PROCEEDINGS

OF THE

ROYAL IRISH ACADEMY

VOLUME XXXII

DUBLIN: HODGES, FIGGIS, & CO., LTD.
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SECTION A.—MATHEMATICAL, ASTRONOMICAL, AND PHYSICAL SCIENCE.

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SECTION A.

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PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY

PAPERS READ BEFORE THE ACADEMY

I.

THE LARGE IONS IN THE ATMOSPHERE.

By H. KENNEDY, M.A., M.Sc., University College, Dublin

Read April 14. Published June 27, 1913.

This paper is a continuation of a previous one[1] by Prof. McClelland and the author dealing with observations of the large ions in the atmosphere. In the previous work over 400 sets of observations were made of the number of large ions per cc. at intervals over a period of more than a year. The extreme values obtained were 3,700 per cc. and 60,000 per cc., the average value being about 16,000 per cc. The observations were made at University College buildings in Dublin, and it seemed to us that the number of large ions might be very different in purer air at a distance from the city, in view of the fact that large ions, which have the same mobility as those that occur in the atmosphere, are found in gases drawn from flames of various kinds, when sufficient time has elapsed after leaving the flame. The vast number of sources of combustion in the city must produce great numbers of such ions, and as, unlike the case of small ions, the time necessary for them to disappear by recombination when once produced is very great, it seemed likely that the atmosphere of the city must contain a great number of large ions artificially produced. It was, therefore, desirable to make observations at some place at a distance from the city. An opportunity of doing this was afforded through the kindness of Prof. A. W. Conway,[2] who provided at his house in Dalkey a room in which to set up the necessary apparatus. Dalkey is a small town

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[1] Proc. Roy. Irish Acad., vol. xxx, Sec. A, pp. 72–91.

[2] I am also much indebted to Mr. J. M. Walsh of Dalkey for the use of his electrical supply to charge the accumulators necessary for the observations.

situated on the sea-coast about eight miles to the south-east of Dublin, and Prof. Conway's house, which is detached, lies quite close to the water's edge. The situation is eminently suitable for making observations in pure air, inasmuch as the air in north-east, east, and south-east winds comes from over the sea, and in south-west winds from over a country which is not very thickly populated. West winds bring air from the direction of the town of Dalkey, while north-west winds come from the direction of Dublin. This paper contains the results of the Dalkey observations, which extended over a period of about two months.

Apparatus.

The apparatus was designed so as to be more portable than that used in Dublin. It consisted, as shown in fig. 1, of four equal cylindrical brass tubes of radius 3·1 cms. and length 150 cms. mounted parallel to each other on a wooden frame, with the ends *A*, *B*, *C*, *D* let into one face of a rectangular box *F*. The section of the box was square, and the openings *A*, *B*, *C*, *D* were symmetrically placed so that equal quantities of air were drawn through each tube by means of a gasometer connected to the pipe *E* fixed at the centre of the opposite face. Inside each of the tubes and insulated from it, a concentric brass tube of radius 1·4 cms. was fixed as shown in fig. 2. *N* is a closely fitting ebonite plug attached by means of a screw to the brass rod *L*, which passed through the outer tube, being insulated from it by means of ebonite collars *M*, and kept in position by nuts screwed on outside. By means of such a support at each end, it was possible to make the tubes coaxial, and keep them rigidly in that position. The inner tubes were connected to the electrometer and the outer ones to a voltage sufficient to remove all the large ions in the air passing through the annular space between the tubes. The capacity of the system was ·00055 microfarad, so that it was possible to deal with much slower air-streams than with the apparatus used in Dublin. By using four tubes instead of one it was possible to get a sufficiently large volume of air passing through per sec. without having too great a velocity, and thereby necessitating the use of very high voltages to produce saturation.

The apparatus was set up with the open ends of the tubes close to a window opening towards the sea-front, so that, when the window was opened, the air could be drawn in from outside and tested. The saturation-current measures the total ionisation in the atmosphere, and from it, assuming that each ion bears the electronic charge, the total number of ions per cc. may be calculated. Such measurements give the sum $N + n$ of the number N of large ions and the number n of small ions per cc.

Some observations of the small ions were also made at Dalkey, so that the

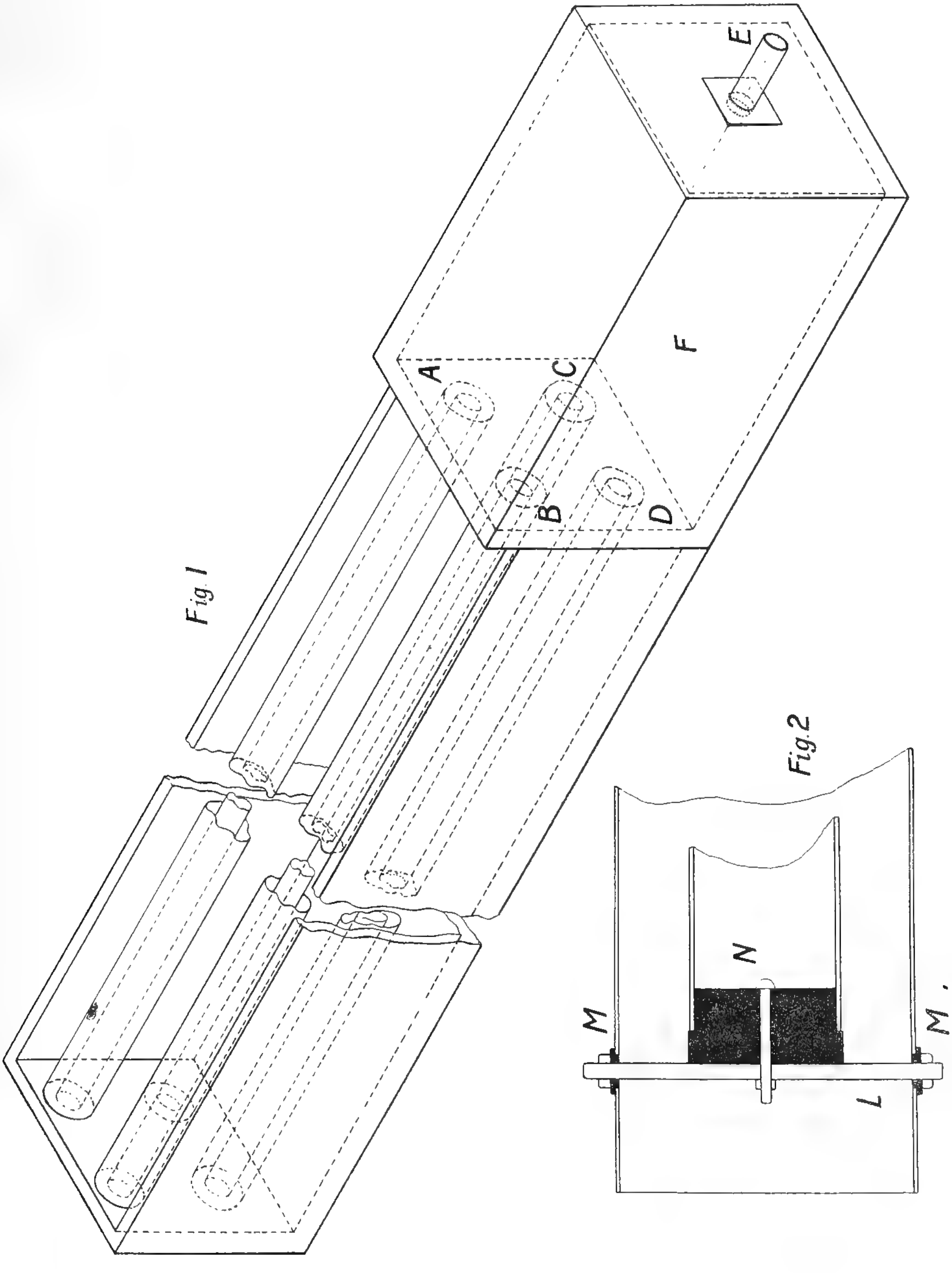

Fig. 1

Fig. 2

total number could with certainty be divided into the large and small classes. The apparatus for small ion work described in the previous paper was used.

The results of all the observations are shown in the following table:—

TABLE.

DATE	$(N+n)+$	$n+$	$n-$	$N+$	REMARKS.
1912 Dec. 17,	1430	—	—	—	Strong S.W. wind.
,, 18,	2000	—	—	—	W. to S.W. wind.
,, 19,	2960	—	—	—	Clear day; light W.S.W. wind.
1913 Jan. 4,	< 300	—	—	—	S. to S.W. wind.
,, 7,	1150	—	—	—	S.W. wind.
,, 9,	300	—	—	—	After rain and storm S. wind.
,, 12,	3800	—	—	—	Light wind from Dublin; fine frosty day.
,, 12,	10600	—	—	—	Limits of a number of observations during two hours, 3800 to 10600. Mean 7600.
,, 12,	7600	—	—	—	
,, 13,	1600	1380	—	220	S.W. wind.
,, 14,	700	600	—	100	S.E. wind.
,, 15,	1400	300	—	1100	S.W. wind.
,, 24,	900	600	600	300	S.W. wind.
,, 26,	1550	200	—	1350	S.W. wind.
,, 27,	1670	340	—	1330	S.E. wind.
,, 28,	—	300	0	—	S. wind.
,, 29,	—	700	0	—	S. to S.W. wind.
Feb. 5,	1500	250	350	1250	S.W. wind.
,, 7,	1520	1180	1360	340	S.W. wind.
,, 10,	1230	220	210	1010	S.W. wind.
,, 12,	700	290	280	410	S.E. wind after disappearance of thick fog.
,, 13,	5770	70	80	5700	S.E. wind, very thick fog. 8.15 p.m.
,, 16,	1080	460	410	620	E. to N.E. wind.
,, 17,	2700	2500	2500	200	Strong E. wind.

