for the analogies which the two kingships present are so remarkable that it is impossible to escape from the conclusion that they belong to the same order of ideas, if indeed they are not more closely connected still.

The candidate for the priesthood of the grove at Aricia challenged the existing incumbent to single combat by the rite of breaking the "Golden Bough," and if in the combat he succeeded in killing the priest, he *ipso facto* succeeded to the office. Sir James Frazer has convincingly shown that this strange practice was based on the desire to have the strongest man available. One who from weakness or want of vigilance permitted himself to be killed was clearly unsuitable for the responsible office of royal deity.

It is perfectly obvious from the history, as it is enshrined in the works of the "official historians," that the king of Temair, like the king of the grove at Aricia, reigned by virtue of having slain his predecessor. This point, which Dr. Bantán seems to have missed, is one of the most important arguments in favour of the thesis which both he and I sustain.

Omitting the kings of the Fir Bolg and of the Tuatha Dé Danann, I find 110 kings enumerated in *Ériu* as having reigned from Eremón down to Óenán Cú-áthach, the grandfather of Cormac mac Áirt. Of these, 89 are said to have been killed by their successors. As we have already seen, the "official historians" explained this as a blood-feud going back to the time when Eremón, the first king, killed his brother Éber at the battle of Geashill. But this explanation will not serve at all. The whole scheme of relationships on which it is based is utterly irreconcilable with the data. Any group of the kings will show this; the following series, selected at random, will serve as an illustration.—

Finn	reigned 22 years and was killed by Setna.
Setna	" 20 " " " Siomón Brecc.
Siomón	" 6 " " " Dui son of Setna.

¹ Lismore Lives, ed. Stokes, 2675.

² Surely no one will be so prosaic as to take this remark for anything but a *jeu d'esprit*!

Dui	reigned 10 years and was killed by Muiredach son of Siomón.
Muiredach	„ 1 year „ „ Enna son of Dui.
Enna	„ 12 years and died of plague.
Lugaid	„ 9 „ and was killed by Sírlám son of Finn.

—which means that fifty-eight years intervened between the death of Finn and the succession of his son Sírlámh. Improbabilities of this kind are too frequent in the list of kings to make it possible to accept it literally. On the other hand, it is not a mere paradox to say that the fact that such obvious improbabilities exist is the best possible argument in favour of the view that there is a genuine tradition underlying the list of kings. Mere forgers would not have filled their work with so many difficulties. But in the light of the wealth of illustrative examples which Sir James Frazer has collected from all over the world, we must see in this organized slaying of the king by his successor something other than a blood-feud extending through a large number of generations, and involving relationships spread over impossible lapses of time. Doubtless the “official historians” were puzzled by the regularity with which each king met his death at the hands of his successor, and felt obliged to explain it. Not knowing of the system of the Arician priesthood, they had to cast about elsewhere; and they found a blood-feud as the easiest way of accounting for the perplexing fact. The genealogies were manipulated accordingly, the *slayer of a slayer* being assumed to be a relative of the first victim; but the result only makes obvious the impossibility of the “blood-feud” theory.

If in the light of this we look back at what I have called the “epic” dynasty, we find an unexpected corroboration of these conclusions. For the practice of predecessor-killing does not begin till the fourth name in the Ultonian and the Fir Bolg lists; the Tuatha Dé Danann version is not so clear, but does not contradict the observation. That is, the kings do not kill their predecessors until they cease to be gods by nature and become men.

There does not appear to be anywhere extant an indication of the process whereby a candidate for royalty challenged the reigning king. At Aricia the candidate for the priesthood broke what was called the Golden Bough, which Sir James Frazer has tried to prove was the mistletoe. This may be so; and the description of the cutting of the mistletoe contained in an oft-quoted passage of Pliny may not inconceivably be in some way connected with the election of a new chieftain—Pliny has no information to give us as to the occasion on which, and the purpose for which, the remarkable rite which he described was performed.¹ The prohibition against bringing arms into

¹ Pliny, *Nat. Hist.*, xvi, 95.

Temair after sunset¹ was perhaps designed for the protection of the king against a surreptitious attack.

In the short list of kings quoted above it will be seen that one of them, Enna by name, died of plague. It is almost an invariable rule that when the kings do not die at the hands of their successors, there is something unexpected or sudden about the manner of their departure from life—battle, lightning, plague; in the case of Slánoll, already mentioned, “an unknown disease, whereby he was found dead in Temair”; nearly always some exceptional accident is invoked to explain why he died without the assistance of an ambitious rival. Such an event as the *natural* death of the king was probably regarded as a direct interposition on the part of some god. This is actually so expressed in the case of king Eterscéle. From *Toigtil Buidae Dá Derga* we learn that he died naturally;² the “official historians” tell us that he was killed by his successor Nuadu Necht. But Nuadu Necht is only a manifestation of the great god Nuadu;³ the king was therefore killed by the god.

When such an event took place, it became necessary to restore the succession. From Antiqua we have, apparently, no answer to the question of what happened if the Rex Nemorensis should happen to die a natural death.⁴ Probably the case never arose, in a city full of slaves such as Rome was, there would always be someone who would prefer even the anxious life of the King of the Grove, to the hopeless toil of servitude; for the Rex Nemorensis was always an escaped slave. But in Ireland the untoward event sometimes took place. I explain certain remarkable rites of which we have a record as being the means whereby in such a case the succession was restored.

Someone, presumably a druid, glutted himself with the flesh and broth of a white (sacred) bull, and then went to sleep, while four druids chanted over his body an *antrú*, or “spell of taint.” The appointed king would appear to the sleeper amid the nightmares induced by his overloaded stomach. Doubtless it was understood that he had made himself one with the bull-divinity by eating as much of its flesh as was physically possible, and that in his dreams he was thinking the thoughts of the god. For inspiration by mutilation we may compare the curious anecdote of the lazy pupil of

¹ *Lebor Aicle*, in *Ancient Laws of Ireland*, iii, 82.

² *Revue celtique*, xxii, 22.

³ See Rhys, *Hibbert Lectures*, pp. 122-124, where this is clearly shown.

⁴ Sir James Frazer has kindly confirmed this in a private letter to me.

⁵ See *Serglige Con-Chulainn* in *Irische Texte*, i, 213; *Revue celtique*, xxii, 22; and also in Frazer, *The Moon*, Art. i, 381-383. For many analogies to this custom of eating a bull by divination, see Mr. Hartland's essay, *The Voice of the Stone of Destiny* (*Folk-lore*, xiv, 28-60).

Mael-Ruain of Tallaght, who was inspired with knowledge of his unlearned lesson by sleeping on the knee of Oengus, the author of the *Féilire*.¹ It is tempting to ask whether a story originally told of the deified hero, Oengus of the Brug, may not have been transferred to his saintly namesake, with such modifications as were necessary to adapt it to a monastic background: all the more so as we are told immediately before that Oengus was so diligent in his labours in the monastic corn-store that "the corn-blades grew through his hair." This looks like an idea suggested by some picture of the Corn-spirit.

To return, however, from these speculations to the subject before us, we learn next that the king, thus selected, had to pass through certain rites, which are enumerated in a tract called *De Shll Chonairi Móir*.² It is not strictly correct to call these rites "ordeals," which would imply that they were primarily means of *selection*. If the new king failed to fulfil all the conditions of the rites, he would naturally be rejected, and as they are described in the text before us this would appear to be their main purpose. But it is evident that the primary intention of the rites was *initiation*. The king, having been already chosen by the incubation process just described, was now to be inducted to office. The ceremonies of initiation were four in number, and as described in the text quoted were as follows:—

(1). The candidate mounted on a chariot, which tilted under him if he were not legitimate, and the horses, which were new to harness, sprang at him.

(2). The candidate put on a mantle, which would be too big for him if he were rejected.

(3). The candidate drove in the chariot to the stones Blocc and Bluiene (Móel is not mentioned in the text): these opened out wide enough to let him through if he were accepted, but closed before him if he were rejected.

(4). The candidate, having passed these tests successfully, was led up to Fál, which uttered a shriek against the chariot-wheel if he were accepted, and was silent if he were rejected.

But surely all this impossible magic belongs to the region of fairy-tales! Who ever heard in real life of screaming and moving stones, of knowledgeable horses, of elastic mantles? A very reasonable criticism this, on the list of rites as they are set forth in the text before us. But the difficulty lies, not in the rites, which are simple and commonplace enough in themselves, but in the fact that the author who has transmitted the record of them to us was completely in the dark as to what they meant. If we are more fortunate than he was, the reason is because we have a large body of records of savage life and ceremonies at our disposal. In the corroborates of the aborigines of Australia, a country unknown to the ancient writer, lies the clue to the

¹ *Féilire Oengusso*, Bradshaw ed., p. 12.

² Edited by Mr. Lucius Gwynn in *Ériu*, vi, 130.

comprehension of the rites which he describes. Let us consider these initiatory rites in order, and see what we can make of them in the light of modern anthropological knowledge.

The horse-test cannot be dissociated from the most interesting account of the inauguration of the chieftains of Cenél Conaill described by Giraldus Cambrensis,¹ to the righteous indignation of Keating and other worthy souls. Peace be with them—it was simply impossible for Giraldus, with the limited knowledge of his time, to invent “so charmingly complete an account of a savage totemistic initiatory rite. A white mare was led to the place of inauguration: the candidate entered on all-fours—in fact, he pretended to be a horse, as the kangaroo and emu and witchetty-grub totem-groups of Australia pretend on occasion to be kangaroos, and so forth, in action as in name. The mare was then killed, and the chieftain elect bathed in its broth, while he and his people partook of a solemn feast of its flesh. Nothing could more clearly show that Cenél Conaill was a tribe with a horse-totem, and that the chieftain of the tribe was, on his initiation, admitted, as we may express it, to “horse-ship.” We need not perhaps infer that the rite was practised in its pristine perfection at the late date at which Giraldus wrote, even though he reports it as contemporary. But if not, he must have had access to some authoritative literary description of the custom, descended from the time at which it was in use. That it should have been an invention is a sheer impossibility.

So, at Temair, the king began with some kind of encounter with horses. But what was the nature of this encounter? The description which we possess has been worn down to the lowest possible terms: all that we are told is that if (for reasons unstated and to us obscure) the candidate was not “to be king of Temair, the horses would spring at him” (*condugetis ind hich fris*).

Certain analogies presented by primitive Greek rites suggest that in the original form of the ceremony it was rather the king who sprang at the horses. M. Saluzary Belouch, in his paper on Hippolytus,² has argued persuasively that the legend of the virtuous youth torn in pieces by his horses has arisen out of a savage rite in which it was the horses that were torn in

¹ *Topographia Hiberniae*, iii, 25.

² That delightfully naive person, Lynch, the author of *Cambrensis Eversus*, after expending much in denunciation of the shamelessness of Giraldus for reporting this ritual, goes his whole length away by adding *condugetis tam foeda, alibi tulerit indultione dicitur, quae quibusdam gentibus, et tunc quibusdam, et tunc quibusdam, et tunc quibusdam* and then giving two examples of parallel rites which admitted the best possible continuation of Giraldus available in the literature at his disposal. Could he have tried to read some modern compilations of savage practices, it is to be feared that he would have had to strike out the words *nullibi tam foeda!*

³ *Hippolyte in Cultes, Mythes, et Religions*, iii, 54.

pieces; and that, like Dionysos, Zagreus, Adonis, Pentheus, Orpheus, Actaeon, the tale told about his being thus dismembered had its origin in a custom wherein a totem animal suffered the treatment (*σπαραγμός*) and was devoured whole (*ὠμοφαγία*). Just such a rite is clearly to be seen in Giraldus's account of the Cenél Conaill ceremonies. The purpose of the rite is to quicken the life of the clan by feeding on the totem animal: that the chief *par excellence* was to be steeped (literally as well as metaphorically) in the being of the totem is indicated by the custom which required him to immerse himself in the animal's broth and to drink of it without the intervention of any vessel, even his hand. If anything was wanting to confirm the substantial accuracy of Giraldus's account, it is this important detail. Just as in Greek legend the horse torn in pieces became the chaste youth Hippolytus, slain by his chariot-horses, so in Irish legend the horse torn in pieces became the unsuccessful candidate for monarchy, "at whom the horses would spring." The totem animal rejected the illegitimate aspirant. But it may perhaps be, that the report of the rite in the text before us is due to a confusion with another rite, probably (though not certainly) independent of inauguration ceremonies such as we are discussing. We must not omit to compare the Thracian rite of sacrificing men to secure fertility for the land, the victims being put to death by being trampled by horses.¹ Possibly a sacrifice of this kind took place on the occasion of the inauguration of a monarch of Temair, and the author who reported the ceremony mixed the victim with the king. The king, having been chosen for office by the solemn incubation, would hardly himself be the victim.

The successful candidate, probably by devouring the flesh of the horse, passed into a state of "horse-ship": and it is not for nothing that so many kings of Temair, in the official history, bore the name *Eochu*, a derivative from *ech*, "a horse." Eochu Oll-athair and Eochu Oll-flaith, who, as we have seen, are avatars of the founder of the monarchy, bore the name; we may perhaps conjecture that all the kings, as a matter of course, originally were called Eochu, as a sign of their partaking of the divine horse. Eremón himself appears later in the roll of kings as Eochu Airem.

Here again we have a most remarkable parallel between the worship of the Arician grove and that of Temair. For one of the divinities enshrined at Nemi was the ancient Italian god Virbius; and a legend had it that this Virbius was no other than the young Greek hero Hippolytus.² We may refer the reader to Frazer's discussion of this equation and its probable basis; but

¹ See Cook's *Zeus*, vol. i, p. 75, and references in foot-note 7 on the same page.

² Frazer, *The Magic Art*, i, 19.

we cannot pass over the coincidence of a horse deity at Aricia and a totemistic horse-ritual at Temair.

There is another explanation of the chariot-rite possible. Mr. Cook has referred me to his valuable articles in the *Classical Review*, vols. xvii, xviii, in the course of which he brings evidence to show that the chariot-races at the Olympic games and at similar celebrations were originally intended as tests for the selection of a god-king. It might therefore be suggested that at Temair there was also a chariot-race, whereby the king was selected; or, preferably, that the king, already selected by the incubation, was required to prove his ability to control wild horses (sun-horses?). In the concluding section we shall see how the rites of Temair are linked to other rites recorded from elsewhere in Europe; and the analogies which the passages brought forward by Mr. Cook present must be accorded their full weight. We must also not forget the remarkable horse-racing, feasting, sacrificial, and military scenes represented on the well-known series of early iron age Venetian *sitular*, which have every appearance of referring to similar celebrations. But the Cenél Conaill rite blocks the way to a complete acceptance of this alternative explanation. We here plumb a yet deeper stratum of primitive custom; and, perhaps, we see enacted before us the ceremonies which later developed into the Olympic horse-race—just as the gracious figure of Hippolytus may have developed out of a savage who tore a horse to pieces and devoured it raw and half alive!

The second rite, that of the magic mantle can best be understood in the light of the third, which we accordingly shall consider first of the two.

The third rite was that of the stones Blocc and Bluicne. It will be remembered that these were two of three stones set over certain druids of the same names. Now there is a very remarkable expression used about these stones in PD 21, to which we have not yet referred. We there read of them *teara clocha ar éirthe foisna druidh*, "the three stones that were placed upon the druids." In the descriptions of other standing stones, such are called the *leacht* or gravestone of So-and-so; but this expression is not used here. VD iii 75, 76 uses an equally curious expression; *forra atáil na trí clocha dastarláir Máil mór-Macha*, "on them (i.e. on the three druids) are the three stones which Máil of great Macha flung." These passages point to some deed of violence; we may perhaps be not far wrong if we infer that Móel and his fellows were buried alive under the stones.¹ This is confirmed by what

¹ Like the hostages of Fíachta, *Revue celtique*, xxiv, 184. Compare also the sentence passed upon the daughter of the Ulster king in *Togáil Bruidne Dá Derga*, *ibid.*, xxii, 18, 19. Mr. Cook suggests to me a comparison with the myth of the invulnerable

follows in PD: *hit é a anmáid .i. Móel*, etc.: "these are their names (i.e. the names of the stones), Móel," etc. The personalities of the druids had passed into the stones erected over them; in fact, these stones *are* the druids, and as such they help to initiate the rightful king.

Móel, Blocc, and Bluicne became the stock names for druids at Temair: so important were the stones associated with them. They appear in the tale *Baile an Scáil*,¹ as the persons who interpreted the scream of Fál to Conn Cét-chathach. And they appear in the story of St. Patrick's contention with druids of king Loeguire. For surely it is clear that

LOCHRU ET LUCETMAEL,

the names of the two druids with which the saint had to deal, are simply corruptions of

(B)LUICNE ET (B)LOCC ET MAEL,

the same names, in the reverse order.²

But how did the stones open or close before the candidate? To this question there is but one possible answer. The stones were set close together—though we need not take *au pied de la lettre* the assertion that they were normally so close together that "only the edge of a hand could pass between them"³—and the candidate had to squeeze between them. If he failed to do so, he was rejected.

Similar rites of squeezing through a narrow space—a split tree, a hole in the ground, an opening in a rock, or a space between two objects set close together—are found in many parts of the world. The custom is followed for a variety of purposes: as a curative act, in cases of disease; as a test of legitimacy of birth;⁴ or, as in the present case, as a test of worthiness for some privilege. The rite has ramifications which here we cannot follow; they have been studied by Henri Gaidoz in a monograph.⁵ The nearest analogue to the Temair rite is to be seen in a mosque at Jerusalem, and

Kaineus, crushed into the earth by Centaurs under a heap of fig-branches. Indeed the representation of the scene on the broken frieze of the Theseion (Baumeister, *Denkmäler* fig. 1868) seems to show the Centaurs pressing him into the ground under the weight of a great stone. The burial of the druids might have taken place to secure luck, at the original establishment of the sanctuary: cf. the well-known Iona story.

¹ O'Curry, *MS. Materials*, p. 618.

² For these druids see *Tripartite Life*, p. 273. Móel was also the name of a druid at Cruachu; *ibid.*, p. 92. ³ *Ériu*, vi, 134.

⁴ See Doubdan, *Le voyage de la Terre Sainte* (Paris, 1666), p. 57, or Morison, *Relation historique d'un voyage nouvellement fait au Mont de Sinaï et au Jerusalem* (Toul, 1704), p. 347, for a rite of this kind observed in the seventeenth century at the Church of the Holy Sepulchre, as a test of legitimacy. For similar rites carried out for other purposes, reference may be made to the brochure by Gaidoz, mentioned in the following foot-note.

⁵ *Un vieux rite médicale. Opuscule offert à Anatole de Barthélemy*, Paris, 1892.

another at Cairo. In each of these places there is a pair of pillars, set close together, and the custom inform visitors that only he who can squeeze between the pillars can obtain admission to heaven. At Cairo the space between the pillars has been appreciably widened by the attrition of the inner surfaces of the pillars: at Jerusalem an iron grille has been inserted to prevent the experiment being made—it is said because a certain fat man met his death by endeavouring to force himself through the narrow space.

Sir James Frazer, quoting the essay by Gaidoe,¹ says that its author "rightly rejects the theory that all such passages are symbols of a new birth"—as though the patient were born into a new world of health, of legitimacy, of fitness for office or what-not. This, however, does not exactly express the conclusion of the French scholar, as reference to p. 77 of his essay will show.² It is not the entire fact of physical re-birth which he rejects as explanatory of this rite, but the ethical ideas which for us form almost the exclusive sense of the word "regeneration." In this he is no doubt right; but he does not, and so far as I can judge he should not, wholly reject the view that the rite is essentially an attempt to express the notion of a physical re-birth. If this idea be associated with the ceremony, it is doubtless not to the exclusion of others. For instance, the split tree through which a sickly infant has been passed is ever afterwards linked with the life of the child; we must therefore infer that the tree and the child bore some physical connexion for which the re-birth theory would not wholly account. But in the study of folk-belief and folk-beliefs inconsistencies and complications of this kind are only what we may expect. Very few primitive rites and ceremonies are capable of a *simple* explanation. They all, as it were, possess tentacles to which other notions early attach themselves; and as these accretions vary considerably in different circumstances the study even of the most rudimentary ceremony becomes a matter of extreme complexity.

Whether or not any additional ideas were associated with the rites of the stones of Meck, France, and Blinque, the most reasonable explanation of what we are told about them, in the light of other practices elsewhere, seems to be that the condition for being lit by squeezing between them, was regarded as having been born into a new life. And when we learn that before the ceremony a mantle was put upon him which was required to be close-fitting, we may fairly regard this as a confirmation of this explanation. For in re-birth ceremonies an essential part of the rite would be the reproduction of the

¹ *Balder the Beautiful*, ii, 171, note.

² "Nous admettons bien,—pour quelques-uns des cas que nous avons cités,—la théorie de la re-naissance, pourvu qu'il s'agit d'une image matérielle et en quelque sorte d'une idée matérialiste."

prenatal life of the neophyte. He is tightly folded in a covering that represents the womb.¹ From this he shuffles his way out into the new life that awaits him. This is what appears to be the meaning of the mantle-rite which we passed over just now. That the candidate went through the proceeding in a state of ceremonial nudity is implied, though not definitely stated, by the description of the horse-rite in Giraldus; the nakedness of Conaire, which is emphasized at the beginning of *Togáil Buidne Dá Derga*, is perhaps a reminiscence of this.

But it will be objected that the document before us asserts that the king drove up to and between the stones *in his chariot*. If this is to be accepted, it is useless to attempt to explain the ceremonies which are at the moment occupying our attention. It is safe to say that whatever may or may not have happened at the inauguration of a monarch, he did not drive up to certain standing stones in his chariot, expecting them to open before him of their own accord. The writer who reports the ceremonies has misunderstood and naturally has garbled them; it is only by comparison with similar rites that it is possible to reconstruct their original form. It is easy to understand why our author has introduced the chariot so awkwardly here. The ceremony begins with a chariot-rite; the final test, at Fál, is against a wheel, supposed to be the chariot-wheel. The writer who is our authority naturally inferred that the king remained in his chariot the whole time.

As an alternative explanation it has been suggested to me that the robe might have been a sort of ἱερός πέπλος by means of which the king was symbolically invested with divinity. The theory is worth putting on record, though I find in it one serious difficulty—such an investiture would not be likely to have taken place *before* the passage through the stones, if only for the practical reason that it would very seriously hamper the neophyte's progress through the narrow space, and would be sure to get torn. Had the mantle been assumed *after* the passage through the stones, this would obviously have been the only reasonable explanation of the part which it played in the inauguration. Moreover the explanation offered above explains why the robe was meant to be close-fitting: a mere symbolic robe would be more likely to be full and flowing.

We have seen that the tract mentions only two stones, omitting Móel. Groups of two stones are on the whole commoner than groups of three; and for the purpose of the squeezing rite two stones would be sufficient, and three a superfluity. It is hard to decide which version is correct. The Patrician

¹ See some examples in Frazer, *Taboo and the Perils of the Soul*, p. 113; *The Magic Art*, i, 380.

documents reduce these three druids to two, but the way in which their names are stated shows that there were originally three separate names—otherwise we might reasonably suppose that there were actually only two stones, called Móel-Bluicc and Bluicne. In such a case Blocc would necessarily have been the name of a god, otherwise unattested; for the formula Móel- is essentially theophorous, like Fer-, Nia-, Mug-, and sometimes Mac-. On the other hand, the three names are cast into the formula usual in such triplicities. These are almost invariably in the form A.B.B', in which B' is an orthographical variant of B, or at least is connected with B by assonance or alliteration. Thus, the three sons of Tuairiu, otherwise called the "gods of the Tuatha Dé Danann," were Brian, Iuchar, Iucharba. The three guardian spirits of the sacred well of Sid Nechtain were called Flese, Lese, and Luam. Even in the modern chapbook reprinted in Thackeray's *Irish Sketch-book* we find the same formula, Hudden, Dudden, and Donald O'Neary.¹ In such cases it will generally be found that it is the individual with the singular name—A of the formula—that is the effective personality; the other two, B and B', being merely the chorus. Here, however, we have a remarkable exception to this rule: Blocc and Bluicne are the important stones, while Móel is in the background.

The evolution of the formula is easily understood. The Celtic gods originated in groups of shadowy beings of indefinite number and very feebly developed personality, who gradually crystallized into clear-cut individuals. Thus, the sun-god Lug is a condensation, so to speak, of a previous group of Lugages, for whose existence we have epigraphic evidence. When attempts were made to form a conception, either mental or graphic, of these beings, it was natural to figure them in threes—three being the first number in which plurality can be expressed; one figure represents *θεός*, two *θεῶν*, and three *θεοί*. Such symbolical groups of three figures inevitably suggest groups of three independent personalities. When it comes to name these, one of them will be given a name in the singular number, derived from the plural by which the original group was known; and the other two will be fitted with factitious names which will naturally tend to resemble one another. Such a group as Móel, Blocc, and Bluicne is therefore only what we might expect. Thus there were most probably three stones, not two; but only two of them, set the more closely together, were used for the squeezing rite. It will not escape notice that what has been said above is fatal to Petrie's identification of these

¹ Other examples of triplicities similarly constructed will be found in a list of the Tuatha Dé Danann in *Irish Texts*, iii, 58. The assonance of the added names (B, B') is interesting in the assonance frequently observed in the names of twins; on which see Rendel Harris, *The Cult of the Heavenly Twins*, chap. viii.

stones with the small stones in the churchyard. Though described as *clocha becca*, these stones must have been at least as high as a man's shoulders.

Finally the candidate, thus "re-born," was led up to Fál, which uttered a scream if he were acceptable. *Dind-shechas Érenn* says that it screamed under the new king, as though he stood upon it. The well-known quatrain of Cináed ó hArtacáin, beginning *an cloch forstad mo dí sháil*, "the stone on which my heels stand," accords with this. The tract *Sil Chonairi Móir* says that it screamed "against the axle of the chariot."

The stone variously called Fál, or Lia Fáil, was the central "fetish" of Temair, and it becomes a matter of great importance to find out what it was. So important was it, that *Inis Fáil*, *Mag Fáil*, are familiar names for the whole of Ireland. Temair itself was *Temair Fáil*, Fál's Prospect-hill, to distinguish it from the other places called Temair in Ireland.¹ The personal name Fraech Fáil is also recorded.² The followers of Find mac Umail are the "Fiana of Fál."³

Whatever the camp-followers of Celtic studies may suppose (be they mediæval chroniclers or modern ecstasies of the Fiona MacLeod type), we may take it for granted that the signification of *Lia Fáil* is nothing so poetical as "Stone of Destiny." "Stone of the Fence," or "of the Hedge," would serve as a translation, with a possible reference to its use as a guardian of the fitness of the king. In such a case, however, we should have expected the definite article. The fact that it is omitted, and that the stone is frequently spoken of simply as "Fál"—which, indeed, appears to be its most legitimate name—indicates that Fál is to be taken preferably as a proper name, either of a man or of a god.⁴ As there does not appear to be any trace of a man of the name, we prefer to interpret it as the name of a god.

The stone Fál is called *Ferp Cluche* in the tract *Sil Chonairi Móir*. *Ferp* is a loan-word from the Latin *verpa*; and Baudiís infers (*loc. cit.* p. 106) that the stone was a phallus. This inference, however, is not justified. The fact that a loan-word is used is strongly against it, as indicating that we are to see an ecclesiastical denunciation of a pagan monument rather than a genuine tradition of the significance of the stone.⁵ It is, in fact, one more of the spiteful

¹ See Rhys, *Hibbert Lectures*, p. 207, and references there.

² *Revue celtique*, xxix, 138.

³ *Festschrift Whitley Stokes*, p. 9.

⁴ Cormac explains *fál* as *rí* (king). O'Davoren says *rí no muir*, "king, or sea." The expression "lia Fáil" is used in the poem by Cináed ó hArtacáin entitled *Aided a forní do hUaislib Érenn* simply in the sense of "a big stone": see *Revue celtique*, xxiii, 306, line 3, and the note on the passage, p. 333.

⁵ Compare *Cenwerbe*, the name given to Cenn Crúich in Colgan's *Secunda Vita Patricii*.

Another point of importance to notice about Fál is a constant tradition that it was not native to Temair: coupled with an expectation that it was not destined to remain there for ever. As to the place from which it came, authorities differ: but they agree in representing that it came from elsewhere.

Thus, Lebor Gabála enumerates it among the four treasures brought into Ireland by the Tuatha Dé Danann. It came, so we are told, from the city Fálías; while Lug's invincible spear was brought from Gorias, Nuadu's sword from Finneas, and The Dagda's inexhaustible cauldron from Múrias.¹ Thus the stone is brought into association with three of the most important deities in the pantheon. The names of the cities are obviously factitious, formed by someone who had deciphered a name like *Ercias* on an Ogham inscription, and recognized the common name *Erc*, but was not very clear as to the meaning of the archaic genitive termination *ias*. Fálías is thus formed from the name of Fál; and the apparent meaning of Fál ("wall") has suggested Múr, and thus given a foundation on which to base the city Múrias. Some vague recollection of a legendary king Nuadu Finn-fáil has suggested Finneas, whence Nuadu obtained his sword; and Gorias (*gor* = fire) is a suitable place for the sun-god Lug to find his destroying spear. Thus Fál lies at the base of three out of the four cities in which the Tuatha Dé Danann learnt their magic.

Baile an Scáil, the tale to which reference has already been made, tells a different story. According to this interesting text, the druids Móel, Blocc, and Bluicne explained to Conn Cét-chathach that the stone came from Inis Fo-ail, was set in Temair Tíre Fáil, and was destined hereafter to find its way to Tailltiu.

Inis Fo-ail is merely a perversion of Inis Fáil, in the interests of an absurd etymology (*fo ail*, "under a king"). Thus, what the druids said was that the stone came to Temair from Inis Fáil. This implies that Inis Fáil is not Ireland, but some other island. When we seek for another island bearing this name, we have not far to look. The little islet in Wexford Harbour,² now called Beggery Island (a corruption of Beg-Éire, Little Ireland), also bears the name of Inis Fáil.

Beg-Éire is the site of a very ancient ecclesiastical establishment, associated with the name of Ibar, traditionally said to have been one of the pre-Patrician saints of Ireland. Now it may be laid down as at least a working hypothesis, that the existence of an ancient Celtic monastery on such an island is presumptive evidence of the pre-existence of a pagan sanctuary

¹ *Book of Ballymote*, facs. 32 a 15-25.

² No longer an island, owing to land reclamation.

on the same spot: the missionaries and early fathers of the church in Ireland being desirous of diverting the sanctity of the island from the false to the true Faith. This is certainly the case of Inis Muiredaig in Sligo Bay; the church there, called *Tionnall na Tionnall*, with its sacred fire-hearth (site of "one of the three sacred perennial fires of Ireland"),¹ preserves the memory of some fire-ceremony that assuredly was not Christian. It seems also to be the case at Inis Ceitina, where, as I have shown in my account of the site, there is very complete evidence for the former existence of a sacred tree. And the name of Inis Fál affixed to the island of St. Ibarcan only mean that this island was a centre of rites similar to those which centred in the stone of Fál: at least that in some way or other the god immanent in the stone of Fál was there honoured.

Of the servant of Christ who founded and laboured in the church of Beg Éire, and who now enjoys his reward, nothing is known. For it is clear that the few facts recorded of him belong not to him, but to his pagan predecessors. His very name is forgotten: that of the sacred yew-tree (*ibor*) of the island has been substituted. Another island in Wexford Harbour had a sacred oak-tree upon it, from which it derived the name *Dair-inis*, "Oak Island." Probably Beg Éire had an alternative name analogous to this *Inis Ibor*, "island of the yew-tree." In time this was understood to mean "Island of Ibor," interpreted as referring to the forgotten founder of the monastery. In like manner, the unknown hermit of Inis Cathaigh has been tricked out (unconsciously with the name of the river-god Senan, who probably had a sanctuary in the conspicuous island at the mouth of the river.

Let it be clearly understood that the historicity of these saints is not in question. That is amply attested by the existence of the ruins of the religious houses associated with them. But their names have suffered the usual fate of names handed down by tradition, and have become confused with other names which by possession of a much larger history stretching far back into the unknown abysses of pagan ages had made a deeper impression on popular memory.

A case even more remarkable than the two above cited is that of the foundress of the nunnery at Kiltane. There was doubtless here, in pagan times a college of priestesses who tended a perpetual fire, and who (presumably with orgastic rites resembling those of the Gaulish priestesses of Sena) honoured the fire-goddess Brigid, this divinity being immanent in the sacred stone which gave to the place the name that it still bears. Probably the head of the college was regarded as an incarnation of the goddess, and so bore

¹ *Silva Gadelica*, i, 42 : ii, 41 : Wakeman, *Inismurray*, pp. 51-56.

her name, as the kings of Temair bore the name of Eochu. But one of the succession came under Christian influence, and, embracing the Faith of the Cross, she accomplished the tremendous feat of converting the pagan sanctuary into a Christian religious house—a work in its way far more wonderful than the miracles with which her biographers credit her. It is no detraction from the honour due to her for this achievement, that she could not quite rid the establishment over which she presided of all its pagan vestiges; “the bright lamp that lay in Kildare’s holy fane” still “burnt through long ages,” not, as Moore foolishly says, of “darkness and storm,” but of Christian Faith and Works. And though it is most probable that she herself changed the official name “Brigid” which hitherto she had borne (for no Christian lady would willingly continue to bear a name so heathenish while paganism was still a force), it was too deeply rooted in the folk-memory, and continued to be used locally to designate her.

To return to St. Ibar, we are told that he resented the coming of St. Patrick,¹ which would hardly be to his credit if he were a Christian, but would be intelligible if the story were first told of a pagan. His mother’s name Lassar (“flame”) is suggestive in this connexion,² as well as her origin from the Déisi of Breg. He is one of the saints to whom a life of portentous length is assigned by the Annalists (the Four Masters, for example, tell us that he died A.D. 500 at the age of 304 years; the Martyrology of Donegal adds another century). And a “very ancient old book” cited by the Martyrology of Donegal states that in habits and in life he resembled St. John the Baptist—a remark of great significance, as we shall see.

Beg Eire is situated in the estuary of the river Slaney. We have already seen that the god of the Slaney, under his two names, Slainge and (Mo-)Donn(os), appears as the leader of both the Fir Bolg and the Milesian invasion; and we have suggested that the latter is the original form of the story, the former a contaminated version. In Ptolemy’s time the south-east corner of the island seems to have been endowed with peculiar sanctity. We see in his map the *Sacred Promontory*, and names like *Birgos* (the river Barrow), and the tribe of the *Brigantes*, containing the same linguistic element as the name of the fire-goddess *Brigid*. It is suggestive in this connexion that the traditional Ibar is in his life brought into close association with Kildare. The same element enters into *Bregna*, a name for the Boyne preserved in Cormac’s *Glossary*. The enormous earthen ring-fort, called Ballytrent, one of the largest and finest earthworks in Ireland, a short distance north of Carnsore

¹ *Féilire Oengusso*, Glosses, Bradshaw ed., p. 118; *Life of St. Declan* (Irish Texts Society), p. 36.

² But see Kuno Meyer’s note, Todd Lect., xvii, 109, note on p. 6, line 10.

Point (The Sacred Promontory), may well have been a sanctuary of some kind; indeed, there is at Carnsore Point itself a ring-wall, now consecrated by the ruined chapel that bears the name of Mo-bheóc.¹

When we recollect further that the plain round Temair is called Mag Breg, after which Temair itself is named Temair Breg, and that in Ptolemy's time Temair had not yet attained a sufficient general importance to obtain a place on his map: that there was a tradition, *valde quantum*, that Fál had been brought thither from somewhere called Inis Fáil: and finally, when we remember that it would be quite possible to imagine the names Éire and Inis Fáil being transferred by advancing conquerors from the smaller island to the larger, but that the reverse process is highly improbable, we see the inference stated above confirmed. And having thus concluded that the Slaney estuary saw the first landing of the incoming Celts, we look up the "official histories" to see what they have to say on the subject. Here we find it stated that the Milesians first came to land in Inber Slainge—the Slaney estuary—though the druids of the Tuatha Dé Danann were able to keep them off by magically causing the country to disappear, so that they sailed round it three times without knowing what they were doing, and finally came to land in Inber Seane—supposed to be Kenmare River. Whatever we may make of the latter part of this episode, the first part certainly indicates a tradition which agrees with our deductions.

True, there is another explanation for the island in the Slaney estuary being called "Little Ireland." We are told that Ibar and Patrick having quarrelled, the latter pronounced sentence that "Ibar should never be in Ireland;" "Ireland shall be the name of the place wherever I shall be," retorted Ibar; so that he called the island of his exile "Little Ireland."² This reminds us of the curious statement already referred to, that "Cenannus was the name of every place where Fiachu built his house": perhaps the record of an advancing host, ever establishing a sanctuary for its culture-hero when it reaches a fresh stage of its march. Hogan's *Uaimhstíon* records only two places of the latter name in Ireland (Kells in Meath and Kells in Ossory), and one in Scotland (Kells in Galloway). There are other places now called Kells in Antrim, Clare, Kerry, and Limerick. These data however, are scarcely sufficient to enable us to trace the spread of the cult of Fiachu.

¹ I have to acknowledge the kindness of my friend the Rev. R. Fitz Henry, P.P., of Broadway, for guiding me over these sites and also over Beg Éire. There is nothing, however, now to be seen at the latter spot having any direct bearing on the subject of this paper.

² *Féilire Oengusso*, Bradshaw ed., p. 118.

There seems to be a further reminiscence of the importation of the Fál cults into Temair from somewhere else, in the legend of Tea and Tephí. Tephí, as we are told, was buried in Spain, the traditional land or origin of the Milesian people. Tea saw her monument there, and built Temair in imitation of it. That is to say, the structure of Temair was modelled on the pattern of some other structure, in the place (not necessarily Spain) where the worshippers of the gods of Temair came from. When the incoming Celtic-speakers had spread inland, and had established their domination over the whole country, they took over the ancient sanctuaries, Temair among them, and there established their new gods, amid the sacred waters, animals, and trees of their Bronze-Age predecessors.

Such, then, appears to be the meaning of the statement in the prophecy called *Baile an Scáil*, that Fál came from Inis Fáil. The Celtic conquest was still comparatively recent when that story was first told. It was still remembered that the cult of Fál had not been indigenous at Temair, but had been imported from an island that bore this name. We need not suppose that the stone itself came from Inis Fáil; it may have been already on the spot, and have been adapted as the representation of the deity.

But *Baile an Scáil* has something more to say about the stone, which is less easy to explain. It may be remarked parenthetically that this story of the "Spectre's Ecstasy" is to the effect that Conn Cét-chathach stepped one day by hazard on the stone of Fál; that it uttered its scream; and that the druids Móel, Blocc, and Bluicne explained its meaning to the king. The historical background of the occurrence, the essential point of which is Conn's ignorance of the properties of the stone, is probably the fact that Conn, as grandfather of Cormac, was the founder of a new dynasty under which a new order was fated to hold sway in Temair; but the story itself is completely mythical, being full of impossible magic and mystery. After the druids had prophesied of the virtues of the stone, a theophany of Lug appeared and marshalled before Conn in a prophetic vision the kings that were to reign after him: a sort of anticipation of the procession of kings in *Machth*.

Now the druids told Conn that the stone was fated to remain perpetually in the Land of Tailltiu; and that there should be a field of games (i.e. periodical religious festivals, with sacred games, &c.) at Tailltiu so long as there should be a monarchy in Temair. Also, that the king who on the last day of the feast should not see the stone would be a doomed man (*trú*, that same year.¹

There is a remarkable variant of this story in the Book of Leinster (facs. 9a). According to this passage, the properties of the stone were tested

¹ See O'Curry, *MS. Materials*, p. 618; also *Zeitschr. celt. Phil.*, iii, 459.

by Cu-Chulainn and by his foster Lugaid, and the stone remained obstinately silent under both of them: nor did it scream thenceforth till Conn stood upon it, when its heart burst from it, and flew to Tailltiu, where it still remained, called by the name *Cride Fáil*, "Fál's Heart."

Tailltiu was the special sanctuary of Lug, the sun-god, and the games there held had been instituted by him. There must have been some stone there called by the name "Fál's Heart," which was supposed to have come from Temair in some such way. It is quite likely that the king who was responsible for the growth and fruitfulness of the crops might have to repair to the sanctuary of the sun-god periodically to renew his strength; and it may be that the rite which was transacted at his inauguration at the "Stone of Fál" was renewed from time to time for this purpose at the "Heart of Fál." That is the best attempt at an explanation of these two extremely difficult passages which occurs to me. The possibility, referred to on a previous page, that the *groves* of Temair were buried at Tailltiu may be recalled in this connexion.

But the new king is waiting for the god to accept him by means of a scream. This scream requires a section to itself. We may, however, note here the naive explanation of the scream given by Keating and other late writers, that the stone contained a demon which lost its power at the birth of Christ. This is additional testimony in support of the interpretation that sees in Fál a baby. The gods of the elder faith are the demons of the new.¹

5. THE VOICE OF FÁL.

Had was the voice of Fál produced? That it was some trick on the part of the bruids, or whatever religious functionaries presided at the inauguration ceremonies, may be taken for granted,—that is, if there be any truth at all in the tradition of the "scream" of the stone. If there be no truth in it, we may as well renounce all hope of separating truth from falsehood in the early Irish records.

I dare not here profess to guess that the scream was a ventriloquial feat on the part of one of the religious functionaries *á-moestid*. But I have now a different theory to offer. There is a means of making a noise which has been, and still is, employed in various parts of the world in inauguration ceremonies; and I now propose to bring forward testimony to show that the same means was employed at Temair; that the "Voice of Fál" was the sound made with the post-cornucopæ well known to anthropologists as the Bull-roarer.

¹ See St. Michael of Herten conjured Satan into a neighbouring pillar-stone: see *Féilire Oengusso*, Bradshaw ed., p. 94.

The bull-roarer is a lath of wood attached to a string and whirled round in a wheel or circle. Descriptions of the instrument and of the noise that it makes are contained in Lang's *Custom and Myth*, and in Haddon's *Study of Man*, chap. x. It is used by the primitive populations in Africa, North and South America, and Oceania for a variety of purposes, tabulated in the latter work, to which the reader may be referred for authorities, and for geographical and other particulars. In general we may say that these different *uses* fall into the following groups:—

(a) *In mysteries, initiation ceremonies, and the like*: used (i) as the credential of a person of authority; (ii) to summon those who are to take part; (iii) to scare off non-initiates, and especially women; or (iv) as a sacred noise-making instrument in the ceremonies themselves.

(b) *At funeral ceremonies, to scare off spirits.*

(c) *As a weather-control, to make (i) wind, (ii) rain, or (iii) thunder and lightning.*

(d) *To drive cattle*: it appears that the noise terrifies them. In the Malay Peninsula, to imitate the noise of a tiger, and so to scare away elephants.

(e) *As a hunting and fishing charm.*

The following *beliefs* held about it in different places are noted by Haddon, *op. cit.*

(a) That it is a god, and its sound the voice of a god.

(b) That playing with it will invite a storm of wind.

(c) That any woman seeing it will die (in some places she would be killed, as would a person who showed it to a woman). Children also would die were they to see it. Other misfortunes (floods, scarcity, and the like) are threatened if this prohibition should be broken.

The evidence for the use of the bull-roarer in ancient Ireland centres in the personality of a druid or magician known as Mug Ruith. This name means "slave of a wheel." As we have already noticed, the prefix *Mug* gives a theophorous sense to a name, and indicates that the second element of a name in which it occurs is something divine, if not actually a divinity. The "wheel," therefore, is a divine wheel.

For a deity *Roth*, ancestor of a clan, we have evidence in two Ogham stones, one at Drumloghan, in Waterford, reading BIR MAQI MUCOI ROTTAIS; and the other at Lamogue, Co. Kilkenny, reading (as I have ascertained by a recent visit) SEVERRIT (MAQI MUCOI ROTTAIS. The top of the latter stone is

broken away, doubtless with intention, showing that the ancestral name was conceived as having pagan associations.¹

This Mug Ruith, then, is the servant of a divine wheel, which seems to be conceived as being the ancestor of a sept established in the present counties of Kilkenny and Waterford. From Mug Ruith himself the people of Fermoy are alleged to trace their descent. He is credited with the invention, or at least the use, of an instrument of divination called *Roth Ramach*, an expression that can most conveniently be translated "paddle-wheel." Such a name is evidently very suitable for a rotating bull-roarer, and it is noteworthy that the same simile is found at the Antipodes. In Australia, where the bull-roarer is of great importance in initiation ceremonies, women are most carefully excluded from the sight of the sacred instrument. If by accident a woman of the Kurnai tribe should happen to find the head of a bull-roarer that has flown off its cord and been lost, and should ask what it may be, she is told that it is the paddle of Tumam, whose voice had been heard in the ceremonies, who had descended "to make the boys men," and who had dropped it in his return journey to the sky.²

The first text relating to the *Roth Ramach* which we may cite is contained in the account of Tlachtga in *Dind-shechus Éirenn*. Tlachtga, identified, rightly or wrongly, with the Hill of Ward near Athboy, is certainly an ancient sanctuary. We learn from the text cited (which will be found in full in *Revue celtique*, xvi, 61) that it derives its name from Tlachtga, daughter of Mug Ruith, and that she and her father went to Simon Magus to learn the world's druidry. There she had relations with the three sons of Simon, and there she made "for Trian" (*de Triann*) the Roth Ramach, the Stone in Fencarthu, and the pillar-stone (*ceachtar*) of Cnánchoill. Returning to the hill called Tlachtga she there bore three sons—Dorb, Cuma, and Muach—from whom are named Mag Dorb, Mag Cuma, and Mag Muach: "and till their names are forgotten in Ireland, the vengeance of foreigners will not visit it."

Like so many other articles in *Dind-shechus Éirenn*, this description is provokingly *allusive*. It assumes knowledge on the part of its readers such

¹ The alleged Gaulish deity Roth, concerning whom some rather nebulous speculations will be found reviewed in *Revue celtique*, i, 137, is not here in point, even if there were any convincing proof of his real existence.