The Large Ions.

It will be seen immediately that only on two occasions, namely, on January 12th and February 13th, do the number of large ions approach the values obtained in Dublin. The mean of the values of N when this quantity was determined separately is less than 1,000 as compared with the mean value, 16,000, obtained in the experiments conducted in the city atmosphere. The large values of ions on Jan. 12 are explained by the fact that on that day the place of observation was enveloped in air coming from Dublin, and bringing with it the artificially produced large ions of the city. In fact, on that day it was easy to see that Dalkey was in the track of the smoke brought by the light breeze from Dublin. The only other occasion, as has been pointed out above, on which values of N were found comparable with those in Dublin was on Feb. 13, on the occasion of an exceedingly thick sea-fog. Even this value is small compared with the number, 53,000, obtained in a similar fog in Dublin.

It would seem, therefore, from the Dalkey observations that by far the greater part of the large ions existing in the atmosphere of the city are due to local combustion products. The great variations in the number per cc. on different occasions are probably to be attributed to changes in magnitude and direction of air-currents, sometimes, as may happen on clear days, making the gases from chimneys rise to great heights, and sometimes producing the opposite effect, and so tending to concentrate the large ions near the ground.

The results of experimental work on large ions, as far as it has gone at present, bear a very striking analogy to those furnished by the classical researches of Aitken on condensation-nuclei in the atmosphere. In the first place, as has been pointed out above, ions are produced from flames which have ultimately a mobility the same as that of the large atmospheric ion. Aitken found that myriads of condensation-nuclei are produced from the same sources. For example, in a room lighted by gas-jets he found that the number of such nuclei per cc. increased from 26,000 to 3,000,000 on lighting the gas, and that only half of these had disappeared next morning. The numbers got by him in various cities varied from 40,000 to 300,000, while in pure air he obtained values as low as 200. Extremely low values were found in the West Highlands of Scotland and on the Swiss mountains, the air in these regions being remarkably free from artificial contamination. The Dalkey experiments furnish the corresponding parallelism in the case of the large ions. At one station in the South of France, Aitken got values the mean of which was 3,500, except on one day when the wind blew from Toulon, nine miles distant. The number of nuclei per cc. then rose to 25,000. Exactly similar to this is the effect observed at Dalkey on the one day in which there was a wind from the city. Aitken got exceedingly high values on the occasion of a snowfall in Glasgow. The number of large ions during a snowstorm in Dublin was as high as 54,000. During some observations on the top of the Eiffel Tower the number of nuclei per cc. on one occasion fell from 104,000 to 226 during an exceptionally heavy downpour of rain. This suggests a comparison with the very great values, on one occasion as high as 60,000, obtained by us in Dublin during very heavy rains. In fact, reading over Aitken's earlier work, there is no feature of it which could not be explained by considering the dust-particles which he measures as being the same as the large ions, and including the nuclei from which large ions are formed when they become charged; and by considering both as minute drops of a certain fixed stable size, formed, at least for the most part, in the cooling gases rising from sources of combustion. Other work at present being carried on in the laboratory may lead to direct evidence as to whether the nucleus from which the large ion is formed is the same as that occurring in the atmosphere normally as the centre of condensation.

THE SMALL IONS.

Theoretical considerations regarding the large ion as a nucleus which has attached to it a small ion, lead to the conclusion that for a given ionising agency the number of small ions will be less, the greater the number of large ions and nuclei from which they are formed. Now, in the previous paper, a remarkable discrepancy is pointed out existing between the number of small ions obtained in the atmosphere by observers at various centres using the Ebert apparatus, and those obtained by Langevin in Paris, Pollock in Sydney, and by us in Dublin. Pollock[1] first drew attention to this discrepancy. The mean value obtained by him was 38 for the negative and 39 for the positive ions. The value obtained by Langevin was about 200, while the mean value obtained by us was 78. These numbers are in striking contrast with those found by the Ebert apparatus, which range from 500 to several thousands. The explanation seemed to be that the values given by the Ebert apparatus are too great, inasmuch as it possibly collected not only all the small ions, but a great number of large ions as well, the large ions being far more numerous than the small ones. In order to obtain further information on this point, a series of measurements of n were made at Dalkey as soon as it became apparent that the value of $N + n$ was much less than in Dublin. It will be seen from the table that the values of n are much greater than those found in Dublin, and are in fact of the same order as those found by observers with the Ebert apparatus. The mean value of n is about 700, which is about the same as that found by Simpson on the voyage of the "Terra Nova." It seems, therefore, that the true explanation of the small values of n referred to above is that these observations were made in cities where there is an immense number of large ions and of nuclei from which large ions are formed, the effect of these being to diminish the number of small ions present at any time.

In conclusion, I wish to thank Professor McClelland for suggesting the investigation, and for his valuable interest in the work during its progress.

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[1] Science, N. S. xxix, pp. 919–928. 1909.

II.

NOTE ON THE USE OF CONJUGATE FUNCTIONS IN SOME DYNAMICAL PROBLEMS.

By H. C. PLUMMER, M.A.

Read January 26. Published March 6, 1914.

1. It has been shown by Bohlin (Bull. Astr. xxviii, p. 113) that, by means of the transformation

$$x + iy = a\xi^2, \quad x - iy = a\eta^2, \quad (i^2 = -1),$$

with a corresponding change of the time variable, the problem of two bodies under mutual attraction according to the gravitational law is reduced to the problem of motion under a force proportional to the distance.

2. The above transformation is imaginary; but it suggests the real transformation in terms of conjugate functions

$$x + iy = (\xi + i\eta)^2$$

or

$$x = \xi^2 - \eta^2, \quad y = 2\xi\eta,$$

to which correspond in polar coordinates

$$r = \rho^2, \quad \theta = 2\phi.$$

The kinetic energy is

$$T = \tfrac{1}{2}(\dot{x}^2 + \dot{y}^2) = 2(\xi^2 + \eta^2)(\dot{\xi}^2 + \dot{\eta}^2),$$

and the potential energy is

$$V = -\mu r^{-1} = -\mu(\xi^2 + \eta^2)^{-1},$$

so that the equation of energy is

$$2(\xi^2 + \eta^2)(\dot{\xi}^2 + \dot{\eta}^2) - \mu(\xi^2 + \eta^2)^{-1} = h.$$

The Lagrangean equation corresponding to ξ is

$$4\frac{d}{dt}\{(\xi^2 + \eta^2)\dot{\xi}\} - 4\xi(\dot{\xi}^2 + \dot{\eta}^2) = -2\mu\xi(\xi^2 + \eta^2)^{-2},$$

which becomes, in virtue of the preceding equation,

$$2\frac{d}{dt}\{(\xi^2 + \eta^2)\dot{\xi}\} - h\xi(\xi^2 + \eta^2)^{-1} = 0.$$

If, then, the time variable t is changed to τ, where

$$dt = (\xi^2 + \eta^2)\,d\tau = r\,d\tau,$$

the equations of motion become

$$\frac{d^2\xi}{d\tau^2} - \tfrac{1}{2}h\xi = 0,$$

and, by symmetry,

$$\frac{d^2\eta}{d\tau^2} - \tfrac{1}{2}h\eta = 0.$$

Thus the problem is reduced to that of motion under the central force $\frac{1}{2}h\rho$, varying as the distance. The equation of energy becomes

$$2\left\{\left(\frac{d\xi}{d\tau}\right)^2 + \left(\frac{d\eta}{d\tau}\right)^2\right\} = \mu + h(\xi^2 + \eta^2).$$

3. For elliptic motion, we have $h = -\mu/2a = -\frac{1}{2}n^2a^2$. A solution consistent with the last equation is therefore

$$\xi = \sqrt{(1-e)a}\cos\tfrac{1}{2}na\tau,$$
$$\eta = \sqrt{(1+e)a}\sin\tfrac{1}{2}na\tau,$$

to which correspond

$$x = a\cos na\tau - ae,$$
$$y = a\sqrt{1-e^2}\sin na\tau,$$

and $$r = \xi^2 + \eta^2 = a - ae\cos na\tau.$$

Hence $$nt = n\int r\,d\tau = na\tau - e\sin na\tau,$$

which is the simple solution in terms of $na\tau = E$, the eccentric anomaly.

For parabolic motion, $h = 0$; and the motion in the (ξ, η) plane is rectilinear. A solution consistent with the equation of energy is

$$\xi = \sqrt{\tfrac{1}{2}p}, \qquad \eta = \sqrt{\tfrac{1}{2}\mu}\,.\,\tau,$$

or $$x = \tfrac{1}{2}(p - \mu\tau^2), \quad y = \sqrt{\mu p}\,.\,\tau.$$

Hence, $$t = \int\tfrac{1}{2}(p + \mu\tau^2)\,d\tau = \left(\frac{p^3}{4\mu}\right)^{\frac{1}{2}}\left\{\left(\frac{\mu}{p}\right)^{\frac{1}{2}}\tau + \frac{1}{3}\left(\frac{\mu}{p}\right)^{\frac{3}{2}}\tau^3\right\},$$

which becomes the ordinary solution when we notice that

$$\left(\frac{\mu}{p}\right)^{\frac{1}{2}}\tau = \tan\tfrac{1}{2}\theta.$$

For hyperbolic motion $h = +\mu/2a$, and the appropriate solution is

$$\xi = \sqrt{(e-1)a}\cosh\frac{1}{2}\left(\frac{\mu}{a}\right)^{\frac{1}{2}}\tau, \qquad \eta = \sqrt{(e+1)a}\sinh\frac{1}{2}\left(\frac{\mu}{a}\right)^{\frac{1}{2}}\tau,$$

corresponding to

$$x = ae - a\cosh\left(\frac{\mu}{a}\right)^{\frac{1}{2}}\tau, \quad y = a\sqrt{e^2-1}\sinh\left(\frac{\mu}{a}\right)^{\frac{1}{2}}\tau, \quad r = ae\cosh\left(\frac{\mu}{a}\right)^{\frac{1}{2}}\tau - a.$$

Hence, $$t = \left(\frac{a^3}{\mu}\right)^{\frac{1}{2}}\left\{e\sinh\left(\frac{\mu}{a}\right)^{\frac{1}{2}}\tau - \left(\frac{\mu}{a}\right)^{\frac{1}{2}}\tau\right\},$$

which is the analogue of Kepler's equation for hyperbolic motion.

Finally, in the case of a repulsive force, the equation of energy becomes

$$2\left\{\left(\frac{d\xi}{d\tau}\right)^2 + \left(\frac{d\eta}{d\tau}\right)^2\right\} = -\mu + h(\xi^2+\eta^2) \quad \text{and} \quad h = +\mu/2a.$$

The appropriate solution is now

$$\xi = \sqrt{(e+1)a}\cosh\frac{1}{2}\left(\frac{\mu}{a}\right)^{\frac{1}{2}}\tau, \qquad \eta = \sqrt{(e-1)a}\sinh\frac{1}{2}\left(\frac{\mu}{a}\right)^{\frac{1}{2}}\tau,$$

which lead to

$$x = ae + a\cosh\left(\frac{\mu}{a}\right)^{\frac{1}{2}}\tau, \qquad y = a\sqrt{e^2-1}\sinh\left(\frac{\mu}{a}\right)^{\frac{1}{2}}\tau, \qquad r = ae\cosh\left(\frac{\mu}{a}\right)^{\frac{1}{2}}\tau + a.$$

Hence,

$$t = \left(\frac{a^3}{\mu}\right)^{\frac{1}{2}}\left\{e\sinh\left(\frac{\mu}{a}\right)^{\frac{1}{2}}\tau + \left(\frac{\mu}{a}\right)^{\frac{1}{2}}\tau\right\},$$

which completes the solution for every case.

4. Bohlin has indicated the application of his transformation to the problem of three bodies. An analogous transformation has been given by Thiele (Astr. Nachr., 3289), which applies with advantage to the restricted problem of three bodies in which the two finite masses are equal. This is

$$x + iy = \cos(E + iF),$$

or

$$x = \cos E\cosh F, \qquad y = -\sin E\sinh F.$$

This is simply the transformation to elliptic coordinates commonly employed in the problem of two fixed centres of attraction. But further, the time t is changed to ψ, where

$$dt = r_1 r_2\, d\psi,$$

and r_1, r_2 are the distances of the third mass from the two finite masses. The equations of motion then take the form

$$\frac{d^2E}{d\psi^2} - (\cosh 2F - \cos 2E)\frac{dF}{d\psi} = \tfrac{1}{4}\sin 4E - \tfrac{1}{2}K\sin 2E$$

$$\frac{d^2F}{d\psi^2} + (\cosh 2F - \cos 2E)\frac{dE}{d\psi} = \tfrac{1}{4}\sinh 4F - \tfrac{1}{2}K\sinh 2F + 8\sinh F,$$

where K is a constant occurring in the equation of energy.

An orbit of special interest, called an orbit of ejection, is that in which the small body is projected from one of the finite masses, and, after describing a relative path resembling a cardioid in shape, returns to the mass from which it started. The result of the above transformation is that the corresponding trajectory in the (E, F) plane is a simple closed curve free from any singularity, performed with a velocity which is everywhere finite. This orbit has been investigated by Burrau and Strömgren (V. J. S. der Astr. Ges., xlviii, p. 222).

5. The result of such transformations may be examined in a more general form. Let the equations of relative motion in their original form be

$$\ddot{x} - 2n\dot{y} - n^2x = \frac{\partial V}{\partial x}$$

$$\ddot{y} + 2n\dot{x} - n^2y = \frac{\partial V}{\partial y},$$

or, as they may be written,

$$\frac{d}{dt}\left(\frac{\partial T}{\partial \dot{x}}\right) - \frac{\partial T}{\partial x} = \frac{\partial V}{\partial x},$$

$$\frac{d}{dt}\left(\frac{\partial T}{\partial \dot{y}}\right) - \frac{\partial T}{\partial y} = \frac{\partial V}{\partial y},$$

where $T = \frac{1}{2}(\dot{x} - ny)^2 + \frac{1}{2}(\dot{y} + nx)^2.$

Let $x + iy = f(\xi + i\eta),$

so that $$\frac{\partial x}{\partial \xi} = \frac{\partial y}{\partial \eta}, \quad \frac{\partial x}{\partial \eta} = -\frac{\partial y}{\partial \xi},$$

and

$$J = \frac{\partial x}{\partial \xi}\cdot\frac{\partial y}{\partial \eta} - \frac{\partial x}{\partial \eta}\cdot\frac{\partial y}{\partial \xi} = \left(\frac{\partial x}{\partial \xi}\right)^2 + \left(\frac{\partial x}{\partial \eta}\right)^2 = \left(\frac{\partial y}{\partial \xi}\right)^2 + \left(\frac{\partial y}{\partial \eta}\right)^2.$$

Then $T = T_2 + T_1 + T_0,$

where $T_2 = \frac{1}{2}J(\dot{\xi}^2 + \dot{\eta}^2),$

$$T_1 = n\dot{\xi}\left(-y\frac{\partial x}{\partial \xi} + x\frac{\partial y}{\partial \xi}\right) + n\dot{\eta}\left(-y\frac{\partial x}{\partial \eta} + x\frac{\partial y}{\partial \eta}\right),$$

$$T_0 = \frac{1}{2}n^2(x^2 + y^2).$$

The equations of motion may be written

$$\frac{d}{dt}\left(\frac{\partial T_2}{\partial \dot{\xi}}\right) + \frac{d}{dt}\left(\frac{\partial T_1}{\partial \dot{\xi}}\right) - \frac{\partial T_1}{\partial \xi} = \frac{\partial T_2}{\partial \xi} + \frac{\partial T_0}{\partial \xi} + \frac{\partial V}{\partial \xi},$$

$$\frac{d}{dt}\left(\frac{\partial T_2}{\partial \dot{\eta}}\right) + \frac{d}{dt}\left(\frac{\partial T_1}{\partial \dot{\eta}}\right) - \frac{\partial T_1}{\partial \eta} = \frac{\partial T_2}{\partial \eta} + \frac{\partial T_0}{\partial \eta} + \frac{\partial V}{\partial \eta};$$

and the integral of energy is

$$T_2 = T_0 + V - h.$$

Hence

$$\frac{\partial T_2}{\partial \xi} + \frac{\partial T_0}{\partial \xi} + \frac{\partial V}{\partial \xi} = \frac{1}{2}\frac{\partial J}{\partial \xi}(\dot{\xi}^2 + \dot{\eta}^2) + \frac{\partial T_0}{\partial \xi} + \frac{\partial V}{\partial \xi}$$

$$= \frac{1}{J}\frac{\partial J}{\partial \xi}(T_0 + V - h) + \frac{\partial}{\partial \xi}(T_0 + V$$

$$= \frac{1}{J}\frac{\partial}{\partial \xi}\{J(T_0 + V - h)\}.$$

Also it is easy to show that

$$\frac{d}{dt}\left(\frac{\partial T_1}{\partial \dot{\xi}}\right) - \frac{\partial T_1}{\partial \xi} = -\ 2nJ\dot{\eta}.$$

The equations of motion thus become

$$\frac{d}{dt}(J\dot{\xi}) - 2nJ\dot{\eta} = \frac{1}{J}\frac{\partial}{\partial \xi}\{J(T_0 + V - h)\}$$

$$\frac{d}{dt}(J\dot{\eta}) + 2nJ\dot{\xi} = \frac{1}{J}\frac{\partial}{\partial \eta}\{J(T_0 + V - h)\}.$$

If then we put $dt = Jd\tau$, these become simply

$$\frac{d^2\xi}{d\tau^2} - 2nJ\frac{d\eta}{d\tau} = \frac{\partial V'}{\partial \xi}, \qquad \frac{d^2\eta}{d\tau^2} + 2nJ\frac{d\xi}{\partial \tau} = \frac{\partial V'}{\partial \eta},$$

where $V' = J\{V + \tfrac{1}{2}n^2(x^2 + y^2) - h\}$,

and $\left(\frac{d\xi}{d\tau}\right)^2 + \left(\frac{d\eta}{d\tau}\right)^2 = 2V'$

is the equation of energy.