² A. W. Howat, *et. op.* Haddon, *Study of Man*, p. 314. The name is spelt Turmdun by other authorities.

³ Possibly the tradition of the wisdom-seeking voyage of an actual druid, such as we imagined *ante*, p. 317.

as we no longer possess. There was doubtless some story about the three sons of Tlachtga, and the reason why the memory of the sacred plains that bore their names should guard Ireland from foreign vengeance. This reminds us of the folk-stories which turn on the necessity of keeping some mysterious and outlandish "word of power" in the memory.¹ Ireland no longer enjoys the safeguard; the names are totally forgotten, and the plains cannot be identified. Who Trian, for whom Tlachtga made the three fetishes, may have been we do not know; it looks, at least at first sight, as though he were a god: of this, however, I am doubtful. Forcarthu is said to be near Rathcoole in Co. Dublin; of several places called Cuánchoill, the spot now called Cleghile, in Co. Tipperary, is usually identified with the place mentioned in our text. A search of the Ordnance map has failed to reveal any standing stone now existing at or near either place.

Some further information is to be gleaned from the poem which accompanies the prose text. As reproduced in the Book of Ballymote facsimile, 406 b 12-44, this poem consists of fourteen stanzas. The first names Tlachtga daughter of "the bright Slave of the Royal Wheel" (*ingen Modharril Righ-Roigh*) as its eponym. The next three stanzas give the names of members of the family of Mug Ruith: his father, Fergus of Fál (*mac Fergusa Fáil*) son of Ros;² his mother, Cacht daughter of Caithmiu;³ his foster, Roth son of Righoll, from whom he was called Mug Ruith; his sons, Buan and [Fer]corb; his wife, Der-droighen,⁴ sister of the mother of Cairpre Liffchair of the Coreu Bairdue of Dun Cermna. Especially interesting in this connexion is the name of Mug Ruith's mother. She is called "daughter of Caithmiu, king of Britain," in the prose genealogy of Mug Ruith, which will be found, *inter alia*, in the *Book of Ui Maine*, 19 v 1. She is therefore a sister of the mysterious Camsón, of whom we have heard in connexion with Tephí. The fifth stanza of the poem tells us how Tlachtga went with her father to Simon Magus; and the sixth and seventh tell us of her connexions with the three sons of Simon, whose names, it appears, were Nero, Cairpeint, and Uetir. The eighth stanza tells us how Tlachtga, in association with Mug Ruith and Simon, made the Wheel *do Trian air bo thím*, which seems to mean "For Trian who was not feeble," though it gives us no

¹ See on this subject Clodd's *Tom Tit Tot*, especially chapter ix.

² Elsewhere *Caindeasg mac Firglain*, YBL facs. 190 a, BB 266 a.

³ King of the Britons of *Man* (loc. cit. in previous note).

⁴ Otherwise Dron, daughter of Oengus Mor mac Echach Lairen (loc. cit. in previous note).

enlightenment as to who or what Trian may have been.¹ The ninth stanza tells us of the making of the stones of Forcathu and of Cnámchoill. The tenth warns us that "everyone who shall see it, the rough, hairy (?), surly wheel, shall become blind, everyone who shall hear it shall become deaf, everyone whom it shall touch shall die." This is just the sort of thing that would be said of a bull-roarer in Australia, or in any other region where the instrument is held in reverence. The remaining four stanzas tell of Tlachtga's return, of the birth of her sons, of her death in childbirth,² of the plains named after them, and of their guardianship of Ireland against foreigners, as set forth in the prose text.

The transactions of Mug Ruith with Simon Magus are further described in two important texts. The first of these, called the Adventures of Mug Ruith* has already given us some variants in the traditions of his family relationships, but adds little to the subject before us. We learn from it, however, the interesting fact that Mug Ruith was a pupil of Scáthach before going to study with Simon Magus. We are also told that he was blind, having lost one eye "slaying a yearling calf at Sliab Elpa in a great snow" (*ce ruda gearra na S. E. saochta mór*)—a reference to some story not apparently preserved to us; and having lost the other by having made the sun to stand still so that he made one day of two in Dairbrin (Valentia Island).⁴ Tlachtga makes no appearance in this story, which is to the effect that, having returned home, blind, after thirty-three years' absence with Simon, he learnt from his attendant that his wife was in his house with a young man. The youth was really his son, now grown up, but Mug Ruith assailed the pair with an axe in jealousy. The second source of information is the prose genealogy of Mug Ruith, to be found in the Book of Ui Maine (as quoted above) and also in Rawl. B 502 166s. p. 157, 36-45. The latter

¹ I suspect that a stanza has here been lost at a very early stage in the history of the text. No. 7 tells us of the love that Simon's sons gave to Tlachtga. A stanza following this might have told of some gift that they had presented her with, after which would follow the present eighth stanza. "Tlachtga of the third part [of this gift, whatever it may have been, made the Rath Ramech] along with Mug Ruith and Simon. The following stanza seems to mean that she made the Lia Forcathain and the pillar of Cnámchoill of the *sestium*, i.e. of the other two-thirds. This would give a *raison d'être* for the intrusion of Simon's sons in the narrative.

² Omitted in the Rennes ms. of the prose text, but duly mentioned in the Edinburgh ms.

³ YBL facs., p. 190 a; BB facs., p. 266 a.

⁴ This may be an imitation of the miracle of Joshua, but it appears elsewhere in Irish legend. The sun stood still for nine months at the birth of Oengus of the Brug (Todd Lect., x, 37).

is the better copy, so we give it here, with *variae lectiones* from the Book of Lecan, p. 269¹:—

Mug Ruith mac Fergusa, a quo Fir Maigi Feine, is e luid do foglainn druidechta co Simon ndruid, 7 is mar oen doronsat in Roth Ramach, tic dar Eoraip riambraith, hisin bliadain ria cathugud do Simon fri Pol 7 fri Petar. Ocus is aire chairgthir for Eoraip, ar daig dalta cacha ceneil robae moalle fri Simon i cathugud fri Petar. Cacht ingen Cathmind rig na mBretan² mathair Moga Ruith. Roth mac Riguill rodnalt; is de asberar Mug Ruith. Da mac Moga Ruith, Buan 7 Fercorb. Derdraigen³ mathair da mac Moga Ruith 7 [Lifean]⁴ mathair Chairpre Lifichair, di siar⁵ do Choreo Barddeine o Dun Chermna. Dron imorro, ingen Lairine [do Erndaib]⁶ cet muintir Moga Ruith [mathair Labrada meic Moga Ruith]⁶ ocus ingen do Mug Ruith Tlachtga ut alii dicunt, corus toirrehitar .iii. maca Simoin ria tichtain anair 7⁷ ruc tri maceo doib; 7 hissi tue le cairthi Cnamchaille⁸ .i. fuidel ind Roith 7 is⁹ nodmbris e. Dall cach noen nodnaicefe, bodar cach oen nocluife, marb cach oen frisambena.

Mug Ruith son of Fergus, from whom are the people of Fermoy, it is he who went to learn druidry to Simon Magus, and it is together they made the Roth Ramach, that comes over Europe before the Judgment, in the year before Simon's contention with Paul and with Peter. And for this reason is Europe censured, because a pupil of every nation was with Simon as he contended with Peter. Cacht daughter of Caithmiu king of the Britons was mother of Mug Ruith. Roth son of Rigoll fostered him; thence comes the name Mug Ruith. The two sons of Mug Ruith were Buan and Fercorb. Derdraigen the mother of the two sons of Mug Ruith, and Lifean the mother of Cairpre Lifechair, twain sisters of the Corcu Bairdine of Dún Chermna. Now Dron daughter of Lairine of the Erna, the first people of Mug Ruith, was mother of Labraid son of Mug Ruith, and Tlachtga was daughter of Mug Ruith as others say, so that the three sons of Simon got her with child before she came from the east, so that she bore three sons to them; and it is she who brought with her the pillar-stone of Cnamchoill, that is, the leavings of the Wheel; and it is she that broke it. Blind everyone that shall see it, deaf everyone that shall hear it, dead everyone that it shall touch.

¹ Another copy, from Laud 610, is published without translation in Zeitsch. celt. Phil. viii, 332.

² ri Manann no Breatan, LLec.

³ Der 7 Draigean, LLec.

⁴ This word omitted in Rawl. LLec reads *Lifin siur eile doib mathair*.

⁵ LLec omits *di siar*.

⁶ These bracketed words omitted in Rawl.

⁷ conid afus ruc, LLec.

⁸ Spelt by oversight *Cnamcham chaille* in Rawl.

⁹ ise, Rawl.

Here we are introduced to an extraordinary feature of the Roth Ramach—its adaptation to Christian eschatology. But before we examine the texts which display this side of its manifold activities, we must look at a very important entry in Cormac's *Glossary*. Here the Wheel is actually alluded to under the name of Roth Fáil—the Wheel of Fáil. This passage will be found in the *Glossary* under the heading *Foi*. It is extremely difficult to understand: here is the original passage—

FOI, .i. Cnámchaill, ut dixit Grúibne fili fri Core mac Lúgdhach, “in fess f6 Foi,” .i. ba fessach Cnámchoille. Item “Mog Ruith peribit quod Roth Fáil perueniet, dicens co ri Duirluis Find ‘iar Fhoi,’” .i. iar Cnámchaill.

The purpose of this entry is to show by illustration that Foi is another name for Cnámchoill—a fact also stated by O’Cleary in his *Glossary* (*Revue Celtique*, iv, p. 421). The reference to Duirlas (Thurles) indicates that the Cnámchoill intended is the place now called Cleghile in Tipperary. In support of this explanation of Foi two passages are quoted: one of them an obscure line, with which we are not now concerned, from Grúibne the poet; the other a passage from some Latin writing to the effect that Mug Ruith will perish because the Wheel of Fáil will arrive, saying to the king of White Durlas “after Foi,” that is, “after Cnámchoill.”¹ In the absence of the context of the Latin extract, it is impossible to make out its meaning fully; but the association of Mug Ruith and Cnámchoill with the Roth Fáil makes it quite clear that the “Wheel of Fáil” is one and the same thing as the “Paddle-wheel.” We have already seen that the writer of the tract *Síl Chonairí Móir* says that Fáil emitted its noise *against a wheel*, which he naturally supposed to be the wheel of the chariot. If we can correct him in this, it is because we have the Australian aboriginals at our disposal, to show us the right way to interpret these passages.

It will not escape notice that the warning that everyone who *hears* the Roth Ramach *perishes* *deaf* shows that it is something capable of emitting a noise.

We have now found the following facts hidden in the confused mass of details about the Roth Ramach:—

- i. A certain stone was said to scream *against a wheel*.
- ii. There was an instrument called the “wheel” of that stone.
- iii. It was also called a “paddle-wheel”; just as the Australians, on occasion, call the “bull-roarer” an oar.

¹ A translation in which some of the words are rendered differently will be found in Rhys, *Hibernia Antiqua*, p. 212. Without the context it is impossible to decide which is correct, but the question is here of minor importance.

iv. It made a noise.

v. It was looked upon as the invention of a prominent druid, or of his daughter.

vi. It was looked upon with awe, as a thing dangerous to touch, hear, and see.

I claim that these six facts constitute the clearest proof that we have a right to expect, that the Voice of Fál was produced by a bull-roarer. This conclusion is of some importance, as the bull-roarer has not hitherto been identified in any region north of the Alps. In ancient Temair as in modern Australia, at the remotest ends of the earth from one another, the sound of the bull-roarer was used in initiation ceremonies, and was regarded as being the voice of the god.

It is perhaps possible to see a reminiscence of the bull-roarer and its destructive powers in the description of the plague that ravaged Britain in the time of Lludd, as related in the story of Lludd and Llefelys: a great shriek that was heard every Beltene-eve over every hearth in Britain; it penetrated the hearts of the people, so that men lost their colour and their strength, women the children in their wombs, boys and girls their reason. Animals, trees, land, water were all barren. The sequel of the story explains this as being the outcry raised by two dragons, which were ultimately imprisoned and made harmless in Snowdon. But this may well be a late explanation; dragons are essentially mediaeval, but a mysterious noise that brought destruction to unauthorized persons that came within its influence is a primitive idea. Such a noise would be the sound of the bull-roarer.

It is useless to expend many words on some of the minor details alluded to in the extracts that have been set before the reader. The reference to the "breaking" of the stone of Cnámchoill must point to a lost myth.¹ Indeed, it is not very clear what place the "Stone of Forcarthu" and the "Pillar of Cnámchoill" occupy in the scheme; it is most probable that these were cult-centres, similar to Tlachtga, and that the stones were oracular stones similar to Fál. We shall see presently that Fál was by no means the only "speaking stone" in Ireland. That Tlachtga and Temair were closely connected is indicated by the coincidence of date of the annual sacred fire lighted at these two centres, as we shall see in the following section; and by the fact that

¹ O'Curry's version, that Mug Ruith used the Wheel as a sort of flying-machine (*MS. Mat.*, p. 402), with the addendum that "it met with an accident" (Rhys, *Hilbert Lect.*, 211), explains how there came to be "fragments," but does not rest, so far as I can discover, on any very secure literary evidence.

Mug Ruith is intermediate in descent between "Fergus of Fál"¹ and Tlachtga. It is impossible to understand some of the allusions contained in these passages: and we are inclined to suspect that the writers had not a very clear idea themselves of the meaning of what they were writing.

The Ruth Rantach must have figured more conspicuously in the earliest Irish literature than the surviving fragments of that literature would lead us to suppose: and there must have been a number of tales related of it and of its wonder-working powers. When the bull-roarer was forgotten, scribes racked their brains to imagine what the "Paddle-wheel" might have been, and they concluded that it was some sort of a ship that flew in the air. Its destructiveness to those who meddled with it showed that it was something dangerous: and before long we find it has become a terrible, destructive instrument which will sweep over the world in general, and Ireland in particular, at or before the Day of Judgment. In their desire to invent apocalyptic horrors, the Christian eschatologists drew on the resources of ancient pagan tradition.

The reason why Europe is to be visited with this plague has already been seen: it is because there was a representative from every nation at the school of Simon Magus, all of whom were involved with him in his contest with the Apostles. But murder and more heinous crime blackened the record of Mug Ruith, in which account Ireland is to suffer especially from the "Paddle-wheel." The *Book of O'Meara* contains two poems (so-called) on the subject of the execution of St. John the Baptist. One of these which will be found at fo. 172b. 1 (pencil pagination)² relates the familiar story of the Baptist's beheading at Herod, Salome's dancing, and the demand for the Baptist's head as a reward. The other poem (fo. 60a. b) which has been edited by Miss Searle in *Proc. R. I. A.* 171, associates the story with a number of extra-Biblical interpolations, including an interminable dispute between members of the royal family. Both poems imply (the first indeed definitely asserts) that no one in Ascalon (sic) could be found to execute the impious sentence, till they came to Mug Ruith, who for a reward undertook to act as executioner.

¹ Is this Fergus the same person as the brother of Starn and Iarbonel? (p. 295). And is he the person after whom "Fad Fergusa" and the Cross of Fergus were named? We need not trouble ourselves with precise questions of chronology in dealing with a passage that brings into connection a sister of the abductor of Tephia, a pupil of Simon Magus, and the mother of Queen Lachair. The facts, which we learn from YBL facs. 190a. 22, and a parallel passage in BB 296a, that Mug Ruith learned the art of war from Salome, whose further chronology is suggestive in connexion with what has been said on p. 323.

² Printed in a more abbreviated form from an Edinburgh ms. by Professor Mackinnon in *Celtic Review*, viii, 168.

When we read an extravagance like this, our first impulse is to ask helplessly with G eronte, *Que diable allait-il faire dans cette gal ere?*—and then to pass on to some other study which promises to be a less dismal waste of time. But when we look at the eschatological literature, to which reference was just now made, we are tempted to take a second glance at the story. For this literature consistently affirms that the trouble is to fall on Ireland on St. John's Day, in revenge for the death of the Baptist. There must therefore have been a real tradition at the basis of these poems, which in some way connected Ireland with the crime of Herod.

The "Paddle-wheel" is sometimes associated with, sometimes superseded by, another instrument of vengeance in these prophecies of judgment to come. This is called the *Sc uap a Fanait*, which must be translated "The Broom from Fanad," however we are to interpret the expression. We have even less materials for determining the nature of the *Sc uap a Fanait* than we have for the *Roth Ramach*. That it likewise played a large, and to the early Christian writers unintelligible, part in Irish literature is perhaps indicated, *inter alia*, by the fact that it seems to have suggested to Colcu ua Dunechda the strange title *Sc uap Chr abaid*, "Broom of Devotion," for the prayer composed by him.¹

The "Broom from Fanad" may have been an instrument of pagan worship, like the *Roth Ramach*: but the expression might well mean a rushing or whirling wind, supposed to have been raised by magic; if the druids were not wind-raisers and rain-makers, they knew little of the craft of the medicine-man. The raising of magical winds is a conspicuous element in the story of the landing of the children of M il in Ireland, as related in *Lebor Gabala*.

But why Fanad? What has this remote Donegal promontory to do with magical winds in the rest of the country? It can hardly be explained merely as another way of saying "a north wind." Such an explanation strikes us at once as insufficient. We may possibly find the clue in a Teutonic myth, which also associates the Baptist with a mighty wind.²

It appears that Herodias, who is here treated not as Herod's wife, but as his dancing daughter, is "placed at the head of the 'furious hosts,' or of witches' nightly expeditions, together with Diana, with Holda and Perahta (Berchta), or in their stead." We further learn that Herodias "is revered by the third part of humanity" (*op. cit.*, p. 284), and that "from midnight

¹ Published in *Otia Merseiana*, ii, 92.

² It will be found discussed in Grimm's *Teutonic Mythology*, tr. Stallybrass, vol. i, p. 283 ff.

till first cockerow she sits on oaks and hazel trees, the rest of her time she floats through the empty air. She was inflamed by love for John, which he did not return: when his head was brought in on a charger, she would fain have covered it with tears and kisses, but it draws back and begins to blow hard at her; the hapless maid is whirled into empty space, and there she hangs for ever."

As Grimm rightly says, this reference to the *torbo* or whirlwind "looks mythical and of high antiquity." Further it is quite clear that he is correct in saying "the Christian myths [sic] of Herodias got mixed up with our native heathen fables." Herodias therefore, who is connected thus with the Baptist and with a whirlwind, stands in the place of a Teutonic wind-divinity. Grimm shows by a number of passages for which reference may be made to the original work, that in Teutonic mythology Herodias, borrowed from Christian lore, is identical with Diana borrowed from classical lore, and again with Hilda, Frø Hilda, or Phaulunis, the native Teutonic sky- and fertility-goddess. Though Hilda is as a rule a benign being, presiding over and rewarding the various branches of human industry, yet she runs with witches and is not unconnected with storms and whirlwinds (*op. cit.* ii, 883).

But we may perhaps venture a step farther. Grimm (*op. cit.* i, 287) quotes a passage from the *Roman de la Rose* relating to a certain *Dame Habonde* or *Dame Abondance*, a domestic deity who increased the riches of the dwellings which she frequented. Of this lady the *Roman de la Rose* says:—

*Dautre part, que li tiers du monde
aille ainsinc avec Dame Habonde—*

showing that Abundia and the being whose place Herodias has usurped are one.

Abundia therefore is a goddess of fertility who is in some way associated with whirlwinds on St. John's Day. May we see this name buried in the supposed *Saug a Fionn*? I suggest that "Fionn" is the guess of some lexicographer trying to make sense of a word to him incomprehensible. What he had before him, in the exemplar which he was studying, was not *Saug a Fionn*, but something like *Saug a Fionn*—a corruption (or perhaps the end of a long series of corruptions) of *Fionn Abundant*. At least, I offer this as a first attempt at explaining something that has never yet been explained.

Some of the eschatological literature may now be summarized as briefly as possible. The *Saug a Fionn* is to destroy the men of Ireland on the feast of St. John, he reaped for the death of the Baptist (*Fidre Chugussa*, Lebor

Brecc Glosses).¹ The descriptions of the plague there given would suit a rushing wind. According to the strange prophetic tract called *Inmacallam in dá Thuarad* one of the signs of the coming end of the age is to be a "conflict round Cnámehoill,"² which the Rawlinson MS. explains in a gloss thus: "the Roth Ramach will proceed till it will be in contact with Cnámehoill." Among the writings of the prophecy-mongers who compiled lists of portents in the names of Adamnán, Colum Cille, and Moling, the Roth Ramach figures conspicuously; a collection of allusions to it will be found in O'Curry's *Manuscript Materials* (references *sub voce* "Roth Ramhach" in index). Putting these together, we gather that they understood the Roth Ramach to be a sort of ship³ which was to sail out of Cnámehoill; and that it was to be associated with a "fiery dart" which was to destroy a large number of the men of Ireland on St. John Baptist's Day, and with the Scúap a Fanait, which was also to work much mischief. Even when the magical instruments are not mentioned, the Feast of St. John the Baptist is indicated as a time when evils may be expected; see for example in *Adamnán's Second Vision*, published in *Revue celtique* xii, at page 424. In the *Dind-shenchas* of Crotta Cliach (*Revue celtique* xv 440) the affliction takes the shape of a dragon.

It is noteworthy, for a reason that will presently appear, that Adamnán's "Prophecy" tells us that "a flame of fire swift as a blast of wind" is to kill three-fourths of the men, women, boys, and girls of Ireland in the twinkling of an eye.

All this mass of seemingly incoherent nonsense becomes intelligible when we remember that *St. John Baptist's day is Midsummer day*, and that all over Christendom the saint has entered on the heritage of the Midsummer rites of Pagandom. In these prophecies of judgment to come, with this clue in hand, we can discern the fragments of a lost folk-tale, told to children in ancient Ireland to warn them against meddling with things that do not concern them.

Our interpreters, the Australians, once more come to our assistance. The Kurnai of Gippsland have a story to the effect that once upon a time "some children of the Kurnai, playing about, found a bull-roarer, which they took home to the camp and showed the women. Immediately the earth crumbled away, and it was all water, and the Kurnai were drowned."⁴ This is the

¹ Bradshaw edition, p. 190. August 29.

² See *Revue celtique*, xxvi, 47, for the text.

³ O'Curry, in his ms. catalogue of manuscripts in the Royal Irish Academy Library, speculates on the possibility of the Roth Ramach being a prophecy of a steamer's paddle-wheel! Nicholas O'Kearney seems to have had no doubt of this.

⁴ Quoted from Rev. L. Fison in *Lang's Custom and Myth*, p. 35; also Haddon, *op. cit.*, p. 310.

Kurnai version of the universal deluge-myth: it also contains a warning of what will happen again should anyone show a bull-roarer to a woman. With this in mind it is not difficult to reconstruct at least in outline, the Irish tale on which the prophecies quoted above are based. It would run somewhat as follows:—

"Once upon a time there was a Midsummer corroboree at Cnámchoill. Mag Ruith was there, swinging the bull-roarer. The voice of the Bull-roarer is the voice of Fal, and whoever sees it without authority becomes blind, whoever hears it becomes deaf, whoever touches it dies. But some profane person was there and he So waters broke forth, and lightning flashed, and there came a powerful whirlwind, and three-fourths of those who were there perished."