6. If we write $f_1 = f(\xi + i\eta)$, $f_2 = f(\xi - i\eta)$,

then $r^2 = x^2 + y^2 = f_1 f_2$, and $J = f'_1 f'_2$.

Let us consider the case of central forces, $n = 0$, $V = \mu r^{p+1}$. If we put

$$x + iy = f(\xi + i\eta) = (\xi + i\eta)^k,$$

then $V' = k^2(\xi^2 + \eta^2)^{k-1}\{\mu(\xi^2 + \eta^2)^{\frac{1}{2}k(p+1)} - h\}$.

The first term becomes constant, and the second corresponds to a central force varying as ρ^q, if

$$k - 1 + \tfrac{1}{2}k(p + 1) = 0, \qquad 2(k - 1) = q + 1,$$

whence $(q + 3)(p + 3) = 4$, $\quad k = -\dfrac{q + 1}{p + 1}$.

The different cases are thus associated in pairs, except that of the force r^{-5}, which corresponds to itself, and that of r^{-1}, which is otherwise excluded. The problems soluble by elliptic functions are arranged in pairs thus :—

$$\begin{array}{lcccccc} p = & 5 & 3 & 0 & -\frac{1}{3} & -4 & -5. \\ k = & \frac{1}{4} & \frac{1}{3} & \frac{2}{3} & \frac{3}{4} & -2 & -1. \\ q = & -\frac{5}{2} & -\frac{7}{3} & -\frac{5}{3} & -\frac{3}{2} & -7 & -5. \end{array}$$

It is natural that any one of these problems is converted into one of the same class; and it is also to be noticed that the relation between p and q

secures that a stable circular orbit shall be converted into a stable orbit, and an unstable into an unstable. Among the problems soluble in terms of circular functions, we have $p = -2$, $k = 2$, $q = 1$, which is the case already examined in detail. The remaining case in this class is $p = -3$, corresponding to which q becomes infinite. Here it is readily seen that the result of making JV constant is to convert the problem into that of a parallel field of force in which the potential is of the form $\mu e^{c\xi}$.

7. In the problem of two fixed centres of gravitation

$$\begin{aligned} V &= \mu_1 \{(x-c)^2 + y^2\}^{-\frac{1}{2}} + \mu_2 \{(x+c)^2 + y^2\}^{-\frac{1}{2}} \\ &= \mu_3 (f_1 - c)^{-\frac{1}{2}} (f_2 - c)^{-\frac{1}{2}} + \mu_2 (f_1 + c)^{-\frac{1}{2}} (f_2 + c)^{-\frac{1}{2}}. \end{aligned}$$

Hence

$$V' = \frac{f_1'}{(f_1^2 - c^2)^{\frac{1}{2}}} \cdot \frac{f_2'}{(f_2^2 - c^2)^{\frac{1}{2}}} \left\{ \begin{matrix} \mu_1 (f_1 f_2 + f_1 c + f_2 c + c^2)^{\frac{1}{2}} \\ + \mu_2 (f_1 f_2 - f_1 c - f_2 c + c^2)^{\frac{1}{2}} - h (f_1^2 - c^2)^{\frac{1}{2}} (f_2^2 - c^2)^{\frac{1}{2}} \end{matrix} \right\}.$$

This naturally suggests writing

$$f = c \cos \phi,$$

whereby V' becomes

$$V' = \phi'_1 \phi'_2 \{2\mu_1 c \cos \tfrac{1}{2}\phi_1 \cos \tfrac{1}{2}\phi_2 + 2\mu_2 c \sin \tfrac{1}{2}\phi_1 \sin \tfrac{1}{2}\phi_2 - c^2 h \sin \phi_1 \sin \phi_2\}.$$

Taking ϕ to be the simple linear function $\xi + i\eta$, we then get

$$V' = \mu_1 c (\cosh \eta + \cos \xi) + \mu_2 c (\cosh \eta - \cos \xi) - \tfrac{1}{2} c^2 h (\cosh 2\eta - \cos 2\xi),$$

which leads to the equations

$$\frac{d^2 \xi}{d\tau^2} = (\mu_2 - \mu_1) c \sin \xi - c^2 h \sin 2\xi,$$

$$\frac{d^2 \eta}{d\tau^2} = (\mu_2 + \mu_1) c \sinh \eta - c^2 h \sinh 2\eta,$$

with

$$\left(\frac{d\xi}{d\tau}\right)^2 + \left(\frac{d\eta}{d\tau}\right)^2 = 2V',$$

and

$$t = \int J d\tau = \tfrac{1}{2} c^2 \int (\cosh 2\eta - \cos 2\xi)\, d\tau.$$

This is the ordinary solution, ξ and η being expressible as elliptic functions of τ. (Cf. Whittaker, *Analytical Dynamics*, p. 95.)

8. In the simplest case of the problem of three bodies, the restricted problem with equal finite masses, we still have with this transformation

$$J = \tfrac{1}{2} c^2 (\cosh 2\eta - \cos 2\xi);$$

and it is necessary to add to V' the term

$$\begin{aligned} \tfrac{1}{2} n^2 J (x^2 + y^2) &= \tfrac{1}{2} n^2 f_1' f_2' f_1 f_2 \\ &= \tfrac{1}{8} n^2 c^4 \sin 2\phi_1 \sin 2\phi_2 \\ &= \tfrac{1}{16} n^2 c^4 (\cosh 4\eta - \cos 4\xi). \end{aligned}$$

With unequal masses it would be necessary to remember that the origin of

(x, y) in this term is the centre of gravity of the large masses, and not the point midway between them. But if $\mu_1 = \mu_2 = \mu$, we have

$$V' = 2\mu c \cosh \eta - \tfrac{1}{2}c^2 h(\cosh 2\eta - \cos 2\xi) + \tfrac{1}{16}n^2c^4(\cosh 4\eta - \cos 4\xi)$$
$$= \frac{1}{2}\left(\frac{d\xi}{d\tau}\right)^2 + \frac{1}{2}\left(\frac{d\eta}{d\tau}\right)^2;$$

and accordingly,

$$\frac{d^2\xi}{d\tau^2} - nc^2(\cosh 2\eta - \cos 2\xi)\frac{d\eta}{d\tau} = -c^2h \sin 2\xi + \tfrac{1}{4}n^2c^4 \sin 4\xi,$$

$$\frac{d^2\eta}{d\tau^2} + nc^2(\cosh 2\eta - \cos 2\xi)\frac{d\xi}{d\tau} = 2\mu c \sinh \eta - c^2h \sinh 2\eta + \tfrac{1}{4}n^2c^4 \sinh 4\eta.$$

If in these equations we put $n = 1$, $c = 1$, $2\mu = 8n^2c^3$, or $\mu = 4$, $h = \frac{1}{2}K$, $\xi = E$, $\eta = F$, and $\tau = \psi$, we have at once the equations of § 4. Here the dependent variables are not separated, and it is seen immediately how the simplest case of the problem of three bodies transcends in complexity the problem of two fixed centres.

9. A purely algebraic transformation may be worth noticing. This is

$$x + iy = \tfrac{1}{2}c\{(\xi + i\eta)^2 + (\xi + i\eta)^{-2}\},$$

and it is convenient to write

$$\xi = \rho \cos \phi, \quad \eta = \rho \sin \phi.$$

Then $J = f_1'f_2' = c^2\rho^{-2}(\rho^4 + \rho^{-4} - 2\cos 4\phi)$,

$$x = \tfrac{1}{2}c(\rho^2 + \rho^{-2})\cos 2\phi, \quad y = \tfrac{1}{2}c(\rho^2 - \rho^{-2})\sin 2\phi,$$
$$r_1 = \tfrac{1}{2}c(\rho^2 + \rho^{-2} + 2\cos 2\phi), \quad r_2 = \tfrac{1}{2}c(\rho^2 + \rho^{-2} - 2\cos 2\phi),$$
$$V = \frac{\mu}{r_1} + \frac{\mu}{r_2} = \frac{4\mu(\rho^2 + \rho^{-2})}{c(\rho^4 + \rho^{-4} - 2\cos 4\phi)}.$$
$$\tfrac{1}{2}n^2(x^2 + y^2) = \tfrac{1}{8}n^2c^2(\rho^4 + \rho^{-4} + 2\cos 4\phi).$$

Hence

$$V' = 4\mu c(1 + \rho^{-4}) + \tfrac{1}{8}n^2e^4\rho^{-2}(\rho^8 + \rho^{-8} - 2\cos 8\phi) - c^2h\rho^{-2}(\rho^4 + \rho^{-4} - 2\cos 4\phi)$$

which can be easily expressed in terms of ξ and η. The expressions

$$\frac{\partial V'}{\partial \xi} = \cos \phi \frac{\partial V'}{\partial \rho} - \frac{\sin \phi}{\rho}\frac{\partial V'}{\partial \phi},$$
$$\frac{\partial V'}{\partial \eta} = \sin \phi \frac{\partial V'}{\partial \rho} + \frac{\cos \phi}{\rho}\frac{\partial V'}{\partial \phi},$$

are probably too complicated for any practical use. The effect of the transformation is, however, to give the equations of motion in a form which involves only rational algebraic functions of the variables. The pole $\rho = 0$ is not of consequence, since it corresponds to a point at infinity in the (x, y) plane.

10. The equations of motion, as found in § 5, may also be expressed in the polar coordinates (ρ, ϕ), and they become

$$\frac{d^2\rho}{d\tau^2} - \rho\left(\frac{d\phi}{d\tau}\right)^2 - 2nJ\rho\frac{d\phi}{d\tau} = \frac{\partial V'}{\partial\rho},$$

$$\frac{d}{d\tau}\left(\rho^2\frac{d\phi}{d\tau}\right) + 2nJ\rho\frac{d\rho}{d\tau} = \frac{dV'}{d\phi},$$

$$\left(\frac{d\rho}{d\tau}\right)^2 + \rho^2\left(\frac{d\phi}{d\tau}\right)^2 = 2V',$$

a form directly adapted to the above transformation. The transformed equations are equally well adapted to Sir George Darwin's method of mechanical integration. For, if R be the radius of curvature in the (ξ, η) plane,

$$\begin{aligned}\frac{1}{R} &= \frac{\eta''\xi' - \xi''\eta'}{(\xi'^2 + \eta'^2)^{\frac{3}{2}}} \\ &= \frac{1}{2V'}\left\{\frac{\xi'}{(\xi'^2 + \eta'^2)^{\frac{1}{2}}}\frac{\partial V'}{\partial\eta} - \frac{\eta'}{(\xi'^2 + \eta'^2)^{\frac{1}{2}}}\frac{\partial V'}{\partial\xi}\right\} - \frac{2nJ}{(2V')^{\frac{1}{2}}} \\ &= \frac{P}{v^2} - \frac{2nJ}{v},\end{aligned}$$

where $v^2 = 2V'$ and P is the component of force normal to the trajectory. Hence, if ψ is the inclination of the normal to the axis of ξ, and σ is the arc of the orbit from a chosen point,

$$P = \cos\psi\frac{\partial V'}{\partial\eta} - \sin\psi\frac{\partial V'}{\partial\xi},$$

and

$$\psi = \psi_0 + \int\frac{d\sigma}{R}$$

$$\xi = \xi_0 + \int\cos\psi\,d\sigma$$

$$\eta = \eta_0 + \int\sin\psi\,d\sigma.$$

A final quadrature will give

$$t = \int Jd\tau = \int\frac{J}{v}\,d\sigma.$$

III.

REAL AND COMPLEX NUMBERS CONSIDERED AS ADJECTIVES OR OPERATORS.

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I.—Introductory.

The object of this paper is to define the symbols +, –, and i, so that the rules to be followed in using them may be obvious, and that what are called negative and imaginary solutions of problems may have as real and precise a meaning as those called positive.

In this paper, the properties of ordinary or rational numbers, which include, of course, integers and fractions, are assumed as proved, and also the extension of these properties to irrational numbers. Such an extension is purely arithmetical, in other words, quite distinct from the extension of number by the introduction of algebraic symbols.

Assuming, then, that this extension has been made, we can proceed to reason as if we could always obtain rational numbers to measure quantities of the same kind by means of a unit. By a unit we mean any arbitrary quantity which we select as a standard in terms of which to measure other quantities of the same kind. Here we note the fundamental difference between the terms "number" and "quantity." A quantity is a noun, and requires for its statement two elements. One is the unit we have selected, in terms of which the magnitude of the quantity is to be expressed. The other is a qualifying adjective, the number, which expresses the number of times the unit is to be taken. Similarly, generalised numbers and complex numbers, which will be introduced subsequently, are adjectives; in fact, any complex formula in algebra is an adjective which may be used to qualify any unit.

Now, when we proceed to make calculations involving the quantities which occur in nature, we find that those of the same kind can further be subdivided into two groups. For instance, distances may be measured forwards or backwards along a line; money may be received or paid out;

money may be owed by or due to a person; time may be reckoned forwards or backwards from a specified date; liquid may be put into or drawn from a cask; and so on. To distinguish, we measure one group in terms of a unit α, the other in terms of a unit β, and for convenience α and β are taken to be of the same absolute magnitude. Thus, a man wishing to concisely state the position of his affairs may do so, and make his initial approach to algebra by writing down, say:

$$7\alpha,\ 9\beta,\ 11\alpha,\ 12\beta,\ (2\tfrac{1}{2})\alpha,$$

where α is £1 owed to him, β £1 owed by him; and by these symbols, written in a line, separated by commas, he means:—I am owed £7, but I owe £9, so my position is financially the same as if I owed £2; but I am owed £11, so I am owed £9; but I owe £12, so I owe £3; but I am owed £2 10*s*., so my position is financially the same as if I owed 10*s*. A corresponding statement might be made in which α would mean one mile walked in a forward direction from an initial position on a road, and β a mile walked in a backward direction, and the object of the statement would be, not to find the distance walked, but the distance from the starting-point. Similarly, it might refer to gallons of water put into or taken out of a tank, with the object of finding, not the number of gallons handled, but a number of gallons which, when put into or taken from the tank, as the case may be, would produce the same result as the series of operations referred to by $7\alpha, 9\beta, 11\alpha, 12\beta, (2\frac{1}{2})\alpha$.

Thus the units α, β combine as follows:—$7\alpha, 9\beta = 2\beta$, $7\alpha, 9\alpha = 16\alpha$, $7\beta, 9\beta = 16\beta$, and so on. This operation of combining the units we call addition.

Now any calculation like the above may be altered to an equivalent one in several ways. In the first place, the order may be altered in any way, provided all the quantities are taken account of. The truth of this statement may be derived from the assumption that the order is immaterial when we are dealing with two quantities, that is to say, that the same result is obtained by taking account of 7α and 9β in the order $7\alpha, 9\beta$ or in the order $9\beta, 7\alpha$, and of $7\alpha, 9\alpha$ in the order $7\alpha, 9\alpha$ or $9\alpha, 7\alpha$, and of $7\beta, 9\beta$ in the order $7\beta, 9\beta$ or $9\beta, 7\beta$. Assuming this to be intuitively true, we can alter the order in which a set of quantities is taken account of to be any whatsoever, by alterations in each of which only two consecutive quantities are affected. For instance, to show that $7\alpha, 9\beta, 11\alpha, 12\beta = 11\alpha, 9\beta, 12\beta, 7\alpha$, first alter the order of $9\beta, 11\alpha$ to $11\alpha, 9\beta$, then the order of $7\alpha, 11\alpha$ to $11\alpha, 7\alpha$, thus bringing 11α to the first position; then bring 9β to the second position, and so on, thus

$$7\alpha, 9\beta, 11\alpha, 12\beta = 7\alpha, 11\alpha, 9\beta, 12\beta = 11\alpha, 7\alpha, 9\beta, 12\beta = 11\alpha, 9\beta, 7\alpha, 12\beta$$
$$= 11\alpha, 9\beta, 12\beta, 7\alpha.$$

In the calculation the quantities are then said to be commutative.

Again, we may first calculate any group, say $9\beta, 11\alpha, 12\beta$ in $7\alpha, 9\beta, 11\alpha, 12\beta, 3\alpha$, and denoting the result by $(9\beta, 11\alpha, 12\beta)$, we can prove

$$7\alpha, 9\beta, 11\alpha, 12\beta, 3\alpha = 7\alpha, (9\beta, 11\alpha, 12\beta), 3\alpha.$$

For bring the group into the initial position in the calculation by using the commutative law, then associate its members together, or, in other words, replace the group by a single quantity, then alter by the commutative law, so that the other quantities are in their original order, thus

$$7\alpha, 9\beta, 11\alpha, 12\beta, 3\alpha = 9\beta, 11\alpha, 12\beta, 7\alpha, 3\alpha = (9\beta, 11\alpha, 12\beta), 7\alpha, 3\alpha$$
$$= 7\alpha, (9\beta, 11\alpha, 12\beta), 3\alpha.$$

The quantities are then said to be associative. Thus the calculation obeys the commutative and the associative laws. These laws are dealt with at some length, because the same method of proof will apply to prove that the multiplication of generalised and complex numbers follows both the associative and commutative laws.

At this stage it would be possible and instructive to do some simple and simultaneous equations; but theoretically it is better to postpone doing so until we shall have made the next step.

II.—REAL NUMBERS.

Denoting ordinary numbers by the letters a, b, c, a_1, b_1, c_1, &c., we can multiply any quantity $a\alpha$ by b, and denoting the result by $ba\alpha$ or $b.a.\alpha$, it follows by the commutative law assumed in this paper as proved for ordinary numbers that $ba\alpha = ab\alpha$. This is quite intelligible. Observe in multiplication for the purpose of exposition it is more convenient to take the numbers in order from right to left, than in order from left to right, as we did in addition. Now not only can we multiply $a\alpha$ by b, but we may also change the unit α to β, or if the unit were β, alter β to α. To obtain brief methods of expressing these operations we define $(+b)\,a\alpha$ to mean—multiply $a\alpha$ by b and do not alter the unit to the other unit, so that $(+b)\,a\alpha = ba\alpha = +(ba)\,\alpha$; and we define $(-b)\,a\alpha$ to mean—multiply $a\alpha$ by b and alter the unit to the other one, so that $(-b)\,a\alpha = ba\beta$, $(-b)\,a\beta = ba\alpha$. If we perform any operation $(-b)$ on $a\alpha$, and then the operation $(-c)$ on the result, as the unit has been twice changed it is unaltered, so that $(-c)\,(-b)\,a\alpha = cba\alpha = (cb)\,a\alpha$. Also as

$$(-c)\,(+b)\,a\alpha = cba\beta = -\,(cb)\,a\alpha, \quad \text{and} \quad (+c)\,(+b)\,a\alpha = cba\alpha = (cb)\,\alpha,$$
$$\text{and } (+c)\,(-b)\,a\alpha = cba\beta = -\,(cb)\,a\alpha,$$

the laws of operating in this way, or as we call it of generalised multiplication, are summarised by stating that like signs give + and unlike –.