We have to leave a blank in the middle as it is useless to speculate on what the particular prohibition might have been in Ireland, the breach of which caused the catastrophe; this would naturally differ in different surroundings. But it may well have been, as in Australia, an exclusion of women. The connection of Tlachta with the wheel does not necessarily rule this out; for the Kurnai have two bull-roarers—one large, called *tandun*; the other small, called *whal tuchan* = "Tandun's wife"¹; yet women are excluded from so much as the sight of them both. There may have been two bull-roarers in Ireland, one connected with the magician Mag Ruith, and the other with his daughter Tlachta; and possibly we may see a hint at an exclusion of women even from the smaller instrument in the mysterious reference to Tlachta's *breaking of the Roth Ramach*.

I am inclined to believe that Mag Ruith is rather the name of an office than of a person; that the "Swinging of the Wheel" was the particular druid to whom the duty of swinging the bull-roarer on ceremonial occasions was assigned. A passage in Keating (*History*, I. T. S. edition, ii. 320) bears this out. Mag Ruith is here introduced as a water-finder, and we are told that he lived during two reigns of thirteen kings; a passage most easily explained by supposing that the terminology called "Mag Ruith" was referred to in various records relating to those reigns, and that the "official historians" mistook it for a personal name. In the passage in Keating we are told that Mag Ruith threw into the air a magic spear (*ge-pendilthea*), and where it fell a spring of water burst forth. Is this a record of the use of the divining rod?

We now see the significance of the statement that St. Ita was "like John the Baptist." Before the saint who founded the monastery came to Beg Eire, that island was the scene of Midsummer ceremonies.

¹ Howitt, quoted in Haadon, *op. cit.*, p. 313.

Fál was not the only "speaking stone" that Ireland possessed. The glosses to *Féilire Oengusso*, which contain so much valuable folk-lore material, under the date 15 August, tell us of a stone at Clogher, Co. Tyrone, adorned with gold and silver, called *Cermand Cestach*, that is, apparently, *Cermand of the Questions*—a suitable name for an oracle-giver. Out of this stone, says the note, a demon used to speak—just as Keating tells us a demon spoke out of the stone of Fál; and, on the testimony of the glossator, it was still to be seen in the form of a short stone on the right-hand side as one entered Clogher Cathedral. The marks of the "joints of gold and silver" with which it was decorated were still visible when the note was written. There is a stone now standing near the cathedral, supposed locally to be the stone referred to. I have not seen it, but to judge from a description, with a sketch, that has been most kindly sent me by the Rev. J. E. McKenna, P.P., M.R.I.A., I feel sure that it cannot be the original stone, but (as he suggests) a block—a lintel or sill-stone, perhaps—from some of the predecessors of the present cathedral building.

Now another "idol" of Ireland was decorated with gold. This was the figure called variously *Cromm Crúaich* and *Cenn Crúaich*; and when we notice that the name *Cermand* is merely what the late Lewis Carroll called a "portmanteau word," made up of the alternatives *Cromm* and *Cenn*, we are led to infer that the deity so styled was represented by the stone of Clogher. That St. Patrick's *Cromm* was a speaking stone may be inferred from the name of the "water" near it, *Guth Ard*, to which reference has already been made; and it is curious that in the description of the prostrations before *Cromm Crúaich*, in which king *Tigernmas* met his death, we are told that "three-fourths of the men, women, boys, and girls of Ireland died"—the same expression that *Adamnán* is made to use in the prophecy attributed to him.

The pillar of *Cnámchoill* and the stone of *Forcarthu*—the latter perhaps a *lám-dia* or small hand-stone—were very likely other oracular stones of the same kind. The well-known *Cloch Labhráis* in Stradbally parish, Co. Waterford,¹ and whatever stone gave its name to Clolourish townland in the neighbourhood of Enniscorthy²—itself called after a standing stone, whether the same or some other—may also have been oracular stones, worked in the same way as Fál. A Christian analogy to these oracular stones may be quoted from the Lismore Life of St. Patrick.³ The stone on which St. Patrick was born was wont to shed tears when a false oath was pronounced over it.

¹ See Power's *Place-names of the Decies*, p. 174, for this stone and its legend.

² Joyce's *Social History*, i, 277.

³ Ed. Stokes, line 50.

Cromm Crúaich is called, in the various well-known versions of St. Patrick's encounter with him, "King-idd of adoration." If, as seems likely from the foregoing comparisons, we are to equate Cromm to Fál, this expression will become more intelligible: for, as we have already seen, "king" is one of the meanings which the glossators attach to the word Fál. That he ever seriously bore the name Cromm Crúaich I greatly doubt. The translation of the name is uncertain, depending on whether we are to adopt *Crúaich* or *Crúach* as the form of the second word. In the former case, "crooked one of the mound" or "worm of the mound," might be the meaning: in the latter case, "crooked-guy," or "gory-worm," might be intended.¹ In either case, the name is more probably a nickname given to the god in contempt. The two variants, *Cromm Crúa(i)ch* and *Cenn Crúa(i)ch*, seem to survive in popular recollection in "Raw-head" and "Bloody-bones" (turning *Cromm* to *Croch*), two nursery legics of a less refined past generation. This would favour the renderings involving *crú*, gone: on the other hand, the form of the name which we find in two late "Ossianic" poems is in favour of the "mound" rendering. These are *Crom na Cairrge*² and *Crom ni Carna*.³

It is curious that though it was never forgotten that "Crom" was a god—*ides* in his house continued down to the last century on Galloway Sunday, the Sunday when (or after) Ing-masol, in Co. Clare⁴—yet efforts were made to demitise him. A story to be found in the Book of Lismore⁵ and in the Book of Fermoy (B.L. 1) makes him a man, who from the day of his birth was the humble servant of a crowd of demons in all sin and bad manners, but whose soul at his death was rescued from their clutches by St. Patrick. A modern folk-tale (*Revue celtique*, iv, 175) makes him a servant of St. Patrick. Compare the first tale in Hyde's *Legends of Saints and Sinners*.

And though the bull-roarer was forgotten, and the references to it misunderstood, yet it has lived on in folk-memory. Dr. Holden⁶ tells of how a boy in the Down parish with a bull-roarer, now degenerated to a rustic toy, was reproved by an old woman, who had had that "he was meddling with a sacred thing"; and Andrew Lang, in his article on the Bull-roarer in

¹ The theory that has been drawn between Cenn Crúaich and the Brythonic Penmou-groun (*Journal asiatique*, xxxii, 316) seems to me doubtful. It assumes an identical form of worship among the Brythonic tribes, which must first be proved.

² *Ossianic Soc. Trans.*, ii, p. 53, where the god appears as a monster in Greece.

³ *Book of Dean of Lismore*, ed. Skene, text p. 54.

⁴ *Teste* Brian O'Looney, *Proc. R.I.A.* II, ii, p. 268.

⁵ An excellent copy of Stokes's catalogue of the contents of that ms. prefixed to his edition of the *Book of the Saints*, 1195 f. of O'Logan's transcript of the ms. in the R.I.A. Library.

⁶ *Study of Man*, p. 283.

Hastings' *Encyclopædia of Religion and Ethics*, quotes (vol. ii, p. 891) a note of his own, not, be it confessed, very lucid, but apparently to the effect that a Selkirkshire schoolmaster from Cantire—who happened to be a namesake of my own—told him that the first bull-roarer "in this quarter [Cantire?] fell from Juppiter."

The last event of the inauguration was the *gairm rí*, the proclamation or acknowledgment of the royalty of the new king. Some passages bearing on this act will be found referred to in the note in Meyer's edition of *Cath Finntrága*, p. 82; but the *locus classicus* is certainly the curious paragraph in the *Life of Colmán mac Luacháin*, in which the saint is conferring a reward on one of his followers.¹ The whole incident is very remarkable and worth summarizing briefly. Conall Guthbind king of Meath had killed Mael-Odrán, a refugee with Colmán. Colmán said, "Let the earth swallow up the horses and chariots of the island whence thou hast come";² and so it fell out. Conall came to slay Colmán, but was driven astray by a magic mist. He fell into the hands of his enemies Blathmac and Diarmait, kings of Temair, but escaped from them, only to fall into the power of Mael-Umae, a relative and tenant of Colmán. Mael-Umae slew him; Conall uttered a dying curse that every king who held Temair should revenge his, Conall's, death upon Mael-Umae.

Mael-Umae came and reported the matter to Colmán, who revoked the curse, substituting the blessing—that to Mael-Umae and his descendants should be the privilege of proclaiming the *gairm rí* over every new king in Temair. Here an unknown glossator has drawn a pen-picture of the scene in the margin of his ms.; the note has become incorporated with the text, but is easily separated from it. He describes the king "standing at the foot of *Cairthe na nFíall*," that is, of course, Lia Fáil; and the herald "standing on a flagstone below." Of this flagstone we do not hear elsewhere, but that is no reason why it should not have existed. It reminds us not a little of Saxo's³ statement that "the ancients, when they were to choose a king, were wont to stand on stones planted in the ground, and to proclaim their votes, in order to foreshadow from the steadfastness of the stones that the deed would be

¹ *Todd Lectures*, vol. xvii, p. 72.

² *Is cett dóibsin talam dia sbuend*—an idiomatic expression for an imperative, not a permissive. To translate it literally "the earth has leave to swallow them" is childish.

³ Saxo, tr. Elton and Powell, p. 16. See Frazer's observations on the custom in his *Essay Folklore in the Old Testament* (Essays presented to E. B. Tylor, p. 132). Mr. Armstrong has reminded me of this reference.

lasting." The herald then utters the words which were probably the established formula—*Rígi ocus aircchus hÉirenn duit, a rí!* "Thine the kingship and lordship of Ireland, O king": Then a remarkable thing happens. The king (*a*) utters a curse, and (*b*) makes a cast of a spear at the herald, who (*c*) defends himself "with an unbound horsewhip" (*cehlasc gan imálad*). This has every appearance of being an otherwise unrecorded incident in the ritual, which the glossator has adapted to the special case before him. The formula of the curse is "*Uoderec ort-sa! An tuccais Conall Guthbind le!*" "hast thou brought Conall Guthbind with thee?"—an inquiry altogether meaningless if read in connexion with the story to which it is fitted; but at least as intelligible as the majority of analogous formulae if we remember that the herald has just been speaking and acting in the part of a divine being who is *guth-bind*, "of melodious voice." As to *uoderec ort-sa*, which Kuno Meyer in his edition of the text has not attempted to interpret, may it not mean "The Red Cow upon thee!"—an invocation of a rival and therefore hostile totemic deity, the sacred cows of Temair being *white*.

But why should the king attack the herald? There is a sort of parallel to this singular rite in the inauguration of the kings of Uganda. After the ceremonies there were ended, "two men were brought forward blindfolded, one of whom the king shot slightly with an arrow, who was thereupon sent to Bunyoro as 'scape-goat' with the remains of the sacred fire from the royal hut, the second man was liberated."¹ A more complete explanation may be arrived at, however, if we start with the weapon with which the herald defends himself. I had missed the enormous significance of the horsewhip, which I had supposed to be the cord of the bull-roarer. But Mr. Cook reminded me that the king was now, after the completion of the rites, a divine horse, so that the horsewhip was an appropriate weapon for the herald to use.

This does not however explain why the herald should be thus called upon to defend himself. But let the reader now turn back to the skeleton of the epic poem, in which the beliefs underlying these rites were systematized, and he will see that Eochu Oil-athair (or whatever name we may choose for the demi-god founder of the monarchy) had, or seems to have had, another function besides that of a producer of fertility. He was a *chthonic* deity, Dis Pater, god of the dead. The first thing that the new king does, as soon as he is made a god, is to strike with the devouring spear of death the nearest living creature that he comes in contact with. The herald so *ἰπιόδαμος* subdues the death-horse with the most appropriate weapon, a horsewhip.

¹ Rosscoe, *The Bopprende*, p. 200. I am indebted to Sir James Frazer for calling my attention to this passage.

In a word, this very interesting "footnote" preserves for us the description of what was probably the most primitive rite of the whole series of inauguration ceremonies. We think of the cults which centred in Phigaleia, of the chthonic horse Poseidon who wooed Demeter in the form of a mare, and whose taming is represented on certain gems.¹ The underlying idea is the same in Arcadia as at Temair—the god of death must be subdued, before he can begin to be a god of life. The Red Cow (if my suggested translation of the curse be correct) would most likely have been also a chthonic animal-god.

It may be asked why there is no mention of this singularly interesting part of the ceremony in the tract *Síl Chonairi*. The reason probably is, that it is not really part of the inauguration rite. It is the first action of the king *after* his apotheosis.

6.—THE GODS AND THE CULTS OF TEMAIR.

"Seldom is the sovereignty gained without battles and conflicts; but in the end it is beautiful and goodly." So said the hag, the impersonation of the sovereignty of Ireland, to the youthful Niall, afterwards to be named from his troop of hostages. The man, chosen by the dreams of him who has assimilated the divine bull, made one with the divine horse, reborn, through the stone monuments of the dead and doubtless deified druids, into a life divine, has been led up to Fál. Fál has spoken and has accepted him. The succession, broken by the untoward event of the *natural* death of the previous king, has once more begun. The new king, no longer a man but a god, is to enjoy his office till a day shall come when a stronger man than he shall arrive, to wrest the divine spark from him and to reign as god-king on earth in his stead.

Meanwhile he must carefully guard his divinity. The tract *Teoasca Cormaic* sets forth the idea of kingly duty, as understood in the ninth century—founded, doubtless, on older traditions. Its prescriptions can be divided into (a) *common-place morality*, as firmness without anger, patience without strife, &c.; (b) *duties such as were special to the Irish organization*, as hostages in fetters, manifold sureties, fasting on neighbouring territories, exalting privileged persons, forfeiture of sea-waifs, silken raiment; (d) *duties as a surety of good crops*, as fertility during his reign, mast on trees, fish in creeks, earth fruitful. So the Triads² count as the three qualifications of a king, treaties with other kings, the Assembly of Temair, and abundance during his reign. Again, in the

¹ See Mr. Cook's article on *Animal Worship in the Mycenaean Age* in *Journal of Hellenic Studies*, xiv, especially pp. 138-150.

² Todd Lectures, xiii, 26.

Treasa Cluain,¹ the characteristics of a good chief are set forth. In the very first place of this long list comes *cap sa gessa*, "let him be well furnished with gessa." He is hedged round with a number of restrictions, designed to protect his divinity from injury, and from injuring others. These restrictions, called in the native literature *gessa*, it now becomes our duty briefly to study.

The word *geis* is sometimes translated *tabu*. The translation is not strictly exact. A *tabu* properly speaking has the implication of a reserved privilege, which does not necessarily belong to a *geis*. A *geis* is a precept, positive or negative, differing however from an ordinary precept in that it applies, not to the community at large, but to an individual or to a group of individuals. As examples of these different kinds of regulations, we may take the following instances from contemporary life — "Only members admitted" is a *tabu*, against non-members, in favour of members. "No smoking allowed here" is a *precept*, in this case negative, differing from a *geis* in that it is universal. As an example of a positive *geis* we may cite the ordinary regulation which requires officers to travel first-class on railways. A good example of a negative *geis* is the rule preventing members of the peerage or clergymen from holding seats in the House of Commons. "Officers must travel first-class" (other people being at liberty to please themselves) is a *geis*. "No one but officers may travel first-class" (other people being prohibited from doing so) would be a *tabu*.

One of the most curious and perplexing phenomena in all Irish literature is the power, nowhere explained, which people seem to have possessed of imposing *gessa* on others. Gráda puts a *geis* on the ridge of druidry, or, apparently, a particularly strong and binding *geis* on Diarmuid to elope with her, and Diarmuid is obliged to do so, though it is much against his will. It is curious that all human relations would have been impossible had the power been so simple as is described. Gráda must have done something else, which the sense of propriety felt by the Christian character prevented her from revealing — perhaps a gesture, similar some magical instrument, or what-not—in order to make her *gessa* effective.²

The inviolable stone called *Linn* or *coirt* preserves to us the *gessa* which hedged the life and the body of the king of Tara. Though this comment

¹ Todd Lectures, xv, pp. 2, 12.

² As first sight one would appear to be contradicted from a *tabu* against peers and clergy, in favour of commoners. The difference however is essential. In a *tabu* a minority of the whole community is excluded from a certain status or privilege. In a negative *geis* a majority of the community is thus excluded.

³ There is a curious instance recorded in Meville's story, whereby A can compel B to do something which he is unwilling to do, by referring to the head of a third person who is in a more delicate way connected with B — see *Notes, A History of Meville's Story*, p. 44.

is late, dating from the tenth century, it preserves to us, especially in its opening section, much that is extremely primitive. It may be likened to a telescope, through which we look back far into the early days of our savage ancestors, long anterior to the beginning of written record ; and we thus learn something about their ways of thought.

According to this document the king of Temair was not allowed—

- (1) To let the sun rise on him in his bed in Temair.
- (2) To alight in Mag Breg on Wednesday.
- (3) To cross Mag Cuillind after sunset.
- (4) To slaughter¹ his horses in Fan Chomair.
- (5) To come on Tuesday to Northern Tethba.
- (6) To go on a ship on Monday after Beltene.
- (7) To leave the track of a host on Ath Maigne on Tuesday after Samain.

It is obvious that the greater number of the above restrictions are excerpts from an elaborate calendar of *dies nefasti*, other fragments of which are to be found in the lists of gessa on the provincial kings contained in the same tract. What evil influences were abroad on Mag Breg on the third day of the lunar phase, or on Mag Cuillind after sunset, or in Northern Tethba on the second day of the lunar phase, we are unable to say ; possibly these were holy days and holy places of the aboriginal and therefore rival religion. That such creed-exclusiveness was part of the scheme is shown very clearly by the gessa of the king of the Ulaid, which are by far the easiest to understand. These included (1) presence at Echras Ratha Line among the warriors of Dál nAraide ; (2) listening to the fluttering of birds of Lind Sailech after sunset—clearly because these bird-flights were oracular ; (3) partaking of the feast of the flesh of the bull of Daire mac Daire, that is to say, the ceremonial eating of the flesh of the bull-god better known as Dond Cualnge ; (4) coming on Mag Coba in March ; and (5) drinking of the water of Bó Nemid (the cow of Nemed, the legendary leader of the aboriginal tribes to Ireland) between two darknesses, *i. e.* in the daytime. It is plain that the king of the Ulaid had to be especially careful to guard his divinity uncontaminated from aboriginal rites in the northern province, where the Pictish tribes were more closely concentrated. The Dál nAraide were a pre-Celtic people, and they presumably had a sacred assembly at Echras² Ratha Line ; and in the prohibition of the bull-feast of Dond Cualnge and of the well of the aboriginal sacred cow we see other indications of the war of pre-Celtic and of Celtic creeds.

¹ *Staidi a each.* O'Donovan, who presumably could not guess why the king of Temair should slaughter his horses under any circumstances, gives the milder rendering "incite."

² O'Donovan translates this word "horse-fair," which is hardly exact.

This digression is of service to our present purpose, for the Ulidian prohibitions most clearly enable us to understand that these lists of gessa belong to the dominant Celtic peoples, and that the actions which they are designed to prevent belong to the religion of the aboriginal tribes.¹

Returning to the Temair prohibitions, we remark that the first is not a little reminiscent of the prohibition which forbade the Mikado of Japan from going into the open air, *because the sun was not worthy to shine upon him*.² The sun must not shine on the king in his bed—he must not expose his sacred body, *ai'sheahill*, to the touch of its rays. It is worthy of note that the Monday after Beltene, the first of May, and the Tuesday after the preceding Samain, the first of November, always fall on the same day of the month, except when the intercalary day of a leap-year intervenes; as though naval expeditions on a certain day after Beltene, and military expeditions *on the same day* after Samain, were forbidden. The reference to the horse-sacrifice is especially interesting. The horse would necessarily, as a totem, be a sacred animal, only to be sacrificed on extraordinary occasions, such as the inauguration of a new monarch; the king must therefore lend no countenance to an aboriginal sacrifice of this animal which took place, presumably annually, at Fan-Chemair. We may suppose this locality, now unfortunately unknown, to have been a sanctuary of some pre-Celtic horse divinity.

Beside these restrictions on his liberty, the king enjoyed the following privileges. These were it is now unnecessary to point out, the true *tabus*—the things set apart for the king's use.

- (1) The fish of Boyne,
- (2) The deer of Luibnech,
- (3) The harvest of Manann,
- (4) The sloes of Bri Léith,
- (5) The cresses of Brosna,
- (6) The water of Tlachtga,
- (7) The game of Nás,

¹ At least, in some cases. In others, the geis is designed to prevent the repetition of some action which when performed had been followed by misfortune. Ageis with complicated detail, such as that which forbade the king of Cruachu "to race with the rider of a grey one-eyed horse in Ath Galtra between two hurdles," can only mean that a king of Cruachu once really did the deed specified: something untoward happened afterwards: on the principle *quod licet non propter hoc*, the king's action was supposed to be the cause of the misfortune; and as it was not certain which of the details of the action had offended the Powers, the whole complicated crime was minutely specified to guard against its being committed again.

² *Essays, Fables and the Poems of the Soul*, p. 3, quoting Kaempfer's *Japan* (1727).

and, according to the poem of Cúán ó Lothcháin, which enumerates these tabus, his partaking of these dainties, which were brought to the king on the Calends of August, secured fruitfulness in the earth, victory in battle, and wisdom in counsel.¹

Mr. A. B. Cook has already discussed these tabus.² In addition to the important points which he there brings forward, and which it is unnecessary here to repeat, a possible connexion may be drawn between the Boyne, the river of the white cow, on the bank of which is situate the cemetery of the kings, and the well of the white cow at Temair. Luibnech is doubtless the place of that name near Gorey, in Wexford, chiefly remarkable as the retreat of Finnachta, who in the ninth century abandoned the kingship of Connacht in order to take up the life of a hermit at this place. According to the curious story of the *Ecstasy of Finnachta*³ he was assisted by certain wild cattle in the task of building his church, which seems to indicate a tradition that the cattle of this place possessed a supernatural character. There is nothing to prove the sanctity of Brosna, so far as I know, except the passage before us, which however leaves it beyond doubt. That the water of Tlachtga should be sacred to the king of Temair will be intelligible after what we have already learnt about that place, and the druidess from which it was said to have derived its name.

These gessa and tabus are in themselves quite sufficient to prove that the king of Temair was a god incarnate: after the work that has been done on kindred subjects by Frazer, which has already been applied to the case before us by Cook and by Baudiš, there can be no possible doubt on this subject. But the question remains, what god was supposed to take up his abode in the body of the king?

Probably a simple answer can hardly be given to this question. What has already been said would seem to show that even in primitive times there was a complicated variety of religions and of cults meeting at Temair. But some light is available on this question from a consideration of the Assemblies which at stated intervals were convened on the ridge, and especially from the time of the year at which they were held. The association of a good king with good crops, and of a bad king with bad crops, would lead us *prima facie* to expect that the king was an incarnation of the spirit of vegetation. This is confirmed by the dates of the Temair assemblies.