As $(-a)\boldsymbol{a} = a\beta$ the symbol – enables us to dispense with the symbol β, and any quantity may be expressed by the unit $\boldsymbol{a}$ and a qualifying adjective $+a$ or $-a$. This qualifying adjective is our generalised number, and consists of an ordinary number a with the symbol + or – prefixed. We denote it usually by the letters x, y, x_1, y_1, &c. Now my object is to establish the ordinary use of symbols. Were I to follow what would appear to be a more natural course, I should not introduce the symbols + and – at all, but should introduce one new symbol j, which would have the same meaning as –, in analogy to the symbol i, which will be introduced presently, and so our generalised number would be a or aj. If any student wishes to introduce algebraic operations in a sound logical manner, I advise him to use this symbol j, as it is rather hard to limit the well-known symbols + and – to their precise usage as defined above.

The meaning now of $xyz\boldsymbol{a}$ is clear, and as we see generally that $xyz\boldsymbol{a} = yxz\boldsymbol{a}$, because the numerical part of $xyz\boldsymbol{a}$ is independent of the order of xy, and also the final sign + or – in $xyz\boldsymbol{a}$ does not depend on the order of the signs + or – in x and y; hence it follows that in the process of generalised multiplication generalised numbers obey both the commutative and the associative law, by a method of proof precisely analogous to that given before in proving the corresponding results for addition of quantities.

As we may prefix the sign $+ = +1$ to any quantity, we may dispense with the comma, and according to my view mere juxtaposition of the quantities will signify that they are to be added. Thus $x\boldsymbol{a} + y\boldsymbol{a}$ means that $x\boldsymbol{a}$ is to be added to $y\boldsymbol{a}$, $x\boldsymbol{a} - y\boldsymbol{a}$ means that $x\boldsymbol{a}$ is to be added to $y\beta$. The same quantities may also be denoted by $(x + y)\boldsymbol{a}$ and $(x - y)\boldsymbol{a}$, whereas $xy\boldsymbol{a}$ means that $\boldsymbol{a}$ is to be multiplied first by y and then by x.

We call $+a\boldsymbol{a} = a\boldsymbol{a}$ a positive quantity, $-a\boldsymbol{a} = a\beta$ a negative quantity, $+a$ or a a positive number, $-a$ a negative number, and in future in conformity with usage we shall call a generalised number a real number. By adding any small positive quantity, say $e\boldsymbol{a}$, repeatedly to a large negative quantity we alter it by steps as small as we please to a large positive quantity. We usually talk of this process as increasing the quantity, but we might equally well talk of the reverse process as increasing the quantity, for by continually adding $e\beta$ to a large positive quantity we proceed by steps as small as we please to a large negative quantity. Subtraction is a term which may be dismissed in a line: to subtract any quantity $y\boldsymbol{a}$ from $x\boldsymbol{a}$ means that we look for a quantity such that when $y\boldsymbol{a}$ is added to it we get $x\alpha$, such a quantity is $x\alpha + y\beta = x\alpha - y\alpha$. The introduction of the units α and β has made the operation of subtraction always possible.

The addition and multiplication of real numbers is a distinct forward intellectual step, which will be made immediately, but is not required for the consideration of simple and simultaneous equations, which seem to me to be simplified by retaining the unit α.

As an example—solve the equation

$$\tfrac{1}{4}(x - 5) = \tfrac{1}{5}(2x - 6) + 1.$$

In this form the question has no meaning until we shall have advanced to the consideration of the addition and multiplication of real numbers, but in the following simpler form it has a definite meaning—

Find a real number x to satisfy

$$\tfrac{1}{4}(x\alpha + 5\beta) = \tfrac{1}{5}(2x\alpha + 6\beta) + \alpha,$$

or

$$\tfrac{1}{4}(x\alpha - 5\alpha) = \tfrac{1}{5}(2x\alpha - 6\alpha) + \alpha.$$

Multiply across by 20. We can do so, because if two quantities are equal, it is intuitively true that they are still equal if we change the unit to $a\alpha$, and in addition we may alter the unit α to β on each side, as the operations we use have just the same effect on β in its connexion with α as they have on α in its connexion with β. Thus we can multiply both sides of any equation by any real number.

So we get

$$5x\alpha + 25\beta = 8x\alpha + 24\beta + 20\alpha,$$

add to each side $8x\beta + 25\alpha$, and as $25\alpha + 25\beta = 0$ and $5x\alpha + 8x\beta = 3x\beta$, etc.;

$$\therefore \quad 3x\beta = 24\beta + 20\alpha + 25\alpha = 21\alpha;$$

$$\therefore \quad x\beta = 7\alpha;$$

$$\therefore \quad x = -7.$$

Observe we can reverse every step and proceed backwards from $x = -7$ to the equation.

Simple problem.—How far should I walk in a forward or backward direction along a road, so that should I walk four times as far in the same direction, and then walk 31 miles in a forward direction, I should be 11 miles in front of the point from which I started?

In this problem, denoting a mile walked in a forward direction by α, and one in a backward direction by β, we want to find a real number x to satisfy

$$4x\alpha + 31\alpha = 11\alpha.$$

Adding 31β to each side, $4x\alpha = 11\alpha + 31\beta = 20\beta$, $\therefore x = -5$, or I walk backward one mile.

Note.—Were I to substitute the words "31 miles in the same direction" for "31 miles in a forward direction," the problem could not be stated algebraically, and with the number chosen would not have any solution.

Addition and Multiplication of generalised or real numbers.—(x_1, x_2, x_3, etc.) or ($x_1 + x_2 + x_3 +$ etc.) has the following definite meaning as an operator on any quantity $w\mathbf{a}$, namely, it means that we multiply $w\mathbf{a}$ first by x_1, then by x_2, and so on, and add the results.

Now if $x_1\mathbf{a} + x_2\mathbf{a} + x_3\mathbf{a} +$ etc. $= x\mathbf{a}$, we may multiply as we saw in the above problem by any real number w, so that

$$x_1w\mathbf{a} + x_2w\mathbf{a} + x_3w\mathbf{a} + \text{etc.} = xw\mathbf{a};$$

$$\therefore \qquad (x_1 + x_2 + x_3 + \text{etc.})\, w\mathbf{a} = xw\mathbf{a}.$$

Thus if $(x_1 + x_2 + x_3 + \text{etc.})\, \mathbf{a} = x\mathbf{a}$, the operator $x_1 + x_2 + x_3 +$ etc., on any quantity $w\mathbf{a}$, produces the same result as the operator x, and so in this sense is equal to it, where x is derived from $x_1 + x_2 + x_3 +$ etc., by combining the numbers in the same way as they would combine should we operate with it on $\mathbf{a}$. This is precisely the same as what we mean in arithmetic by such a statement as $3 + 4 = 7$, which asserts not only that 3 units + 4 units = 7 units, but also that if we multiply any quantity say 13 units by 3 and then by 4 and add the results, we get the same quantity as if we multiplied 13 units by 7.

Similarly if $x_1x_2x_3\mathbf{a} = x\mathbf{a}$, multiply each side by w (as we saw we could do), so that $x_1x_2x_3w\mathbf{a} = xw\mathbf{a}$. Hence if we combine the real numbers in the operator $x_1x_2x_3$ in the same way as they would combine were we to operate with it on $\mathbf{a}$, we get an operator x which produces the same effect as $x_1x_2x_3$ when we operate with it on any quantity. In this sense and according to this rule $x_1x_2x_3 = x$. We have thus shown how to add and multiply real numbers, and we note in such operations the numbers are commutative and associative.

Now,
$$\begin{aligned}(x + y)(x' + y')\,\mathbf{a} &= x(x' + y')\,\mathbf{a} + y\,(x' + y')\,\mathbf{a}\\ &= (x' + y')\,x\mathbf{a} + (x' + y')\,y\mathbf{a}\\ &= xx'\mathbf{a} + xy'\mathbf{a} + x'y\mathbf{a} + yy'\mathbf{a},\end{aligned}$$

$$\therefore \qquad (x + y)(x' + y') = xx' + xy' + x'y + yy'.$$

Replacing x' by x and y' by y, and using the notation $xx = x^2$,

$$(x + y)^2 = x^2 + 2xy + y^2.$$

Replacing y by $-y$,

$$(x - y)^2 = x^2 - 2xy + y^2.$$

Replacing x' by x and y' by $-y$,

$$(x + y)(x - y) = x^2 - y^2.$$

Fractions.—What we mean by $\frac{x}{y}$ or x/y is a real number such that when we multiply it by y, or y by it, we get x. Such a number exists, for, denoting the numerical part of a real number x by $|x|$, its numerical part is $|x|/|y|$; and, in addition, we have to prefix the sign + or − as required.

Now, if $\frac{x}{y}\alpha = z\alpha$, multiplying each side by y and by any real number w as we saw we can do, we get

$$xw\alpha = ywz\alpha;$$

$$\therefore \quad \frac{x}{y} = z = \frac{xw}{yw},$$

or a fraction can be multiplied above and below by any real number without altering its value.

Addition of Fractions.—

$$\frac{x}{y} + \frac{x'}{y'} + \frac{x''}{y''} \quad \text{is a real number } z\text{, given by}$$

$$\left(\frac{x}{y} + \frac{x'}{y'} + \frac{x''}{y''}\right)\alpha = z\alpha.$$

Multiply each side by $yy'y''$;

$$\therefore \quad (xy'y'' + x'yy'' + x''yy')\alpha = yy'y''z\alpha;$$

$$\therefore \quad z = \frac{xy'y'' + x'yy'' + x''yy'}{yy'y''}.$$

Quadratic Equations.—In problems, such arise in the form

$$(x^2 \pm 2ax \pm b)\alpha = 0.$$

Adding $(+a^2 - a^2)\alpha$, if $a^2 - b$ is +, we get

$$\{(x \pm a)^2 - (a^2 \pm b)\}\alpha = (x \pm a + \sqrt{a^2 \pm b})(x \pm a - \sqrt{a^2 \pm b})\alpha = 0.$$

This equals 0, when and only when, either

$$x \pm a + \sqrt{a^2 \pm b} = 0 \quad \text{or} \quad x \pm a - \sqrt{a^2 \pm b} = 0.$$

Thus, the mathematical game played with the units α, β is incomplete, as we cannot find a real number x such that $x^2\alpha = a\beta = -a\alpha$; nor can we change $x^2 + a^2$ into the form $(x + w)(x + w')$; nor can we alter $x^2 \pm 2ax + b$ into the form $(x + w)(x + w')$, in other words, find its factors when $a^2 - b$ is −.

Example of a Problem.—What are eggs a dozen, if two more in a shilling's worth lowers the price a penny a dozen?

Here two sets of units occur. Let α denote an egg I am to receive, β one I am to give away, α' a penny I am to pay, β' a penny I am to receive. If then $x\alpha'$ is the price of one egg, and $y\alpha$ the quantity I get for a shilling, the problem states

$$yx\alpha' = 12\alpha',$$

$$\left[\left(y+2\right)\left(x-\frac{1}{12}\right)\right]\alpha' = 12\alpha';$$

$$\therefore \quad y = \frac{12}{x}; \quad \therefore \left\{\left(\frac{12}{x}+2\right)\left(x-\frac{1}{12}\right)-12\right\}\alpha' = 0,$$

$$\left\{\left(6+x\right)\left(x-\frac{1}{12}\right)-6x\right\}\alpha' = 0,$$

$$\left(x^2+6x-\frac{1}{12}x-\frac{1}{2}-6x\right)\alpha' = 0,$$

$$\left\{\left(x-\frac{1}{24}\right)^2-\left(\frac{1}{24}\right)^2-\frac{1}{2}\right\}\alpha' = 0;$$

$$\therefore \quad \left(x-\frac{1}{24}-\frac{17}{24}\right)\left(x-\frac{1}{24}+\frac{17}{24}\right)\alpha' = 0;$$

$$\therefore \quad x = \frac{18}{24} = \frac{3}{4}, \quad \text{or} \quad x = -\frac{16}{24} = -\frac{2}{3}.$$

(Observe, we can proceed backwards from either $x = \frac{3}{4}$, or $x = -\frac{2}{3}$ to the two original equations.) Thus the price I pay for 12 eggs is $12x\alpha' = 9\alpha'$ or $8\beta'$; so either I pay 9 pence or am paid 8 pence to take the eggs.

Indices.—The theory of indices may now be developed in the usual way. We define $x^{\frac{m}{n}}$ when m and n are positive integers, and $\frac{m}{n}$ is in its lowest terms as $\sqrt[n]{x^m}$, and $x^{-\frac{m}{n}}$ as $\frac{1}{x^{\frac{m}{n}}}$. When x is positive, $\sqrt[n]{x^m}$ has two values equal but of opposite sign when n is even, and one if n is odd. Also, we prove generally that a value of $x^{\frac{m}{n}}$ multiplied by a value of $x^{\frac{m'}{n'}}$ gives a value of $x^{\frac{mn'+m'n}{mn}}$. If x is negative, $\sqrt[n]{x^m}$ does not exist as a real number when m is odd and n even; it has one value when m is odd and n odd, and one value when m is even and n odd. We note, then, the theory is incomplete so long as we restrict our operations to real numbers. The binomial exponential and logarithmic series may now be developed, noting that we restrict ourselves to the logarithms of positive numbers.

Trigonometry.—In trigonometry, angles are measured in terms of a unit α, the radian, in the form $x\alpha$, where x is a real number. Associated, then, with any real number x are other real numbers $\sin x\alpha$, $\cos x\alpha$, &c.

III.—COMPLEX NUMBERS.

To generalise still further our operations we take, instead of two units, four units in cyclical order $\alpha, \alpha', \beta, \beta'$. Of these four, two α, β, are a pair of the sort we have considered up to this, so that they combine by addition, $7\alpha + 9\beta = 2\beta$, and so on. The other pair α', β' are similarly related, and form any other pair.

For instance, α, β might refer to money due to or owed by a person, α', β' to distance moved along a line. Or in particular α, β might refer to distances measured along a line, and α', β' to distances measured along a second line inclined at an angle to the first. A simpler representation of the result of complex multiplication is obtained when the angle is taken to be a right angle. Again α, β might be any pair of units, and α', β' a pair to measure quantities of the same kind, but we agree to keep the two quantities distinct.

Having made a selection of any such four, and arranged for them a cyclical order $\alpha, \alpha', \beta, \beta'$, we introduce a new symbol i such that ai written before any of the quantities $b\alpha, b\alpha', b\beta, b\beta'$, means that b is to be multiplied by a and the unit changed to the next in cyclical order. Of course $+ a$ or a written in front of $b\alpha$, &c., still means that b is to be multiplied by a and the unit not changed, and $- a$ written in front $b\alpha$, &c., still means that b is to be multiplied by a and the unit changed to β, &c.

Thus $aib\alpha = ab\alpha'$, $aib\alpha' = ab\beta$, $aib\beta = ab\beta'$, $aib\beta' = ab\alpha$.

Hence, $i^2\alpha = i\alpha' = \beta = - \alpha$, and so on, so that i^2 is equivalent to the operator $- 1$. Again, $i^3\alpha = \beta' = - i\alpha$, thus the operator $- i$ that is $(- 1)(1i)$ (but it is customary to omit the 1 in each), is equivalent to a reversal of the order of substitution laid down for i.

As $i^2\alpha = - \alpha$, $i^3\alpha = - i\alpha$, $i^4\alpha = \alpha$, our most general quantity, $a\alpha + b\alpha' + c\beta + d\beta'$ may now be written as $x\alpha + iy\alpha$ or $(x + iy)\alpha$. Thus our most general number is $x + iy$, and is a complex adjective qualifying the noun α.

Now, defining $(x + iy)z\alpha$ to mean $xz\alpha + iyz\alpha$, where $z\alpha$ is any complex quantity, we get $(x + iy)(x' + iy')z\alpha = \{xx' - yy' + i(xy' + x'y)\}z\alpha$, hence $x + iy$ and $x' + iy'$ are commutative, and hence, denoting complex numbers by z_1, z_2, z_3, &c., in $z_1z_2z_3$,&c.α, z_1, z_2, z_3, &c., are commutative and associative.

Now if $(z_1 + z_2)\alpha = z\alpha$, as the symbols $-$ and i operate on α' in its relation to $\beta\beta'\alpha$ in consecutive cyclical order in the same way as they operate on α in its relation to $\alpha'\beta\beta'$, and so on, it follows that we may replace α by α' or β or β'. Also it follows by intuition that we may increase the unit $\boldsymbol{a}$ to $c\boldsymbol{a}$. Thus we may multiply both sides of the equation $(z_1 + z_2)\,\boldsymbol{a} = z\boldsymbol{a}$, or of any equation, by a complex number $\pm a \pm ib$, for we may replace $\boldsymbol{a}$ by $a\boldsymbol{a}$ and change if necessary $\boldsymbol{a}$ to $\boldsymbol{\beta}$, and also replace $\boldsymbol{a}$ by $b\boldsymbol{a}$, and change $\boldsymbol{a}$ to $\boldsymbol{a}'$ or $\boldsymbol{\beta}'$, then add the results, thus getting from $(z_1 + z_2)\,\boldsymbol{a} = z\boldsymbol{a}$ to $(z_1 + z_2)(\pm a \pm ib)\,\boldsymbol{a} = z(\pm a \pm ib)\,\boldsymbol{a}$.

Thus if $(z_1 + z_1) = z\boldsymbol{a}$, $z_1 + z_2$ produces the same effect as z when we use it as an operator on any complex quantity. In this sense $z_1 + z_2 = z$. In the same sense if $z_1z_2\boldsymbol{a} = z'\boldsymbol{a}$, $z_1z_2 = z'$, for, as we have just shown, we may multiply both sides by z_3, getting $z_1z_2z_3\boldsymbol{a} = z'z_3\boldsymbol{a}$, thus z_1z_2 produces the same effect as z' when used as an operator on any complex quantity, and we note that to get z' from z_1z_2 we combine the symbols in the same way as if they were operating on $\boldsymbol{a}$.

What we mean by $(x + iy)\,\boldsymbol{a} = 0$ is that $x = 0$, $y = 0$, for the unit $i\boldsymbol{a}$ is different in kind from $\boldsymbol{a}$.