The Assemblies, the technical term for which is *féis* or *oenach*, were a prominent feature in the religious life of ancient Ireland. The chief centres

¹ *Lebor na ccert*, ed. O'Donovan, pp. 8, 9.

² *Folk-lore*, xvii, 162.

³ *Yellow Book of Lecan*, facs. 191 a; *Book of Ballymote*, facs. 266 b.

where they were held were at Temair, Tailtiu, Carman, Tlachtga, and Uisnech. There were minor local festivals in other centres as well. It is noteworthy that these assemblies do not seem to have been confined to the tribes in whose territories their sites were situated, but were conventions of the whole country. This point is worth noticing, for it is often erroneously stated that there was no sense of unity in the country at large until it was imposed from without. In point of fact, though it would lead us too far from our present subject to enlarge on this topic, it is not difficult to detect traces of an underlying sense of unity throughout the whole history, obscured to the superficial observer by the endless wars of rival tribes. One of the strongest unifying forces was this system of periodical religious assemblies. We may perhaps compare the influence of the Delphian Amphictyony in developing a Pan-Hellenic instinct among the disunited states of Greece.

The centres of the greater assemblies were all pre-eminent cemeteries; but it would be rash to assume that therefore the assemblies were primarily convened for the worship of the dead. The assemblies may have been the cause of the choice of site for the cemetery, not *vice versa*. On the other hand there is evidence that an assembly-mound was presumably a burial-mound; thus the Eógan, sitting on the assembly-mound beside Sescenn na nAiged, ask their leader, as a matter of course, "Who is the warrior on whose grave we are?"¹ Moreover, we have seen that some of the most important religious buildings at Temair were designed so as to incorporate a mound that has all the appearance of being a tumulus.

We cannot assume that the purpose of the assemblies, and their religious rites, were identical at the different sites. Different assemblies were in honour of different deities, as is shown by the fact that they occurred on different days of the year. The assembly of Uisnech fell on Beltane, that of Tailtiu on Lugnasad, that of Temair on Samhain.² Carman was a Lugnasad festival,³ and Tlachtga a Samhain celebration.⁴ This means that Temair and Tlachtga are to be classed together, as we might have expected. Similarly Carman and Tailtiu are to be classed together. Lugnasad is some sort of festival of Lug, the sun-god — possibly the feast of the marriage of the sun-god and his consort (earth or moon): these places, therefore, are sun-shrines.

We have already seen that it is on Lug-nasad that the king of Temair reserved the *clochán* which were *tuá* to him and so far we may admit an acknowledgment of the sun-god. Doubtless, one of his duties was to make

¹ *Fiannúigecht*, in Todd Lect. Series, xvi, 54.

² *Silva Gadelica*, i, 73; ii, 77.

³ *Metrical Dind-shechus*, Todd Lect, x, pp. 18, 19.

⁴ Keating's *Foras Feasa ar Éirínn* (I.T.S. ed.), ii, p. 246.

the sun shine as long and as brightly as he conveniently could; and it may perhaps be guessed that a certain talisman, called the *Roth Chrói*, described as a golden brooch that was passed from king to king,¹ was an amulet for this purpose.² But the main festival of Temair was not a solar festival. It was the feast of the beginning of winter, when the annual death of the spirit of vegetation was solemnly celebrated.

This being so, we might expect that the re-birth of the same being should be celebrated at or near the vernal equinox. And by rare good fortune we have evidence that this occasion also was a solemn festival at Temair.

The evidence is afforded us by the well-known story of St. Patrick's proceedings at Temair on the Easter after his arrival in the country as a missionary. It is needless to do more than to remind the reader that he lit the Paschal fire in full view of Temair, before the sacred fire was there kindled: a sacrilege so serious that the penalty was death. But the question of the authenticity of this story, which has been attacked by scholars of weight, is one which it is important to consider before we proceed to deduce anything from it.

While the undignified display of magic, with which the saint is said to have confounded the king's druids, is doubtless a legendary accretion,³ I see no reason against accepting the story in its main lines. The druidic prophecy of the coming of the "shave-pates" required no supernatural anticipation of the future. Druidry had been suppressed in Gaul, and was eclipsed in Britain; but it still flourished in Ireland, and we may suppose that many persecuted druids from overseas found there a sanctuary. From these refugees the druids of King Loeguire would have heard of the strange religion whose ritual is so naïvely described in the quatrain ascribed to them. It would only be a matter of time before the "shave-pates" would make their way to Ireland; and the druids sought to warn the king in time to suppress the new teaching, which would inevitably threaten their own supremacy, so soon as it appeared. Their recognition of the Paschal fire, also, needed no miraculous insight. The druids doubtless knew that Patrick had already arrived in Ireland and was making

¹ *Revue celtique*, xx, 138, 421.

² *Cró* means a fence, and it may perhaps be no mere coincidence that this object bore a name with the same apparent meaning as *Roth Fáil*. In any case it was a thing so sacred that the bardic demand for its surrender was the last straw which broke the patience of Aed mac Ainmirech, and determined that king to abolish the bardic order.

³ One of the druids was said to have been caught up into the air and dashed to the ground. This was the legendary fate of Simon Magus, who has an indirect connexion with the Temair traditions through Mug Ruith: the tradition is probably responsible for the "flying-machine" conception of the Roth Ramach. We have already seen that the names given to king Loeguire's druids are not historical.

headway with his work of evangelization. No one else would have dared to disobey the prohibition against strange fire. Unless quenched forthwith, the light of the conquering Faith would never be extinguished. The druids of the semi- (or wholly) pagan king, Diarmait mac Cerrbeil, made a similar prophecy respecting Ciarán of Clonnaeois.¹ The left-hand turn of the king before proceeding to obey the druid's behests—possibly in the stone circle called the Deisel—is extremely interesting, and is one of those vivid touches that would not have occurred to a legend-monger.

Professor Bury, in his *Life of St. Patrick*, sees in this story a legend framed by people with "an instinct for scenic effect. The bold and brilliant idea of the first Easter fire flashing defiance across the plain of Meath to the heathen powers of Tara, and the vision of the king with his queen and sorcerers setting forth from their palace in the depth of night . . . is a picture not unworthy of the best of those nameless story-makers who . . . transfigure the facts of history. The Calendar is disregarded. The idea is that Easter is to replace Beltane, the Christian to overcome the heathen fire; and it is a matter of no import that the day of Beltane was the first day of summer which could never fall on Easter Eve."²

I cannot help thinking that in this eloquent passage Professor Bury does the hagiographers too much honour. Scenic effect was the very last thing at which these deplorably "pedestrian" writers aimed. So much is this the case, that when we come across any specially effective incident, or what seems to be a striking flight of fancy, in all the dreary waste of pointless and often immoral and un-Christian miracles—when, in short, the saint is depicted as other than an inhuman monster, doling out "shortness of life and hell" to all and sundry as the penalty for the least affront—then we may fairly and without paradox affirm that the passage is too good to be *false*, and that here the real saint is shown to us. The delightful colloquy of St. Patrick with the simple-minded maidens of Cruachá—the beautiful interview (infamously travestied by Moore in his *Irish Melodies*) between the hermit of Inis Cathang and her who would have shared his devotion—the noble death-scene of St. Ciarán, one of the most impressive passages in Christian literature—the dignified and solemn self-revelation of the *Confessio Patricii*—such treasures as these are beyond the wit of mediæval hagiographers to invent.

¹ See *Silva Gaddica*, i, 73; ii, 76.

² *Op. cit.*, pp. 106-7.

This pretty story has been spoilt by some mawkish sentimentalist, who has added a tag which made the children *wee* after their meeting with the saint! Had the incident terminated in so gruesome a fashion, we should have heard no more of St. Patrick, for his numerous enemies would have had a very good case for arraigning him on the charge of killing the king's daughters by poison or by magic.

They are the true *Acta Sanctorum Hiberniae*, and we can only regret that there are so few of them. Take, by way of contrast, a single short example of hagiographical imagination. We read in the *Life of St. Ciarán of Clonmacnois* that when he was setting up one of the posts of his church he called out "This in the eye of Trén"—a person who had been hostile to the saint—whereupon, we are told, Trén's one eye burst in his head.¹ The tale arouses a mild interest as an illustration of the belief in sympathetic magic; but the blockheads who concocted, the dullards who, unmoved with indignation, listened to, a libel so atrocious on one of the most Christ-like of Christ's followers in Ireland, would have been quite incapable of the flight of dramatic fancy with which Professor Bury's theory credits them.

But apart from this argument, which is purely psychological and subjective, there is a more serious objection to Professor Bury's criticism. The mistake of supposing that the fire lit by the king was the fire of Beltene was exposed long ago by O'Donovan.² In fact, there is no evidence that the fire of Beltene was ever lit at Temair at all. The *Lismore Life of St. Patrick* asserts that the king was celebrating his own birthday,³ and the statement has been copied more than once from O'Donovan's quotation. There is little or no evidence of the celebration of birthdays as a practice in pre-Christian Ireland⁴; but the hagiographer spoke more truly than he knew.

Easter in A.D. 433, the year of St. Patrick's coming to Temair, fell upon 26 March. As the Paschal Fire was lit on Easter Eve, the festival which the saint violated was held on 25 March. This is the very date on which, in many places, the resurrection of the deity of vegetation was celebrated. For the facts I may refer the reader to Frazer's *Adonis, Attis, Osiris*, i, 306. The death and resurrection of Attis were celebrated in Rome on the 25th day of March. The date corresponds to the 9th of Elaphebolion, the date of the City Dionysia of Attica.⁵ The happy chance of the incidence of Easter in the year after St. Patrick's landing is what apologists used to call an "undesigned coincidence," that goes far to prove (a) the recurrence of a spring festival at Temair on 25 March, and (b) the substantial historicity of the story of St. Patrick's proceedings. It further explains how the king was said to have been celebrating his "birthday." It need not have been the birthday of the man called Loeguire mac Néill; but it was the natal

¹ *Lismore Lives*, line 4399.

² *Lebor na ccert*, introduction, p. 50.

³ Ed. Stokes, line 268.

⁴ Though some sort of connexion seems to have been recognized between persons born on the same day of the year; see *Todd Lect.*, xiv, 16.

⁵ Cook, *Zeus*, i, pp. 680 ff.

day of the spirit of vegetation, of which Loeguire was the incarnation and representative.¹

Incidentally we may notice that this presupposes the adoption in Ireland of the Julian Calendar. We need not assume that the knowledge of the Roman alphabet was the only indirect gift that the Roman Empire had made to Ireland, even though Rome never took the trouble to conquer the country. Once the principle of the Julian calendar became known, its easy applicability to the recurrent phenomena of the solar year would commend its adoption; and we have here an additional piece of evidence that Ireland was by no means outside the current of general European life during the centuries preceding the introduction of Christianity.

The festivals of Temair were thus coincident with the vegetation festivals of the year: the annual birth and death of the spirit of the crops. But these were not the only festivals held throughout the year. We have already seen that the annual supplies were brought for the king's use on Lagnasad. We may fairly assume that the Midsummer celebrations were also held there, as they were universally throughout the country: the fires of St. John still lighted in the West are the relics of this recurring anniversary. And it may be that the strange story of the decapitation of St. John the Baptist, the saint of Midsummer day, by Mug Ruith, may be founded in an annual celebration of the cutting of the last sheaf of the harvest. Frazer has collected an abundance of illustrative examples of this rite,² which is often performed by a special person. It may be that in Ireland the duty was assigned to the functionary to whom the bull-roarer was entrusted.

A passage which has been interpolated into *Toigial Buidne Da Derge* gives us information that seems to be authentic, as to how the Samain fires were lit. When St. Patrick lighted his Paschal fire he "struck it," presumably with a flint.³ This was necessary as he was a newcomer. But the *Buidne Da Derge* passage (the original of which will be found in *Recueil antique*, xvii, 169) implies that a perpetual fire was kept burning from Samain to Samain, the new fire being lighted from an ember of the old. An erection called *torc torad* or *torc caille*, meaning, apparently,⁴ fire-boar, or forest-timber-boar, was made. This seems to have been a structure of logs, fitted closely together, in the heart of which the fire was lighted, so that if a log were removed the fire would blaze out of the opening.⁵

¹ I owe this ingenious observation to Mr. Cook.

² See especially chap. v of *Spirits of the Corn and of the Wild*.

³ *Robemad in tene*, *Liamore Life*, line 326. See Stokes's note, *ad loc.*

⁴ Why should the erection have been called a *boar*? Was it supposed to be the image of a boar-divinity?

⁵ See *loc. cit.*, p. 165.

Something like the pyramidal structure in the "clavie" burnt annually at Burghead¹ seems to be indicated. When the erection had burnt down, the embers were taken, and "stones placed in the Samain-fire"—that is to say, the fire was slowed down so as to be kept alive through the year; and the fire of the following Samain was re-lit from the embers. The writer of this gloss supposed that the succession of Samain fires had begun in the beacon lit at *Dá Derga's* Hostel on the occasion which is described in the romance. In this we need not follow him; but, as is always the case, the fact that such an explanation is given is evidence of the real existence of the thing to be explained—in this case the unbroken succession of the Samain fire. The king, as representative of the divinity that kept the sun alight, was bound to keep alight a perpetual fire at Temair; and to cause it to blaze up at Samain, when the sun was dying, and at the vernal equinox, in order to quicken the sun's reviving flame. In the same way, the Paschal fire burnt continuously, and was the source from which the other fires of a monastery were lighted. When the Paschal fire of St. Ciarán's monastery at Saigir was maliciously extinguished, the brethren had to make shift without a fire at all until it was miraculously re-kindled.²

The passage above quoted from *Togáil Bruidne Dá Derga* implies that the Samain festival was held *annually* at Temair. The constant tradition that appears throughout Irish literature is, however, that it was a triennial celebration. The two statements are not necessarily inconsistent. The celebration may have been held annually, but only publicly every three years. Certainly the festival which St. Patrick interrupted seems to have been confined to the household of Temair. We may, perhaps, venture to compare the Eleusinia, which took place annually, but "seem to have been conducted every four years with especial splendour."³ Every year there was a festival at Temair, but only every three years was there a congress.⁴ As Temair declined in religious interest, owing to the advance of Christianity, the celebration of the *féis* became irregular. The last celebration recorded was in 559 or 560 A.D. Four years later the king Diarmait mac Cerrbeil was murdered. He appears to have been the last king with pagan sympathies, and the *féis* thus came automatically to an end. It was natural for the later hagiographers to connect this cessation of the *féis* with the curse of Ruadán,

¹ See *Reliquary and Illustrated Archaeologist*, i (1895), 22.

² *Betha Chiaráin*, in *Silva Gadelica*, i, 14; ii, 15.

³ Farnell, *Cults of the Greek States*, iii, 165.

⁴ For the meaning of such periodical festivals at intervals of more than one year, see the very ingenious explanation in Frazer's *Spirits of the Corn and of the Wild*, i, 77 sqq.

and to infer that not only was the triennial festival abandoned, but that the ridge itself had been deserted.

It is needless to enter here into the general question of the nature and purpose of fire-festivals such as these. Much has been written on this subject in recent years: and we must confine ourselves in the present study to Temair.

Besides his function as a surety for the goodness of crops, the king was also responsible for the fruitfulness of the cattle. A bad king is marked by failure in the cattle, as well as in the harvest. He is likewise responsible for failure in the fishing.

Returning to the question, *which god* was incarnate in the king, reference should be made to Mr. Cook's articles on the European Sky-god, already alluded to.¹ Much evidence will there be found pointing to Nuadu as the favoured deity. The most noteworthy of these is the passage in *Cóir Aamano*² to the effect that Irel Fáith the king who followed Eremón in the kingdom "was the Nuain Angetlám of the sons of Mil, *but we know not how that comes about (ní fétomar eadh dá ta)*. I refer to this, as it is a most valuable testimony to the care with which the writers of this and similar compilations recorded what they found in the documents before them, even when they confessedly were unable to comprehend them.

Mr. Cook shows also that Lug was supposed to be immanent in the king: and it may be further suggested that the divine woodman Esus (by whatever name he was called in Ireland) was also resident within him. Esus is represented felling a tree under which stands the sun-bull, Tarvos Trigaranos, on the famous altars of Paris and Treves. Now in the monotonous list of kings contained in the "official histories," one of the details told about all the important kings is that they cleared so many plains of timber. This was a work of practical utility, and the annalists doubtless regard it as such and nothing more. But it is possible, without undue straining of probability, to read something deeper into a statement which is repeated with such frequency. The divine woodman alone was privileged to cut divine trees. It was the king's prerogative as the incarnation of Esus.⁴

This multiplicity of incarnations can best be explained by supposing that these important Celtic gods have entered into the inheritance of some older divinity. Such a divinity is Fál, who has no place in the "official" genealogies

¹ See especially the part contained in *Folk-lore*, xvii, 26-71.

² *Irische Texte*, iii, p. 326.

³ *Folk-lore*, xvii, 157, 343.

⁴ For guessed parallels see Mr. Cook's article *Zeus, Jupiter, and the Oak*, in the *Classical Review*, xvii, especially at pp. 180, 181.

of the Tuatha Dé Danann. Now a curious passage in *Cóir Anmann* hints at a tale of a marriage between Fál and Nuadu, which would imply that Fál, in spite of the masculine form of his name, was a goddess. We are told that king Nuadu Finn-Fáil, who is of course only an "avatar" of the deity, derived his name from his being "a fair man," and because he was in the habit of "sporting with and making love to" the Stone of Fál.¹ This seems to indicate a deep-rooted doubt as to the sex to which Fál belonged. Such an uncertainty is not quite the same as a change of sex which has befallen a deity in the course of his history.² Venus is a well-known example of the latter phenomenon. It is rather an indication that the god was borrowed at the first from some external source, without complete knowledge of his special characters.

Now, it is worthy of notice that there is a very ancient Italian god who also shows an uncertainty as to his sex. This is the deity of shepherds, Pales by name, honoured on his solemn feast, the *Parilia*, held on 21 April, but otherwise, apparently, forgotten.³ The *Parilia* was a festival designed to secure the fertility of cattle. Among the rites of the festival was the driving of sheep through or between fires; for the survival in these countries of similar rites down to our time, on Mayday, see Rhys, *Celtic Folklore*, i, 309.⁴

When we recollect that the feast of St. "Ibar" of Beg-Eire, *alias* Inis Fáil, is 23 April, only two days after the *Parilia*, we are tempted to wonder whether there is not here something more than accident. The philologists will no doubt remind me, firmly but (*more suo*) not very gently, that the names Fál and Páles cannot be regarded as possessing more than a superficial resemblance. This we may grant freely—if they are to be regarded as a genuine Indo-European inheritance. But what if the name, like the deity, is a loan from without? Is it impossible that in this seemingly bisexual⁵ deity, buried deep in the traditions of Celtic and Italian tribes alike, connected with agricultural or pastoral rites in both communities, celebrated on almost the same day in

¹ *Irische Texte*, iii, 326.

² We use masculine terms and pronouns throughout this and the following paragraphs to avoid cumbersome expressions such as "his or her" which the limitations of the English language would otherwise impose upon us.

³ See Frazer, *The Magic Art*, ii, chap. xix; also the article *Pales* in Roscher's *Lexikon*.

⁴ See also Keating, *Forus Feasa* (I.T.S.), ii, 246.

⁵ I use the word "bisexual" advisedly, for the very remarkable figure from Qully (Loire-Inférieure), illustrated in *Bulletin de la Société d'Anthropologie de Paris*, ser. iv, vol. x, p. 144, is evidence for the existence of a hermaphrodite deity among the Continental Celts. The figure is in the squatting attitude of Cernunnos, and may well be the representative of a type that became a connecting-link between the male Cernunnos figures and the female "Sheelah-na-gigs."

both communities, we are to see some god of, let us say, an ancient Neolithic non-Aryan tribe in Central Europe?

And here, perhaps, is the direction in which we are to look for the solution of an old puzzle. In a tenth-century MS. preserved in Merseburg Cathedral, there is written a charm for the cure of a lame horse. The charm is one of a well-known type, which relates in the fewest possible words (sometimes in prose, sometimes in rude verse), the story of a cure performed by some sacred personage. Take the following as an example of the commonest form:—

*Saint Pierre sur le pont de Dieu s'assit,
Notre-Dame de Caly vint et lui dit—
" Pierre, que fais-tu là ?"
" Dame, c'est pour le mal
De mon chef, que je me suis mis là."
" Saint Pierre, tu te lèveras,
A Saint-Agie tu t'en iras,
Tu prendras le saint onguent
Des plaies mortelles de Notre-Seigneur :
Tu t'en graisseras,
Et trois fois tu diras,
' Jésus, Maria.' "*

It needs no argument to prove that such a charm is of pagan origin, and that names and formulae sacred in the Christian Faith have been substituted for names and formulae of an older faith; further, that the charm is a worn-down folk-story. The personage invoked (in the above example Notre-Dame de Caly) is reminded of a marvellous cure with which he or she is credited in some current popular tale, and is besought to repeat the act of power for the benefit of the sufferer, using the charm. The Merseburg charm differs from the majority of its kind in preserving the pagan names. It runs as follows:—

*P^{ol} ende Wōdan ruorun zi holza,
Dō wart demo Balderes volon sīn ruoz birenkit.
Thu biguolen Sinhtqunt (sic) Sunnā era suister,
Thu biguolen Frīa, Volla era suister,
Thu biguolen Wōdan so he wola conda.
Sōse bēnrenki, sōse bluotrenki, sōse lidirenki,
Bēn zi bēna, bluot zi bluoda,
Līd zi geliden, sōse gelmīda sīn.²*

¹ From L. F. Sene, *Le Folklore des Hautes-Vosges* (Paris, Maisonneuve et Leclerc), p. 350.

² Jacob Grimm, *Kleinere Schriften*, vol. II, p. 11 et seqq. I have to thank Mr. A. B. Cook for calling my attention to some of the literature on this charm.

“ Phol and Wodan fared to a wood,
 There was Balder’s foal’s foot wrenched.
 Then charmed Sinthgund, Sunna her sister,
 Then charmed Frua, Volla her sister,
 Then charmed Wodan, as he well knew [how].
 As bone-wrenching, so blood-wrenching, so limb-wrenching,
 Bone to bone, blood to blood,
 Limb to limbs, as though they were glued.”

The story alluded to is not elsewhere recorded; but its outline is quite clear. Wodan and his companion find Balder in difficulties, owing to his horse’s lameness. The obscure goddesses named have vainly tried to charm the injured limb—the tale, like the common motive of the *three brothers*, narrated two failures to accomplish the task, and the success of the third attempt, made in this case by Wodan. How far the original story entered into the details of the operation, and the reason for the failures, we have no means of knowing. Our present interest is not with these unanswerable questions, but with Wodan’s companion.

His name is unknown elsewhere in the vast range of Teutonic literature. The context shows clearly that he is a god; but what god? Grimm would equate him to Balder;¹ but as Chantepie de la Saussaye, in his *Religion of the Teutons*, points out, he does not explain why Balder appears under his own more usual name in the following line. To this we may add, that surely the sense of the passage is that Wodan and his companion came to the assistance of Balder, as in the charm previously quoted Notre-Dame came to help St. Peter, and as those who used the charm prayed these supernatural beings to come to their aid.

Though the god’s name is unknown elsewhere, Grimm, with the clue afforded by the charm, has discovered reminiscences of him in certain place-names. Such are Pfalsau in Bavaria, formerly *Pholesauwa*, “ Phol’s island”; Pfalzpoint, formerly *Pholespiunt*, “ Phol’s enclosed field”; Phulsborn, formerly *Pholesbrunnen*, “ Phol’s spring.” He has further discovered from certain legal records of the Palatinate of Upper Rhineland that the second day of May was in that region called *Pfalhtag* or *Palltag*, meaning apparently “ Phol’s day.” It is noteworthy that the region where these names occur is the country intercepted between the upper waters of the Rhine and those of the Danube, the country where for other reasons D’Arbois de Jubainville fixed the cradle of the Celts.

In some other comparisons Grimm hardly appears so happy. The earth-works and other structures, called in modern speech *Teufelsgraben*, *Pfalzgraben*,

¹ *Teutonic Mythology*, tr. Stallybrass, vol. iii, p. xix.

Pfahl (*phal*, *phal*), he would associate with the name thus recovered—the last on account of a supposed M.H.G. word *phal*, meaning “bear.” But we have here in Ireland a “Black Pig’s Dyke” independently of the essential link of Middle High German. As for the words compounded with *pfal*, *pfahl*, he tells us that the commonly received etymology from *Pfahl*, “stake,” cannot be right, as there are no stakes in the structures. This observation we now know to be erroneous. Further notwithstanding the coincidence of Phol’s day with the beginning of May, I hardly see my way to follow him in equating the name Phol with the *Bel* of *Beltene*.

It is surely significant that although Phol takes no part in the proceedings, yet his name is mentioned *à fortiori* that of the great Wodan. This suggests a superiority that can be accounted for, with the facts before us, only on the hypothesis of a superior antiquity. We have, in short, in the charm an interesting case of the stratification of two pre-Christian faiths, just as in the French illustration we have the Christian and a pre-Christian faith superposed. Wodan and Frigg, who with Balder are the only characters in the scene whose names are familiar to us, take the place of some pre-Germanic gods, as Our Lady of Lough and St. Peter take the place of pre-Christian beings in the charm from Haute-Vieges. In this connexion it may not be without meaning that the ending of the verse, written the name in a peculiar way—P^hol, with the *h* above the *P*. Is this possibly an attempt at representing the to him unwonted and foreign sound of ϕ , a *p* followed by an aspirate?

In Carmichael’s *Carmina Gælica*, vol. ii, pp. 14-21, are given a number of Gaelic charms from the Scottish Highlands, so closely resembling that of Mersching that they can hardly be unrelated to it. Most probably they and the Mersching charm are derived from a common source. The Gaelic charms have been christianised; in most of them Christ takes the place of Wodan and of Balder, though in two of them St. Brigit is introduced, not unsuggestively. Remembling what *Cæ. Arcton* hints at, as to a connexion of some kind between Fál and Noctis, may we permit ourselves to guess that in an older version of the incantation *Nidals* occupied the place held in the Mersching version by Wodan? The corruption involved would be easy and natural in a Teutonic branch of the tradition.

However that may be, it is to say the least noteworthy that when we fish in the deeper waters of Italian theology, we hook *Pubs*; when we plumb the depths of Teutonic religion, we find *Phol*, and far down below the surface of the troubled sea of Volvic deities we discover *Fál*. It may be added that in Arcadia we find an extraordinary being, by name *Phobos*. He looks like a Centaur, but is in personage and disposition totally different from the

orthodox Centaurs.¹ He is, in fact, just the sort of being that would develop out of an ancient hippanthropic deity who had originally no connexion with Centaurs, but who found himself among a people that had evolved the conception of the normal type of those disagreeable creatures.² We may suppose that Phol was likewise a deity who had something to do with horses, otherwise his appearance in the Merseburg charm would be inexplicable. Fál had certainly a great deal to do with the inauguration of the divine horse-king at Temair. There is no such traceable connexion of Pales with horses. But perhaps all these scattered beings, taken together, enable us to get a little nearer to the "Divine Horse-man," with whom we began our study in these devious paths.

At any rate, Fál belongs certainly to an older stratum of belief than the divine beings among the Tuatha Dé Danann, who are, so to speak, the *dii consentes* of Irish Celtic tradition. Except the one passage quoted from *Cóir Anmann*, hinting at some sort of connexion between Nuadu and Fál, there is no trace of any relation between Fál and the Tribe of Danu.

But if Fál be borrowed from some non-Aryan, neolithic (?) pastoral horse-divinity, the ceremonies at the stone of Fál which completed the induction of the king would become the more intelligible. Fál, the horse divinity, standing somewhere near Duma na Bó, the mound of the sacred cow, accepted the new king, if indeed he did not infuse his personality into him by his mysterious scream. The bull-roarer does not appear to have been used in the Parilia rites; but this might have been a local legacy from pre-Celtic rites at Temair, and peculiar to that site. To some similar local contamination we may, perhaps, trace the different calendar days sacred to the god in Italian, Celtic, and Teutonic centres. It is a difficulty in the way of the complete identification of Pales, Phol, and Fál, that the first is celebrated on 21 April, the second on 2 May, while the chief festival of Temair seems to have fallen in Samain, at a different time of the year altogether. The transference of the festival to near May-day (as in the Rhineland) is perhaps not difficult to understand; and if there were any evidence (which there is not) that May-day was specially celebrated at Temair, our troubles would be greatly diminished. For the Samain feast began a fortnight before 1 November;³ and if the Beltene feast began equally early, it would

¹ See Roscher's articles *Kentauren* and *Pholos*.

² The Master of Emmanuel writes to me: "Φάλος has no early authority in Greek, Theocritus being apparently the first to mention him; though of course he may be very much earlier. There is no obvious etymology for the name in Greek; it therefore might quite well be non-Greek or pre-Greek. But when it comes to borrowing from an unknown language there are no rules one can go by."

³ *Silva Gadelica*, vol. i, 319; vol. ii, 360.

include the date of the Parilia. The evidence at our disposal would indicate that the Parilia was maintained at or near the proper date when the worship of Fál was established at Beg Éire (as witness the incidence of St. Ibar's day); but that when it was centralized at Temair, the paramount importance of a previously existing Samain feast eclipsed the true festival of Fál, and it fell into disuse. It is possible also that it was absorbed by the mid-March festival of Temair, to which we have already made allusion.

The varied activities of the periodical assemblies are described for us in many places, especially the *Dind-sheanchas* of Carman,¹ which has long been recognized as our chief source of information on the subject. It is needless to analyze this poem here. But a very interesting passage in the poem on *Nás*² must not be overlooked, as linking the assemblies with the periodical *lamentations* that took place annually in many centres of cultus. The lamentations for the wives of Lug, the sun-god, are analogous to the Adonis, Attis, Tammuz, and similar commemorations of which Frazer and other students of early ceremonial have collected a large number from all over the world. Besides the games, hucksterings, legal proceedings, and the like, which were carried on on these occasions, there seem also to have been acts of divination and oracle-giving. Queen Meib had the events of the year foretold to her at Samain.³ These oracles were sometimes distinguished by an ingenious ambiguity worthy of the Delphic Pythia: witness the prophecy that King Loegnaire should meet his death "between Eire and Alba" (two hills of the names), or that Fiú and Umall would perish after drinking from a horn—a prophecy fulfilled by the name of the place where he drank from a well.⁴

The manifestations of religion with which we have been concerned, with the exception of the use of the bull-roarer, are to be associated with the Celtic invaders of the country. But Temair was a religious centre before the coming of the Celtic-speaking peoples. The cults which these introduced were grafted on to the religious rites of their predecessors. We must therefore now enquire what the latter may have been.

We find at Temair traces of the cult of sacred animals, sacred trees, sacred waters, and of the dead. Most or all of these are to be assigned to the aborigines.

(1) *Sacred animals*.—These may be either real or imaginary. Of the cult of the latter, which take the form of monsters, we may perhaps see a trace in

¹ See *Todd Lectures*, x, 2.

² *Op. cit.*, p. 48; see p. 50, line 29 *et seq.*

³ *Sílva Galegiza*, i, 179; ii, 202.

⁴ *Aided Finn* in Meyer's *Cath Finntrága*, p. 74.

the stone of the Mata at the south end of the ridge, and the mound of the Luch-donn, the Brown Mouse—really a terrible monster, in spite of his insignificant name—at the northern end. But it is the cult of real animals which was by far the most important.

The only name common to the three versions of the “epic” dynasty, which we have set forth in a previous section, is *Fiachu*. We infer from this that *Fiachu* is a name from the original epic; indeed this one word is the only fragment of the epic which has survived. In two of the versions of the dynasty, this *Fiachu* is associated in a curious way with cattle; and we have already inferred that in the Celtic epic *Fiachu* was a culture-hero, who taught the arts of the pastoral life to his people.

The invaders found their predecessors worshipping a cattle-divinity on the ridge. The cult of this deity took the form of the maintenance of a sacred cow, or of sacred cattle, in which the god was doubtless supposed to be immanent. The existence of sacred cattle on the ridge is testified to by the name *Duma na Bó*, the “mound of the cow,” so called from *Glas Temrach*, the grey cow of Temair, and by the name of the two wells, that of the White Cow and that of the Calf.

With this aboriginal cow-divinity the invaders probably identified the *Fiachu* of their own traditions.

At this stage a question naturally arises. Was the “Grey Cow” or the “White Cow” one animal, which lived and died once for all and was buried within the mound called *Duma na Bó*; or was there a succession of sacred animals, each taking the place of its predecessor when the latter went the way from which even divine cows are not exempt? The latter alternative is by far the more probable. All analogy is against the maintenance of *one* sacred animal, without provision for a successor. There would be no reason in so doing; for the purpose of the sacred cow was doubtless to insure the presence of the cattle-god in the midst of his people, and so to secure fruitfulness in the herds.

But in that case, it will be objected, we ought to have not one “Mound of the Cow,” but a whole cemetery of sacred cattle. The objection is not, however, valid, and may be met in one of two ways. In the first place, it remains to be determined whether *Duma na Bó* was a burial-mound or not; and the most unfortunate doubt which exists as to the identification of this mound makes it improbable that this vital point will ever be satisfactorily settled. If it was a mound in which the remains of a sacred cow had been buried, we may at least remember that the burial of a single individual sacred animal is not unprecedented. Thus, we may recall the grave-monument of the

horse at Sparta, whose tradition is recorded for us by Pausanias.¹ This seems to have been a single burial of a single sacred animal.

But, on the other hand, *Dama na Bó* may not have been a burial mound at all. It may well have been the site of the sacred dairy, in which the succession of kine was kept or milked. We seem to see an indication of a religious institution analogous in no small degree to the sacred dairies which are the sole temples of the Todas of the Nilgiri Hills.² At this point we may call to mind the tradition that makes one of the founders of Temair a lady called Crí-fínd. This foundress has, I suggest, been evolved from a by-name of Temair, Cathair Crói-fínd, which would mean the "fortress of the white cattle-stall."

The sacred cow was indicated by certain marks, chief of which appear to have been red ears on a white body. The milk of such cattle was an antidote to the poison of weapons; *Lebor Gabála* says that the Milesians, i.e. the Celtic peoples, learnt this useful fact from Drosten (note the name and cf. p. 296) a "druid" of the Cruithne or aborigines. That the sanctity of such animals continued into Celtic times—that, in fact, the incoming Celts took over many of the beliefs and the rites of their predecessors—is shown *inter alia* by the fact that the milk of such cattle was the only food that St. Brigid, as a child, could assimilate.³ This probably means that the head of the college of the goddess at Kildare was under some geis that affected and restricted her food; we may fairly compare some of the food-geasa collected by Frazer,⁴ such as these—"the heir to the throne of Loango is forbidden from infancy to eat pork The head-chieftain of the Masu may eat nothing but *milk*, honey, and the roasted livers of goats" and more especially "the diet of the king of Unyoro in Central Africa was strictly regulated He must live on milk and beef *The milk was always drawn from a sacred herd which was kept for his exclusive use.*"

Sacred trees. Though the syncretism of pre-Celtic and of Celtic religions was carried out to a considerable length, it was not complete. The king of the Ulaid, for instance, might not attend the feast of the Bull of Daire son of Daire—that is, of Oak son of Oak. The connexion of sacred cattle and sacred trees is now a commonplace of comparative religion, and need not here be enlarged upon. We see it in the *Turcos Urigaranos* standing under the sacred tree, on the altars of Paris and of Treves. It must be admitted that there is no record, so far as I have been able to find, of any conspicuous single

¹ III, xx, 9.

² See W. H. R. Rivers' monograph on this primitive tribe (London, 1906).

³ Lismore Lives, line 1225.

⁴ *Taboo and the Perils of the Soul*, p. 291 ff.

sacred tree at Temair; but the statements that it was once a "delightful hazel-grove" (VD i) and that an old name for it was Ros ("wood") must not be forgotten. A grove growing on a ridge so sacred must almost of necessity have been itself sacred; as there was a sacred grove at Aricia, so there was a sacred grove at Temair, which presents so many remarkable points of analogy with the Italian sanctuary. With sacred trees are also associated sacred stones, and we have already been able to draw up a goodly list of these. Some of them were no doubt Celtic in origin, but others may have been pre-Celtic.

Sacred waters. The Ridge of Temair is well supplied with springs; indeed it may have been this fact that first invested it with sanctity in the eyes of the ancient inhabitants. The names these bore, and the qualities ascribed to some of them, are sufficient to show their sacred character.

The Dead. Temair early became the centre of an important cemetery. As has already been said, it is most likely that this was a secondary circumstance, the sanctity of the ridge having attracted the cemetery, and not the cemetery having invested the site with sanctity. The site would, however, derive increased sacredness from the burial mounds, and a cult of the dead would inevitably be added to the other cults which centred in the ridge. This probably lasted into Christianity; the contrast between the total disappearance of some of the grave-mounds, and the fair preservation of the residential earthworks, is very noticeable, and can partly be explained as due to the intentional destruction of the former in order to put a stop to objectionable rites.¹

We may now gather together all the details, and give a connected summary of what we may suppose to have been the religious rites of the sanctuary, in continuation of the historical summary at the end of Section 3.

(1) The pre-Celtic organization being based on mother right, Ungust ruled over his people by virtue of his connexion with his wife or his mother. In view of this fact it was possible for the early traditions to ascribe the foundation of Temair to a woman. With this woman the Celts identified their Tea, daughter of Lugaid (= the sun-god Lug) son of Ith (= corn); this identification indicates the original nature of the settlement on the ridge, as a centre of rites associated with the deities of vegetation. The purely political or secular side of the life of Temair was at first far in the background, if indeed it had any existence at all.

¹ Treasure-hunting may also be partly responsible. The rifling of the graves of the dead is an ancient industry. The first practitioner in Ireland was no less a personage than St. Patrick; see *Acallam na Senórach*, ed. Stokes, p. 31.

(2) The site contained, in pre-Celtic times—

- Sacred wells ;
- A sacred dairy ;
- A sacred grove ;

—and it became the site of an important cemetery. Ungust and his successors were, however, not buried there, but at Brug. It may be that their wives were buried at Tailltiu.¹

(3) The worship-rites here observed in the pre-Celtic period took the form of what we may fairly call *corroborees*, at which the bull-roarer was used.

(4) There was a stone circle at the north end of the ridge, which was very likely the central sanctuary in which these rites were performed. But doubtless the whole ridge was sacred, and there were special rites peculiar to the different holy places upon it.

(5) The Celtic invaders entered at the south-east corner of the country, and there first established their special religious observances. In time they spread over the whole country, and when they reached the sanctuary of Tenney they took it over with its religious, and added their own rites to the ancient ceremonies.

(6) The goddesses imposed the following deities:—Fál, and perhaps *Mairisio*, representing an earlier station,² and *Gáide*, the storm-god, euphemistically called *In Daghac*, with *Eris*, *Nuadh*, *Lag*, and the other deities grouped together as the *Tuatha Dé Danann*. Their union with the gods of the aborigines produced an elaborate syncretism, expressed by genealogical or marital relations between different deities, or by the fusing of two or more gods into one god with two or more names.³

(7) The totem-animal of the incomers was the horse, as that of the aborigines had been the cow.

(8) The ridge now became the centre of a divine kingship in which the king ancestrally connected with the horse, was also an incarnation of the god of vegetation and of richness of cattle.

¹ The situation of wells and fountains in burial even yet persists at Inismurray and elsewhere.

² If Fál should represent the deity called *Pales* in Italy, it is conceivable that *Mairisio* may be comparable with *Mater Matrona*, who in Italy is associated with *Pales*, and even sometimes, apparently, fused with him.

³ The syncretism of an incoming god (like *Gáide*) with an aboriginal *hero* such as *Ungust* has its parallels in Greek religion, where we find correspondences established between *Poseidon* and *Erechtheus*, or between *Dionysus* and *Cadmus*.

(9) The purpose of this king being to secure fertility in its various manifestations, it was essential that he should be married, so as to produce the result aimed at by sympathetic magic.

(10) As it was important that the king should be the strongest man available in the community, anyone who could slay the holder of the office was entitled to succeed.

(11) If the king died in office of an apparently natural death, it was regarded as an interposition of the gods, and the succession had to be repaired by an elaborate ritual, in which the sacred animals (both bull and horse), Fál, and other deities or deified men took part.

(12) The annual celebrations took the form of assemblies connected with the crises of the solar year.

(13) A perpetual fire was kept burning, made to blaze into full life on the occasions when the sun seemed to need quickening.

(14) Cormac mac Airt, a man of enlightenment and alert mind, influenced by what he had learned of the Roman organization of Britain, set himself to develop the political rather than the religious side of the life of Temair; for which he seems to have incurred Druidic maledictions. He was partly, but not wholly, successful. If it fell within our present scope to follow out the later history of the ridge, it would appear that the religious interest was dominant throughout, and that when Christianity conquered the earlier faiths the importance of the site dwindled almost to vanishing point; although it is not correct to say that it ever was wholly abandoned down to the end of the independence of Ireland.

7. THE PLACE OF TEMAIR IN EUROPEAN CULTURE.

Till now we have been considering Temair as the scene of the local corroborations of the pre-Celtic and the Celtic tribes which successively occupied the region in which it stands. We have now to see that it is the centre of a much wider interest.

Our researches have led us to the conclusion that there is an intimate connexion between Temair and the tumulus now called New Grange, which is the chief monument of the ancient cemetery called Brug na Bóinne. When we turn our attention to this structure, we find there a great earthen mound, containing a stone-built passage leading to a central tomb-chamber. The plan is extraordinarily like that of the dromos-tholos tombs of the Late Minoan cultures, of which the so-called Treasury of Atreus is the best-known example. Three burial-chambers radiate from the tholos at New Grange,

corresponding to the one chamber in the Atreus tomb. Though the construction of the New Grange dromos is megalithic, that of the tholos is microlithic, in spite of the facts that the walls are masked all round with colossal blocks of stone, and that the side tomb-chambers are roofed with large slabs. New Grange is thus transitional in style between a megalithic and a microlithic construction. The large stones are elaborately decorated with spirals, lozenges, zigzags, and other geometrical devices.

When the wonderful discoveries that our generation has seen in the island of Crete began to be made, in the closing years of the last century, they were hailed in the first rush of enthusiasm as the source and explanation of all the developments of Bronze-age culture in Central and Northern Europe. It was naturally supposed that the spiral pattern originated in Crete, and passed into the hands of the late Minoans of the mainland—the people that had till then been called Mycenaeans—and that from them it travelled along definite trade-routes to the barbarians of the North. The merchant caravans of the cultured Aegean peoples journeyed to the far north lands of Scandinavia and Britain, and to the far west land of Spain, in search of amber, tin, and other valuable commodities, and in return they taught some of the arts of the Aegean to the rude tribes with which they came in contact. The dromos tombs of Mycenae and Orchomenos, with their rich spiral decorations, were the prototypes; the dromos tomb of New Grange, with its barbaric spirals, was the copy. The date of New Grange was confidently fixed at about 1200–1000 B.C., on the basis of this supposed connexion between it and the tombs of Mycenae, the dates of which can be approximately determined.

In short, the Cretan and Mycenaean traders took the place that an earlier generation of antiquaries had accorded to the Phoenicians. Cretan cults and customs were traced where the contemporaries of Stukeley and of Vallancey had seen the god Baal. Now the god Baal, as understood by Stukeley and his friends, had no existence, even in Phoenicia; and I have for some time felt an increasing suspicion that the far-travelled Cretan merchants are destined to follow him to dreamland.

There can be no denial of the remarkable resemblance between the Mycenaean dromos tomb and the New Grange type of sepulchre. The same plan is followed in both. The same motives of ornament appear in both. But let us for a moment consider what is of necessity implied in the acceptance of these resemblances as a proof of the radiation of art-influences outward from the Aegean basin, along the trade-routes. It means that the traders were not only merchants, but were also enthusiastic missionaries. It means that they took the trouble to teach the barbarians with whom they came in contact how to reverence the dead aright and how to build and to decorate

their tombs. It also means that the barbarians had not the usual conservatism of the savage, but that they were sufficiently interested in the message of the strangers to give up their own ways in favour of the ways of unknown people two thousand miles away. All this is possible, but it is in the last degree unlikely. It may be taken for granted that if an amber or tin merchant goes among a barbarous people, he goes to buy amber or tin, and not to teach new ideas in religion or in art to the natives with whom he has to deal. He carries with him the commodities which he knows by experience they will accept in barter, not plans of cumbersome tombs or designs for their artistic enrichment.

It is, indeed, a fair criticism of the theory that would derive New Grange and allied monuments from the Mycenaean tombs, that *the resemblance between them is too great*. There was certainly a trade in tin and amber between the Aegean culture-centres and the northern tribes. But how would this trade be carried on? Not, surely, by single caravans, travelling the whole distance; but by a number of independent caravans, each oscillating back and forth along one stage of the journey. At the meeting-points, each of them would exchange its goods with the caravan of the next stage. Such traders would no doubt exchange stories and news as well as merchandise, and in this way rumours of the great tombs of Mycenae could conceivably be carried to the north of Europe. But it may be questioned whether these rumours, vague as they would necessarily be, could inspire the northerners to try to build tombs to the Mycenaean model. An imitation with no better guidance than a description carried across Europe by word of mouth could hardly be so successful as it actually is.

So far as the plan of New Grange and its construction are concerned, the building can be completely explained as the evolution, and (so to speak) the glorification of a dolmen of the *allée couverte* type; and we need not go so far afield as Mycenae to look for satisfactory prototypes. I may say at once that I am utterly unable to accept theories of culture-development that do not recognize the possibility of the co-existence of more than one independent culture-centre. I cannot side with those who seek to derive all the world's civilization from one region, whether it be Egypt, Crete, India, Mesopotamia—or even Atlantis! Given anywhere a religion that requires a periodical visit to the tombs, then a dromos-tholos structure of some kind will evolve naturally, without necessary relations with any other centre. That the religion which centred in the Mycenaean tombs was such, may be inferred from the elaborate tholos, which was not in itself a burial-place, but a kind of chapel, an ante-room to the tomb-chamber proper. That the religion which centred in New Grange was likewise such, is indicated by a very interesting

feature of that monument, which has not received the attention which it deserves.

This is a standing stone, which, when the chamber was first opened in 1699, was in the centre of the tholos. It is shown in the oldest plan of the chamber, that of Molyneux. It must have shortly afterwards disappeared, for later writers never mention it—doubtless it was appropriated for a gate-post or for some such purpose. Its existence has in recent times been called into question; but, as I think, unjustifiably. It is difficult to see how Molyneux could have been so positive if he had really seen no such stone; and in our own time at least two analogous monuments, of which Molyneux could have had no cognizance, have come to light. One of these is a similar standing stone in the underground bronze-age burial-place at Ballynehatty, near the Giants' Ring.¹ The other is in one of the burial-urns at Carrowkeel, Co. Sligo, the excavation of which was not long ago reported to the Royal Irish Academy.² This last example is especially interesting, for near it were lying a number of small rounded stones. Precisely similar stones were lying in the right-hand grave-chamber of New Grange when it was first opened. They are represented in Molyneux's cut. The drawing is rude, but the resemblance is unmistakable to one who, like myself, saw the Carrowkeel stones in position. They are certainly basylic hand-stones of some sort; and their resemblance to the Australian *charanga* is too striking to escape notice. These stones, at both Carrowkeel and at New Grange, testify to a cult in which the grave-chamber was periodically visited for some purpose or another.

But someone will at this stage object that I am ignoring the evidence of the spirals. It has become a sort of canon of European archaeology that the spiral motive in decoration travelled through Europe from the Aegean along certain trade-routes; and though the constructional resemblance between the Mycenaean tombs and New Grange can thus be explained away, yet it will be urged that the spirals are still strong enough to bind the two together.

Now, it is true that at Orchomenos in Boeotia there is a dromos-tholos tomb having its ceiling decorated with a beautiful diaper of spirals: and that at New Grange there is a dromos-tholos tomb with what might be called a childish copy of that diaper ornamenting its interior. But spirals cannot travel through the air; they must be depicted on some portable object in order to find their way from Orchomenos to the neighbourhood of Drogheda. The lines of the trade-routes connecting these distant places ought to

¹ See *Ulster Journal of Archaeology*, old series, iii, 358.

² *Proceedings R.I.A.*, xxix C, pp. 326, 334.

be peppered with objects of Late Minoan art bearing spirals. Even a few painted potsherds would be sufficient. But there is no such thing. The media through which the spiral patterns were *ex hypothesi* carried to the North have totally disappeared. When this difficulty first occurred to me, I found refuge in the idea that they might have been woven on textiles, which had been bartered to the native tribes in exchange for their tin or their amber. But to this too easy way out of the difficulty I soon saw a fatal objection. The curves of the spirals are not suitable for the ornamentation of textiles. When they were applied thereto, they became rectilinear, and the "Greek fret" pattern survives to show us what the influence of textile work on the spiral pattern has been. Had woven garments carried the spiral patterns to the north, we ought to have found the Greek fret at New Grange; but that motive of decoration nowhere appears in Northern Europe before the La Tène period.

In short, the goods bartered with the northern barbarians in exchange for their tin and their amber were not treasures of Aegean art, but cattle, the one thing which the rude barbarians could appreciate, and the usual medium of exchange before the invention of coinage. Therefore, if we are to suppose that the barbarians acquired the spiral patterns from the Aegean merchants, we must once more postulate the enthusiastic trading missionary, who taught them how to draw spirals in the intervals of business. I for one cannot believe in that engaging altruist. I prefer to believe that the spirals at New Grange are not derived from the Aegean at all, but that they are an independent growth.

If so, they must have had a meaning. People in the cultural stage of the builders of New Grange do not cultivate "art for art's sake." Some simple religious or magical significance must lie hidden in these patterns. And after what has been said in the preceding pages it is not difficult to see generally what that meaning is likely to be. The admirable photographs in Mr. Coffey's book on *New Grange* shew us that the chief motives are lozenges, spirals, zigzags, triangles, and an oval with two or three holes in a line along its major axis (fig. 4*a*). There are one or two other figures, such as the well-known "palm-leaf," which occur once or twice only; but those enumerated are the materials of which the great majority of the patterns are composed. We may see in the lozenges, the head of the bull-roarer; in the spirals, an attempt to express the motion of the hand in keeping the bull-roarer in motion, and thus a symbol of the rotating bull-roarer; in the zigzags, the lightnings of the thunder-god; in the triangles, the axe or the hammer of the thunder-god. The oval with dots I explain as a variety of the bull-roarer known as a "buzz" in America, where it is used by several

of the native tribes. It consists of a disc of wood with two holes through which an endless loop of cord is passed. This being twisted and passed over the hands, the disc is made to revolve rapidly alternately twisting and untwisting the cord; a sound resembling that of the bull-roarer proper is thus produced.¹

Every one of the principal New Grange "ornaments" can thus be explained in a simple and natural way, as referring to the worship that centered in its dark recesses. Even the quartered lozenge (fig. 4*b*), which in the days when I believed in the Cretan theory I imagined to be a double axe, fits into its place as an *ornamented* bull-roarer; the decoration of these

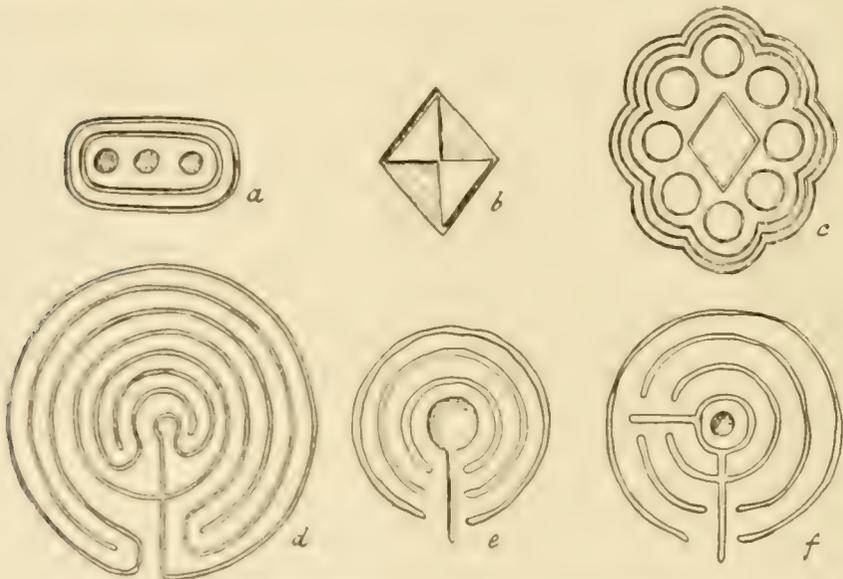


FIG. 4.—Petroglyphs at New Grange and elsewhere.

objects is a study in itself, and is always significant. Around Ungust in his tomb resounds eternally the pealing of thunder and the scream of the bull-roarer; it is little wonder that the incoming Celts should have identified him with *Géide Ollgothach*!

The conclusions here indicated involve the abandonment of everything that had been supposed to have been established as to the date of New Grange. For if New Grange be independent of the Mycenaean tombs, we can no longer use them as having a bearing on the chronological problem. We are driven back to the internal evidence which it presents. Its alliance with the megalithic construction of the dolmens would predispose us (if the Mycenaean analogies

¹ See Haddon, *Study of Man*, p. 284.

had not prejudiced us) to put its date back to the neighbourhood of the dolmen-building period; that is, to about the time of the overlap between the Stone and the Bronze Ages. The axes depicted on its walls are of the flat variety, which would accord with this early dating. The axes sculptured in certain analogous buildings in Brittany are likewise of early type. These indications incline me to put the date of New Grange back to the *beginning* of the Bronze Age—say about 2000—1800 B.C. And if the origin of Temair be as closely bound up with New Grange as I have endeavoured to prove, that will also be the approximate date of the beginning of the sanctuary on the Ridge.

Certain gold ornaments alleged to have been found at the entrance to New Grange, and at one time in the Londesborough collection, would seem to be contradictory of this conclusion.¹ It is natural at first sight to regard these as part of the loot, accidentally dropped by the Scandinavian plunderers of New Grange in the year 862 A.D. But the nature of the collection makes any such interpretation impossible. The objects could not have been associated together; they consist of two late Bronze-Age torques, a gold chain that might possibly be Middle La Tène (probably much later), and a couple of mediæval finger-rings. At the time when these objects were bought by Lord Londesborough, the country was still excited over the Clare gold-find, and everyone was suspicious of his fellow—so much so, that statements then made about the provenance of gold objects are presumptive evidence that they came from some totally different place. The Londesborough “hoard” is clearly a dealer’s “job lot,” said to have come from New Grange in order to invest them with additional interest, and to cover the tracks of the finder or finders; and they have no bearing on the problems of the tumulus itself.

The relation between New Grange and the neighbouring tumuli of Dowth and Knowth is a question on which there is as yet very little to say. Whenever it becomes possible to penetrate into the *arcana* of the last-named hill it may be that light will be found. The exposure of the great stones on the outer kerb of New Grange is also desirable, as these are probably sculptured. The fact that the chambers at Dowth are throughout megalithic in construction prevents us from asserting with over-excessive dogmatism what at first sight would appear the most probable theory, that Dowth was a later imitation of New Grange. The strongest argument for this view lies in the fact that the spirals of New Grange have in Dowth met with the usual fate of the spiral motive, and have broken down into concentric circles. But here

¹ They are figured in *Archæologia*, xxx, plate xii, and also in Lord Londesborough’s *Miscellanea Graphica*,

again we must guard against too great reliance upon Mycenaean analogies. This is certainly what happens in Mycenaean art. The concentric circles of later patterns are quite clearly derived from the spirals of earlier patterns, and there are some interesting transitional forms; this is a commonplace of Aegean art-history, and need not here be enlarged upon or illustrated. But can we now be sure that the spirals of New Grange are necessarily connected genealogically with the circles of Dowth? The former may, as has been suggested, represent the rotating bull-roarer; the latter may represent the sun.

The rotating bull-roarer however appears to be represented at Dowth in another form—as a circle with a large number of radii marked, the radii being in some cases thickened or dilated at the outer ends. These radii may well represent the successive positions of a bull-roarer in its whirling, the thickened end being the head. A similar suggestion might be made with regard to the swastika, in which the four ends of the arms may represent the head of the bull (more slightly bent backwards as it naturally would be in its flight through the air). The circle and radii soon develops into a wheel, which as a *dieu gaulois* has been very fully studied by Henri Gaidoz.¹ There is a danger in research of this kind of spreading a new not too widely and satisfying too many issues; Gustave Housard has not wholly escaped this pitfall when he tries to derive the rose window of a Gothic cathedral from the solar wheel. I therefore content myself here by saying that many or most of the lines which he has collected are quite inconsistent with the idea that the wheel in later times a solar symbol, had its origin in an attempt to represent a rotating bull-roarer.

A question will now naturally arise, namely, how we to reverse the relationship hitherto supposed to have existed between New Grange and the Mycenaean circles, is New Grange the prototype and Mycenae the copy? This is not so impossible as it first sight it would appear to be. If the spirals at New Grange are significant and those at Mycenae merely decorative, then the former represent an earlier stage in development; and if the date here suggested for New Grange be accepted, then that structure is more than 500 years older than the Mycenaean circles. Moreover such a reversal of the accepted theory would be in accordance with an important principle too often lost sight of in developing what I may call the "trade-route" theory of the advance of civilization. We have seen that when a merchant from a civilized centre goes among barbarians, his purpose is to make his own fortune. It is to his interest to keep the barbarians as ignorant as he can.

¹ *Le dieu gaulois du soleil*, in *Revue archéologique*, ser. iii, vols. iv, v, vi (1884-5).

and therefore he teaches them as little as possible. On the other hand, if he finds among them an art or accomplishment which appears to him desirable, he will take steps to acquire it. It follows that *when a trade-route between two communities of different degrees of culture becomes a channel of civilization the culture passes as a rule from the less civilized to the more civilized.* The principle doubtless sounds paradoxical, and it has a host of exceptions—such as, for example, the acquisition of guns by modern savages. It does not run counter to the principle laid down by Rivers¹ that a small community of settlers of high culture can revolutionize the life of a large body of aborigines of low culture. The question of a colonization does not here come in at all. Only the brief periodical visits of traders, whose business is to take as much and to give as little as possible, are contemplated. In such cases the aborigines derive no advantage, except when competition among the traders themselves leads them to give more than they otherwise would, in order to outbid rivals. It is this competition that has introduced firearms, brandy, and other blessings of civilization among modern savages. We cannot therefore state the principle absolutely, but must qualify it by the interjected words “as a rule.” Still, it should never be forgotten, when we are concerned with the study of the influence of ancient trade-routes.

I do not, however, believe that New Grange set a fashion copied by the builders of the Mycenaean tombs. Rather do they appear to me indications of a common culture, universal over Europe at the beginning of the Bronze Age. New Grange comes down to us right out of the heart of this early stage of civilization, with all its barbarism; the Mycenaean tombs are an artistic development of the model, refined by generations of local civilization. On this view of the case, *the civilization that centred in Crete is only a local manifestation of the general culture of Europe during the Bronze Age.* Crete and Egypt, neighbouring countries which early developed intercourse with one another, advanced each other mutually to a pre-eminent position in culture. But Cretan culture is not the parent of European culture; rather is it a brother, hypertrophied owing to a favourable geographical position.

If this be so, other analogies should present themselves. We have not far to go in our search for such analogies. If we leave the chamber of New Grange, and come outside, we find a great circle of standing stones surrounding the mound. This might merely be a fence, delimiting the sacred ground belonging to the sepulchre. But if such were its only purpose, a ring-mound of earth would have been more practical—such a mound as was actually built

¹ *The Contact of Peoples in Essays and Studies Presented to William Ridgeway.*

round the Giants' Ring, near Belfast, or round the cist of Longstone Fort, near Naas.¹ We must seek another explanation.

A constant tradition associates stone circles such as this with a *dance*. Stonehenge is known to mediæval writers as *Chorea Gigantum*. In many places tales are told of dancers who transgressed the bounds of propriety, or who broke the Sabbath, and were as a penalty turned into stone. The stone circle destroyed by St. Patrick represented "Cromm Crúaich" and his attendant deities—that is to say, its stones were aniconic figures of deities; from which we may infer that stone circles elsewhere are groups of aniconic figures. And it is very important to notice that stone circles as a rule consist of the circle *plus* a single stone either inside or (more often) outside the ring, exactly corresponding to Cromm and his sub-gods. The circle called the "Piper's Stones" at Hollywood, Co. Wicklow—about four miles south of Poll a' Phuca waterfall—is of this type; and here a tale is told of how profane dancers were turned to stone; the outer stone, which someone has tried to consecrate by carving a large cross over its top, being the "Piper" who played for the dancers. The field in which these stones stand is called Aughraney, *i.e.*, *Achadh Gillea*, "Sun-field." At Loch Gur, Co. Limerick, is a large circle, called on the Ordnance Map *Rothanna Chruim Dubh*,² which looks exactly as though it had been intended for a dancing-place. And in a pattern several times repeated inside New Grange, we seem to see a suggestion of such a dance at a stone circle. There is a circle of circles—just the way in which a plan of a stone circle would be roughly sketched in an archaeologist's notebook—around which are traced three concentric curving lines representing the course of the dancers; in the centre of the circle is the head of a bull-roarer (fig. 4c), indicating that the dance is accompanied by that instrument.

All these lines of evidence, and others that need not be here enumerated, for they are too many to all intents, point in the direction of a *dance* being an important part of ancient north European religious ritual. The dance was performed *clockwise* or *sunwise* direction, and its meaning is perfectly clear. It was an attempt by sympathetic magic to keep the sun revolving in its appointed course. I conclude that the stones standing round New Grange are representations of worshippers performing an endless sun-dance round

¹ *Proceedings R.I.A.*, xxx. C. 351.

² Both in topography and in toponomy the Ordnance Map of the Loch Gur district has been used by me, as far as with the greatest possible caution. This meaningless name is probably a mistake for *Rothanna Chruim Dhuibh*, the "wheels of Cromm Dubh." It is certainly to be ascribed more to the map-maker than to the invention of some eighteenth-century hedge-schoolmaster, who had read Keating. Some of the "antiquities" marked in the map of this district are of even later invention.

the great man buried within. It is of the same order of ideas as the thunder-symbols pictured on the interior walls. New Grange is the crystallization of an eternal corroboree.

Let us now cross the Continent and visit the sacred island of Delos. Here we find that down to the time of Plutarch the youths were wont to perform a remarkable dance in honour of Apollo. The dance was instituted, as legend said, by Theseus, when, on his return from Crete after slaying the Minotaur, he visited Delos and sacrificed to Apollo, dedicating τὸ ἀφροδίσιον which he had received from Ariadne.¹ The dance was an imitation of the mazy windings of the Cretan labyrinth; and Plutarch, on the authority of Dicaearchus, tells us that the Delians called the ceremony "the Crane Dance."

The current explanation of the name, that the winding twists of the dance were suggestive of the grotesque bowings and dancings characteristic of cranes, is surely insufficient. For why should cranes be taken as the model to follow? The most probable answer to this is that cranes are among the most conspicuous of the migratory birds. They winter in Central Africa and other hot countries; but return northward in early spring. Thus the crane might very early become associated with the re-birth of the warm season; and a dance in which the peculiar motions of the bird were imitated would be a magical ceremony designed to hasten the coming of the spring. We are to understand that originally the dancers personated cranes, probably dressed up as the birds, just as the girls of Brauron dressed up as bears in honour of Artemis.²

The same or a similar dance was to be found in Crete, as Homer³ and Pausanias⁴ tell us. The latter writer, enumerating the works of Daedalus, names Ariadne's Dance in white marble at Cnossos. This brings the labyrinth dance into close connexion with the Minotaur.⁵ A dance in one island of the Aegean connected with the name of Theseus, and another dance on another island of the Aegean connected with the name of Ariadne, especially when both are of a "labyrinthine" nature, are almost of necessity different local manifestations of one and the same rite. It follows that the dance round the bull-god called the Minotaur was a "Crane-dance," even though cranes are not mentioned in connexion with the Cretan rite.

¹ Plutarch, *Theseus* xxi. The ἀφροδίσιον is doubtfully interpreted as being a statue of Aphrodite.

² The *Encyclopaedia Britannica*, eleventh edition, xxvi, 838a, quotes P. S. Pallas, *Reise durch verschiedene Provinzen des Russischen Reichs*, iii, 1778, as an authority for a crane-dance among the Ostiaks of Siberia, in which the dancers are dressed up with the skins and heads of cranes.

³ *Iliad*, xviii, 590.

⁴ IX, xl, 3.

⁵ For a discussion of the Ariadne dance and its meaning, see Frazer, *The Dying God*, p. 75.

Now when so unusual a combination as a bull and cranes occurs, in two different places, it is impossible to suppose that there is nothing more than a coincidence involved. There must be some radical connexion between TARVOS TRIGARANOS of the Paris altar, on which a bull is depicted with three cranes on its back, and those dances of the Aegean islands.¹ But it is hardly to be supposed that the folk-lore of the Minstrel has travelled to Paris, or that the folk-lore of Tarvos Trigaranos has travelled to the Aegean; here again we are to regard them both as local phases of a universal European cult. Tarvos Trigaranos stands in the char under a great tree. His essential connexion with the *Donk Chodoy* has long ago been pointed out by D'Arbois de Jubainville; we must not forget the alternative name given to the Bull of Chaluge in *Zilver en steen*—the Bull of Oak son of Oak, on whose flesh the aborigines of Ulster celebrated a communal feast. Since the researches of Frazer and others, the importance of the oak as a solar emblem has been fully established. The bull of the oak is therefore a solar bull, and the dance of the bull is a solar dance. That the Minstrel is a solar being has been shown by Cook and others.² The crane dance of Deos therefore links on to the dance depicted in the standing stones around New Grange. In a paper like the present we must be content with indicating the arguments thus in bare outline.

It is possible that the same combination of crane and solar symbols is to be seen once more in the well-known type of ornament found on buckets and shields from Eastern Europe and as far north as Denmark, belonging to the end of the Bronze and the beginning of the Iron Age. This consists of a circle, doubtless representing the sun-disk, flanked by the fore-parts of two birds with long necks and heads bent to back. The design much resembles the Egyptian pattern of a sun-disk, or a royal pectoral, flanked by two uraei, and may well have been suggested in the first place by a stray Egyptian scarab. The birds are occasionally identified with swans, but they can just as well be cranes.³ The idea underlying the figure may be the returning sun borne on the backs of the home-seeking migrant birds. — The crane's aerial journeys are of a very extensive kind. . . . Its focus may be observed passing overhead at a marvellous height . . . while the soaring order with which its ranks are marshalled during flight has long attracted attention.⁴ Birds of such habits as these might well be regarded as bringing back the summer sun.

¹ The coincidence has been noticed, though without comment, by Mr. Cook: *Transactions Oxford Congress of Religions*, ii, 186. See also *Zeus*, vol. i, p. 482, where a similar combination of cranes and the sun is cited from Japan.

² See Cook's *Zeus*, vol. i, p. 490 ff.

³ Illustrations will be found in Déchelette, *Manuel*, ii, p. 427.

⁴ *Encyclopaedia Britannica*, s. v. Crane.

The Cretan labyrinth is represented on Cretan coins under a well-known conventional form (fig. 4*d*). This form closely resembles a type of petroglyph common in this country, consisting of a series of concentric circles surrounding a central cup-hollow, with a single radial groove cutting across the circles and projecting outside them (fig. 4*c*). This analogy was first pointed out, so far as I am aware, in an otherwise eccentric and unconvincing book;¹ but in spite of the shortcomings of the setting, the comparison is in my opinion sound. It is not to be supposed that the petroglyphs are copied from specimens of the coins that have found their way into Northern Europe. There are chronological difficulties in the way of such an idea, as well as psychological difficulties. I cannot believe that the bronze-age inhabitants of the district round Lochgilphead in Argyllshire, let us say—where such petroglyphs occur almost by the hundred—were so delighted with the labyrinthine patterns on a chance Cretan coin which came their way that they took the trouble to copy them endlessly on hard rock. The figure must have had a real living meaning for the Lochgilphead people to have induced them to expend so much labour. As in the case of the New Grange spirals, we explain the related patterns as cognate, but not affiliated. They have the same meaning—the crystallization of a sun-dance; but the northern carvings remain rude and barbarous; the Cretan coins are civilized into an artistic form. Attention is also called, in Dr. Krause's book,² to the Roman "Troy" game, founded on a labyrinth, and to certain labyrinths marked out in the earth, especially in Scandinavia, Finland, and Lapland. I am not quite clear what place these have in the scheme; for one thing, their history and their date appear to be very uncertain. Returning to the petroglyphs, especially important is a series at Mevagh, Co. Donegal, if we can trust the accuracy of the drawing which has been published of these remarkable designs.³ Some of them represent groups of circles with two radial grooves, *only one of which reaches the outer circumference*. It is, in fact, a labyrinth with one entrance, but with a complication in the interior suggested (fig. 4*f*).

There is another conventional type of the labyrinth as figured on Cretan stones, designed on the basis of the swastika. If there be anything in what was just now suggested, that the swastika is an attempt to represent the whirling bull-roarer, and if the sculpture in New Grange may be taken as indicating that the bull-roarer accompanied the sun-dance, this form of the Cretan design becomes the more intelligible.

¹ *Die Trojaburgen Nordeuropas* by Dr. Ernst Krause. Glogau, 1893.

² This work is not easily accessible in the libraries of this country, but a sufficient abstract of its contents will be found in Cook's *Zeus*, vol. i, pp. 481-490.

³ *Journal Roy. Hist. and Arch. Assn. of Ireland*, IV, viii, 429.

One of the recorded examples of the European sun-dance is of very great importance in the present connexion. I refer to the ceremony of the college of priestesses on the island of Sena which has been already mentioned as the probable prototype of the pagan establishment at Kildare. In a familiar passage Pomponius Mela describes this island as the seat of a company of nine priestesses, virgins, who could raise storms, transform themselves into animals, cure diseases, and foretell the future—who had, in fact, all the stock accomplishments of witches. M. Salmon Reinach, indeed, in one of his singularly interesting essays¹ has endeavoured to demonstrate that Mela or, rather, the unknown authority on whom he bases his account, is untrustworthy, and that Sena and its priestesses had no real existence: partly on the ground that there is no other evidence for female ministrants in Celtic religion, and partly because the island is too evidently reminiscent of Circe's Isle of Aœa. He considers that the whole story of the Sena priestesses was invented by some romancer, who sought to bring Homer's fancy into the realms of reality. But, as to the first objection, we need not assume that the priestesses were Celts—they may have been the survivals of a pre-Celtic cult; and even if they were, the idea of the *bon-fœtus* is not so foreign to Celtic literature as M. Reinach suggests. As to the other objection, it would be just as reasonable to suggest that so far from Sena being founded on Aœa, Aœa, the island of the daughter of Helios in the western sea, may on the contrary be founded on Sena, the island of the Sun-priestesses in the western sea. We might even go farther, and connecting the name Circe etymologically with *céicteog*, regard her as a personification of a stone circle, or, more accurately perhaps, of whatever spiritual beings were conceived of as being present in the stones of a circle. Putting Homer back to the very beginning of the Iron Age in Europe, the earliest date possible, we yet have plenty of time for the traders to have brought the report of Sena and its priestesses to the shores of the Argæan sea, and it would not have needed a Homer to have recalled its suitability as a picturesque setting for the troubles of Odysseus.

But it is not so much what Mela says, as what Strabo tells us that is of importance. Mela reports the daily life and duties of the priestesses—their wood-raising, oracle-giving, and disease-healing. Strabo records what happened on the island once every year. He calls the women "Samnites," by some corruption which we need not stop to discuss;² there can hardly be any doubt that the same island and the same people are intended. On a certain day in every year these women un-roofed and re-roofed their temple

¹ *Celtica, Mythes et Religions*, i. 195.

² Most probably we are to read *Namnotes*, the name of the nearest tribe on the mainland. "Samnites" would be an inadvertent error for one familiar with Roman history.

before sunset, each of them carrying her load. If any one of them let her burden fall, she was rent asunder by the others, and her limbs were carried round the temple with wild shouts, which were kept up till their rage was abated. Strabo or his informant—probably Pytheas—had not a very exact knowledge of the rite; indeed, it is difficult to see how they could have obtained even the knowledge which they had, seeing that no man dared to land on the island, and that the people in the lands around would be alien in speech to the traveller.¹

But even the fragmentary report which we have of this rite displays close analogies with some of the rites that we have traced at Temair and at New Grange. The unroofing and re-roofing of the temple was evidently a solar rite, and we cannot be far wrong if we assume that the day on which it was performed was Midsummer day. When the sun shone longest and hottest, the temple was opened to entrap as much as possible of the sun's rays, and then was closed again. Probably there was a perpetual fire kept alight in the temple, which was supposed to be quickened by, or else to quicken, the sun. Then, the fate of the woman who dropped her load was simply the fate of every divine king who was getting too old for his work.² She was torn in pieces, as the king of Temair was killed when a stronger than he came to contend with him. The tearing of the unfortunate creature in pieces, and the bearing of her limbs round the temple, have analogies elsewhere: all such rites have for their purpose the increase of the fertility of the soil. The island of Sena, then, was a place where women's rites, analogous to the men's rites of Temair, were carried out, and for an analogous purpose. Temair is thus set in its place as the Irish example of a universal European cultus.

To come down to later times in the Greek world, we may perhaps trace some relics of this European cultus in certain of the rites of the Eleusinian mysteries. Even to touch the fringe of this gigantic subject would swell unduly a paper which has already far transgressed the limits that I had expected it to occupy. But it may be noticed that the bull-roarer, called

¹ Imperfect information due to this cause is perhaps responsible for the inconsistency which is the chief difficulty in the way of reconciling the accounts of Mela and Strabo. Mela describes the Sena priestesses as vowed to perpetual virginity: Strabo reports his islanders as sailing over to the mainland when they desired to have intercourse with the opposite sex. He then proceeds to describe the temple rite: which suggests the possibility that such intercourse may have been an essential part of the rite in question. We are reminded of what was said above as to the necessity for the marriage of the king of Temair.

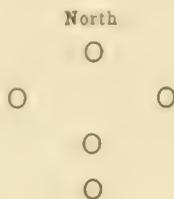
² Just as the king of Onitsha on the Niger was "immediately deposed and perhaps stoned" when he was no longer able to dance publicly with a sack of stones on his back at an annual feast: See Frazer, *Taboo and the Perils of the Soul*, p. 123.

ῥύμιδος, was one of the toys of Dionysus shown solemnly to the initiates: that the daubing of the initiates with clay, afterwards washed off again, seems to be essentially a re-birth ritual, analogous to the ritual of the stones of Blocc and Bluiene: and that the reverent exhibition of an ear of corn reminds us of the sanctuary in the far north-west which was founded, as the story went, by Tea grand-daughter of "Corn." We have already indicated how the Persephone myth can be traced in the confused stories told about the Irish princess.

Here for the present I leave the subject. I close by stating a conviction which this study has impressed upon myself more strongly than ever before: that a knowledge of Irish tradition and Irish archaeology is essential to a full comprehension of Classical antiquity. In Crete and in Classical Greece we see the highest manifestations of the native civilization of Europe. Probably nowhere better than in Ireland can we study the crude materials of which that civilization was composed, and by which it can be interpreted.

NOTE ADDED IN PRESS.

The statement made on p. 278, that no survey of the site before Petrie's exists, must be modified. Mr. Westropp has called my attention to a brief description and sketch in Bishop Peacock's *Tour in Ireland* (ed. Stokes, 1891, p. 177). The sketch is distorted in the printed copy and must be corrected by reference to the original in T.C.D. Library (14.15, page 116). This volume is not, apparently, the autograph: it seems to be a transcript made by some scribe, neat-fingered but not over-intelligent, as is indicated by his writing *Droghda* for the familiar name *Droghda* (mistaking the long s) a few lines before the passage which specially interests us. This, as well as the overwhelming probability that the bishop is writing entirely from memory, must be borne in mind in criticising the description, which is not a little puzzling. It runs thus: "I saw five barrows in this situation—



on which it is possible the five kings sat . . . on the southern one is a stone or pillar set up" [I omit for brevity some speculative matter of no importance].

It is not easy to identify the five mounds which Pococke here indicates. They might be *Pupall Adamnáin*; *Duma na Bó* (Petrie's mound, now missing) side by side with *Duma na nGiall*; *Tech Cormaic*; and *Múr Tea*. This would be interesting for two reasons. It would prove the existence of *Múr Tea*, now almost disappeared, on 6 August 1753, the date of Pococke's visit; and it would indicate the (*a priori* not improbable) fact, that the stone of inauguration then stood, not, as Petrie's local informants told him, on *Duma na nGiall*, but on the traditional foundress's grave. But there are difficulties in the way of this, for the literary evidence is to the effect that Fál was on or beside *Duma na nGiall*. If, however, we are to call Pococke's southern mound *Duma na nGiall* on account of the presence of the stone, we should have difficulties in identifying the four to the north of it the end of *Tach Midchúarta*, *Dall*, *Dorcha*, and *Pupall Adamnáin*, seems the only possible series of identifications; but evidently this is strained, and it would be hard to explain how the Bishop came to miss the conspicuous structures in Ráith Ríg. Suppose the mound with the stone is *Tech Cormaic* (Petrie's *Forrad*), which would contradict Petrie's story that the stone had been transferred after the rebellion of 1798, then the mounds might be *Pupall Adamnáin*, Petrie's *Duma na Bó*, *Duma na nGiall*, and either my *Duma na Bó* or the *Forrad*. It seems impossible to get any nearer to certainty than this, and whatever scheme we adopt presents difficulties. Pococke probably had the privilege of seeing the mounds in an even more perfect condition than Petrie, but he lost the opportunity of making himself useful.

The Bishop also notes the standing stone in the churchyard: the figure upon it reminded him of a "German deity" whom he calls "Pusterus"—a name which in my ignorance I never met with before!

XI.

NOTES ON SOME OGHAM INSCRIPTIONS, INCLUDING TWO
RECENTLY DISCOVERED.

By PROFESSOR R. A. S. MACALISTER, Litt. D.

Read FEBRUARY 11, 1918. Published JANUARY 20, 1919.

BALTINGLASS, Co. WICKLOW.

THE first inscription of which I have to speak has been for over forty years in the Academy's possession but no satisfactory reading has ever been given of it. It is a fragment, or rather a pair of fragments of granite, evidently belonging to one large stone, but impossible to fit together. A crowbar mark in one of the fragments shows that the stone has been intentionally destroyed.

The only references to this inscription are as follows:—(I) Brash (*Ogham Memorials*, p. 324): a mere passing allusion to an "incomplete memorial" from the neighbourhood of Donard deposited in the Museum of the Royal Irish Academy. (II) Ferguson (*Ritual Lectures*, p. 69) says: "In the stone-fences about Donard fragments of Ogham monuments are numerous, and the names of the farmers who broke them up are remembered." This presumably is primarily a reference to these fragments, and suggests that it may have been Ferguson who discovered them first. Though I have been several times in the neighbourhood of Donard I have never seen any of these "numerous fragments" in the fences. (III) Rhys in a paper on *the Ogham-inscribed Stones of the Royal Irish Academy* (*Journ. Roy. Soc. of Antiquaries*, vol. xxxiii, p. 1), under No. 29, mentions these two fragments without note of provenance, and gives as his reading M(?)UIMAO on the first fragment, GRI on the second. These are the only readings that have hitherto been published of the inscription.

The Academy register states that these fragments come from the neighbourhood of Baltinglass and the granite of which they are composed bears this out. The larger fragment measures 2 feet 2 inches by 1 foot 9 inches

by 8 inches. The inscription is picked out in broad bold scores on a rather rounded angle. The lettering is quite clear.

c] C I MA Q [

The first score is carried away by a fracture, all but the top, which is why Sir John Rhys overlooked it; the second, which is his first M, is carried slightly over to the B side of the angle, but not sufficiently so to turn the score into M.

The second score of the Q lies in the line of a natural fissure in the stone, but it is certainly not to be omitted.

We evidently have the end of the name of the owner of the stone, ending in CCI, and followed by MAQI.

The second fragment is clearly the top of the original pillar-stone. It measures 2 feet 2 inches by 1 foot 7 inches by 11 inches. Only a small portion of the scored angle remains, spalls on both sides having carried most of it away. I cannot follow Sir John Rhys in reading GRI, a reading about which he himself seems to have been uncertain. I am inclined to think he has read it upside down, and that it should be

I N [i

in which we may possibly see the end of IAQINI, the name of the owner of the Donard ogham close by. The whole inscription would thus have read:

]CCI MAQ[I IAQ]INI.

Its destruction is much to be regretted, as it comes from a region not very rich in these memorials.

CONNOR, Co. ANTRIM.

I have submitted this, which is probably the most difficult Ogham in all Ireland to read, to a careful fresh examination, the result of which is that I now read it CALUNAI MAQI VOBARACI. This is the most satisfactory reading that has yet emerged from the stone, as it at last gives us something intelligible for the name of the person commemorated. It is the name which we find in the compound CALUNO-VIC at Drumloghan.

AGHALEAGUE, Co. MAYO.

I found this inscription under the following circumstances:—A correspondent had informed me of two Ogham inscriptions at or near Ballycastle, Co. Mayo. Accordingly, I made my way to Killala, and proceeded to the

place indicated. I was considerably disgusted to find when I reached the spot that one of the stones was the well-known cross-inscribed pillar-stone in the cemetery at Doonfeeny, and the other was a *gallán* without the slightest trace of marking upon it. But, in returning to Killala, I passed through the townland of Aghaleague, and there noticed a large stone standing in the field opposite Heathfield National School. Stopping the car I went to examine it, and found that it bore an Ogham inscription. Though so conspicuous, the stone, which doubtless gives its name to the townland (*Achadh Léige*, field of the stone), is not marked on the Ordnance Map.

It is a slab of micaceous sandstone, 7 feet 7 inches high, 7 feet broad at the base, tapering irregularly to the top, and 6 inches thick. The inscription, which is on the angle turned away from the road, is badly worn by the rubbing of cattle. The scores were pocked and rubbed on the stone, not cut with an engraver. My reading is

OTTACI MAQ GARA . . .

The initial O is 1 foot 8 inches above the ground line. Below it the angle is not worn, and though there are here and there traces resembling defaced scores I think they are nothing but natural marks on the stone, and that the o is the first letter. There is a mark like a vowel point, 1 foot 3½ inches above ground followed by a scratch on the inside, but these have an appearance totally different from that of the genuine scores. The o is quite clear, as also are the two r's, though a fissure in the stone cuts through all six scores. The A is very deep and is almost entirely on the H side, but is too short for a consonant score. The first score of the c is very plain, and is carried slightly across the angle, but it is too short on the B side for an M. The second score of the c is invisible; the tops of the two remaining scores can be traced. Only the last dot of the t can be detected with certainty; the places of the other four dots can be fixed by measurement. The MAQ GARA is quite clear, the GAR being on the shoulder of the stone. There is only one vowel point of the last letter traceable; a dense growth of lichen on the top of the stone conceals whatever may remain of the inscription. The name of the person commemorated seems comparable with *Uathach* but till the top of the stone can be satisfactorily deciphered it is useless to speculate on what the second name may be.

BREASTAGH, CO. MAYO.

I took the opportunity of my visit to Killala to re-examine this important monument. I wished specially to see whether there was any possibility of detecting traces of writing in the worn part at the bottom of the south-west

angle, which had hitherto proved completely baffling. For a length of 3 feet 9 inches the angle is worn perfectly smooth, carrying away the name of the owner of the monument. This is the more to be regretted, as we are here in the presence of known personalities. For the inscription on the south-east angle of the stone is certainly MAQ CORR^{BRI} MAQ AMLLONGITT.¹ There are two persons called Coirpre son of Amalgaid on record: one the great-grandson of Eochu Muigneadon, and grandfather of St. Tigernán of Loch Conn; the other the great-grandson of Dathi.² The descendants of the second (who is more likely the "Corrbri" of the stone) are not recorded.

Turning now to the south-west angle the first letter is certainly I, 7 inches above the ground. Then come some vowel-points followed by a double G. I had previously read four points, making E, and this was also the reading of Sir J. Rhys; but I now incline to reading only three, rather widely spaced. The G's are followed by a very doubtful A, 1 foot above ground line. This gives LUGGA, a name which is followed, I think, by MAQI occupying the angle to 2 feet $\frac{1}{4}$ inch above the ground. The MAQI is followed by a very doubtful C, after which is an O, quite distinct, the second score being 2 feet $7\frac{1}{2}$ inches above the ground. Then comes a space of 9 inches, room for about six scores, in which the angle is spalled and the scores broken away. Then come three vowel-points, after which the inscription proceeds SDAILENG^{ESCI} all quite clear; the last vowel most probably was I, but the angle is fractured, carrying off everything after the second dot.

Where so much is doubtful we must walk warily. The chief difficulty, apart from the worn part of the angle, is its division into words. If the inscription begins LUGGA MAQI, what follows is too long for a single name; it is longer than ANAVLAMATTIAS and NIAGRACOLINEA, which are the two longest names as yet found in Ogham. It is possibly CUNEAS DAILENG^{ESCI}, a double name. This is unusual, but not unknown. However I fear that the decipherment of this angle will never be altogether free from conjecture, owing to its damaged condition. I confess I left it feeling very hopeless of attaining to complete certainty of the reading. LUGG . . . SDAILENG^{ESCI}, with three vowel-points before the s and two after the c, is all that anyone can be certain of. It is not impossible that this part of the monument has been intentionally defaced by someone who had an interest in erasing the name and memory of its owner.

¹ My previous reading, AMMLORATTA, is wrong. The NG is concealed under thick lichens, and the following I is fractured. There is no vowel after the final T.

² *Tribes and Customs of Hy Fiachrach*, pp. 10, 98.

THE COTTS, CO. WEXFORD.

The Cotts is a townland between the town of Wexford and Broadway. My friend the Rev. R. Finlenny, P.P. of Broadway, brought me to see a number of standing stones in this neighbourhood, some of them of considerable size. In a field on this townland we saw two small stones of red conglomerate, evidently marking the head and foot of a grave, about 3 feet high and 5 feet apart. Unfortunately I was not provided with a measure or a camera—indeed, the weather was so bad that to have photographed the stones would have been impossible. The southern stone is conical in shape. The inscription, which had not been noticed before, is on the north-west angle of the northern stone, and seems complete, though it is short and the top of the stone is fractured. It ends about 2 inches below the fracture, and reads IARNI.

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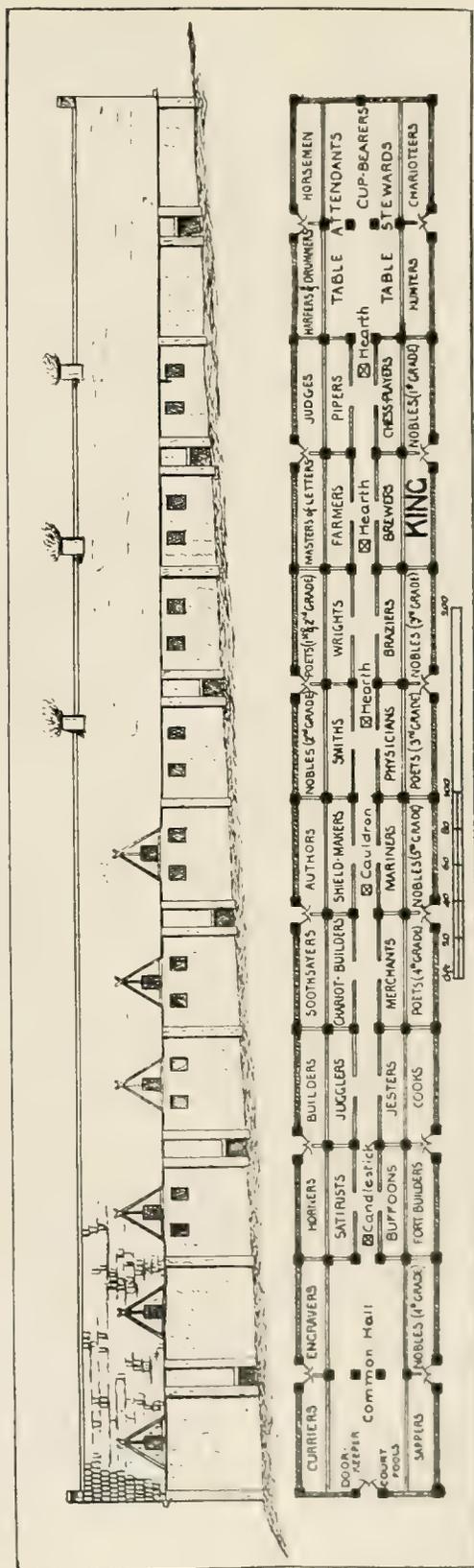
Lastly I may mention a stone in the Windele Collection, now in the Academy's possession, which, at Mr. Armstrong's request, I have re-examined. It bears Ogham script, much obscured by other scratches on the adjacent surfaces. Sir John Rhys read with hesitation *xiuiri*. I think however that it will be found that the inscription reads *airni* and this being so, no more need be said about it. It is not the only nineteenth-century Ogham in the Windele Collection.



Cros Adamnáin
(Photograph by Mr. T. J. Westropp)



The Figure on Cros Adamnáin
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The Northern Cloenfert
(Photograph by Mr. T. J. Westropp.)

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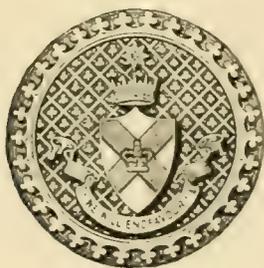
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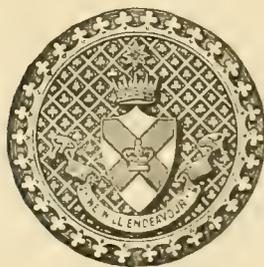
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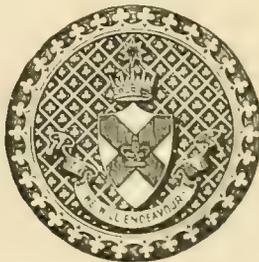
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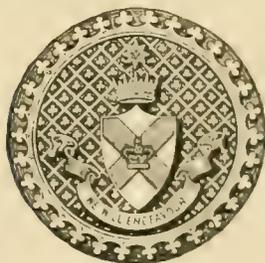
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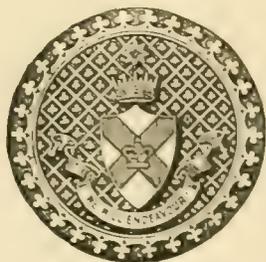
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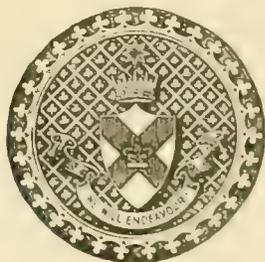
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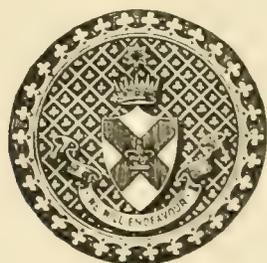
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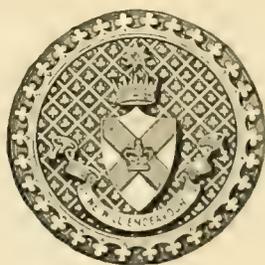
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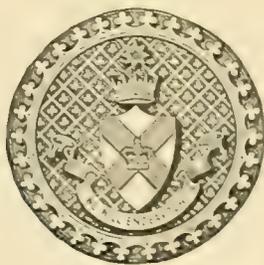
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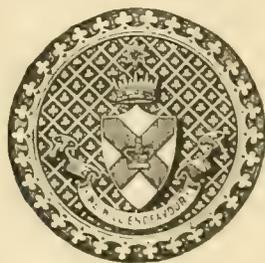
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