If $(x + iy)(x' + iy')\,\boldsymbol{a} = 0$, $xx' - yy' = 0$, $xy' + x'y = 0$, so that if x' and y' are not both equal to 0, multiplying the first by x' and the second by y' and adding we get $x(x'^2 + y'^2) = 0$, $\therefore\ x = 0$, similarly multiplying the first by $-y'$, and the second by x' and adding $y(x'^2 + y'^2) = 0$, $\therefore\ y = 0$. It follows that $z_1z_2z_3\&c.\boldsymbol{a} = 0$ when and only when one of the numbers $z_1, z_2, z_3, \&c. = 0$.

Two square roots can now be found for any number real or complex, say of $x' + iy'$.

$$(x + iy)^2 = x' + iy', \quad x^2 - y^2 = x', \quad 2xy = y', \quad \therefore \quad (x^2 + y^2)^2 = x'^2 + y'^2,$$

taking the positive root

$$x^2 + y^2 = \sqrt{x'^2 + y'^2}, \quad \therefore \quad x = \pm\sqrt{\frac{x' + \sqrt{x'^2 + y'^2}}{2}}, \quad y = \frac{y'}{2x},$$

$$\therefore \quad x + iy = \pm\left\{\sqrt{\frac{x' + \sqrt{x'^2 + y'^2}}{2}} + \frac{iy'}{2\sqrt{\frac{x' + \sqrt{x'^2 + y'^2}}{2}}}\right\}.$$

The two imaginary cube roots of unity have from this point of view precise definite meanings, as either specifies an operation which when performed three times on any complex quantity reproduces the quantity itself.

Fractions.—What we mean by the fraction $\dfrac{x + iy}{x' + iy'}$ is a complex number such that when we multiply it by $x' + iy'$, we get $x + iy$. Assuming it to exist, we call it z, then

$$\frac{x + iy}{x' + iy'} = z.$$

Multiply both sides by $(x'+iy')(x'-iy')$.

$$\therefore \quad z(x'+iy')(x'-iy') = (x+iy)(x'-iy');$$

$$\therefore \quad (x'^2+y'^2)z = xx'+yy'+(x'y-xy')i;$$

$$\therefore \quad z = \frac{xx'+yy'+(x'y-xy')i}{x'^2+y'^2}.$$

If we multiply by $x'-iy'$, we verify that we have obtained the complex number $\dfrac{x+iy}{x'+iy'}$.

If $z=\dfrac{z_1}{z_2}$, then $zz_2=z_1$, $\therefore$ $zz_2z_3=z_1z_3$, $\therefore$ $z=\dfrac{z_1z_3}{z_2z_3}$, or a complex fraction may be multiplied above and below by the same complex number.

As we found above two square roots of the form $\pm(x+iy)$ for any complex number, it follows that any quadratic $z^2+2az+b$, where a and b are complex, may be expressed as the product of two complex factors $(z+\omega)(z+\omega')$, where $\omega=a+\sqrt{a^2-b}$, $\omega'=a-\sqrt{a^2-b}$. In particular $z^2+a^2=(z+ia)(z-ia)$.

To apply these complex numbers to solve problems. Taking the same problem as before, but altering the word "lowers" to "increases" in order to make the solution complex, we want to solve:—What are eggs a dozen if two more in a shilling's worth increases the price a penny a dozen?

Here with the pair of units $\alpha_1\beta_1$ for eggs we associate two others, say α'_1 an apple I am to give away, β'_1 an apple I am to receive, and with the pair α_2, β_2 for pence we associate two others, say α'_2 a pound of corn I am to part with, β'_2 a pound of corn I am to receive, thus getting two fundamental groups each consisting of 4 units properly arranged and in cyclical order $\alpha_1\alpha'_1\beta_1\beta'_1$, $\alpha_2\alpha'_2\beta_2\beta'_2$ respectively.

The price of an egg is a complex quantity $z\alpha_2$, the price of a complex number n of eggs is $nz\alpha_2$, so that if n is the number of eggs I get for a shilling, the problem states

$$nz\alpha_2 = 12\alpha_2; \qquad (n+2)\left(z+\frac{1}{12}\right)\alpha_2 = 12\alpha_2;$$

$$\therefore \quad n=\frac{12}{z}, \quad \text{and} \quad \left(\frac{12}{z}+2\right)\left(z+\frac{1}{12}\right) = 12;$$

$$\therefore \quad (z+6)\left(z+\frac{1}{12}\right) = 6z;$$

$$\therefore \quad z^2+\frac{1}{12}z+\frac{1}{2} = 0;$$

$$\left(z+\frac{1}{24}\right)^2+\frac{1}{2}-\left(\frac{1}{24}\right)^2 = 0;$$

$$\therefore \quad z = \frac{-1\pm i\sqrt{287}}{24};$$

and the answer to the question is $\frac{-1 \pm i\sqrt{287}}{2} a_2$, or I pay for the dozen eggs by receiving one halfpenny, and either giving or receiving $\frac{\sqrt{287}}{2}$ pounds of corn.

One fundamental group of 4 units referred to at the beginning of the treatment of complex numbers is a set $\alpha\alpha'\beta\beta'$, in which $\alpha\beta$ are units of length measured along a line OA, and $\alpha'\beta'$ are units of length measured parallel to a line OB meeting OA at an angle Ω. A complex quantity $(x + iy)\alpha$ for this group may be represented by measuring $OM = x\alpha$ from O along OA and MP from $M = y\alpha'$ parallel to OB. The lengths $x\alpha$, $y\alpha'$ are what are called the coordinates of P referred to the oblique axes OA, OB. Any complex number $x + iy$ provides us with the coordinates of a point P referred to given oblique axes, and conversely the position of P gives us by its coordinates x, y a complex number $x + iy$. In this sense P is a geometrical representation of the complex number. To add two complex numbers represented by P and Q, we draw from P a line equal and parallel to and in the same direction as OQ.

Any complex number $x + iy$ may be written in the form

$$r(\cos\theta + i\sin\theta),$$

where r is taken to be a real positive number, is called the modulus of $x + iy$, and is denoted by $|x + iy|$. The angle θ is called the argument or amplitude of $x + iy$, and has an infinite number of values, as we may take $\theta \pm 2k\pi$ instead of θ without altering $x + iy$, where k is an integer. When the axes OA, OB are taken to be at right angles, the angular coordinates r, θ of a point P, namely the length OP taken to be positive, and the angle POA, also represent the modulus and argument of the complex number represented by the point P. Writing two complex numbers z, z' in the form

$$r(\cos\theta + i\sin\theta), \quad r'(\cos\theta' + i\sin\theta'),$$

their product

$$zz' = rr'\{\cos(\theta + \theta') + i\sin(\theta + \theta')\}$$

by de Moivre's theorem. Thus the modulus of the product of z, z' is the product of their moduli, and the argument of the product is the sum of their arguments, to which we may add, however, $\pm 2k\pi$. As

$$i = \cos\frac{\pi}{2} + i\sin\frac{\pi}{2},$$

when OA, OB are at right angles, the point P' which represents $i(x + iy)$ may be obtained from the point P, which represents $x + iy$ by rotating

OP in the positive direction through a right angle about O. When OA, OB are not taken at right angles, the effect of multiplying $(x + iy)$ by i is not so simply represented, nor have we a simple geometrical representation of the argument and modulus of $x + iy$, nor is the representation of $(x + iy)(x' + iy')$ so simply related to the representation of $x + iy$ and $x' + iy'$.

By $(x + iy)^{\frac{m}{n}}$, where m and n are positive integers, and $\frac{m}{n}$ is in its lowest terms, we mean a number z such that $z^n = (x + iy)^m$. Writing $x + iy$ in the form $r(\cos\theta + i\sin\theta)$, we see that z has the value

$$r^{\frac{m}{n}}\left(\cos\frac{m}{n}\theta + i\sin\frac{m}{n}\theta\right),$$

and $n - 1$ other values obtained by replacing θ by

$$\theta + 2\pi, \quad \theta + 4\pi, \; . \; . \; . \; , \quad \theta + 2(n-1)\pi;$$

that these are all different is easily seen from their representative points, which form a regular polygon of n sides inscribed in the circle of radius $= r^{\frac{m}{n}}$.

$(x + iy)^{-\frac{m}{n}}$ is defined as

$$= \frac{1}{(x + iy)^{\frac{m}{n}}} = r^{-\frac{m}{n}}\left(\cos\frac{m}{n}\theta - i\sin\frac{m}{n}\theta\right);$$

and so its n values are obtained by replacing m by $-m$ in the n values of

$$(x + iy)^{\frac{m}{n}}.$$

As another example of a problem, take the following:—The fore-wheel of a carriage makes 64 revolutions more than the hind-wheel in travelling one mile; but if the circumference of the fore-wheel be increased by 11 inches, it will make only 40 revolutions more than the hind-wheel. Find the circumference of each wheel. With the numbers given, this problem has two real solutions. To understand the negative solution, and complex solutions when the numbers are altered, it is better to alter the problem to the following equivalent one:—There are two lines, P and Q, of which P is contained in a mile 64 times more than Q; but if the length of P is increased by 11 inches, it is contained in a mile only 40 times more than Q. Find the two lengths.

Laying down a direction OA, let $\boldsymbol{\alpha}$ be an inch measured in that direction, $\boldsymbol{\beta}$ one in the opposite direction. Let $x\boldsymbol{\alpha}$ be the length of P, $y\boldsymbol{\alpha}$ the length of Q, and n the number $y\alpha$ must be multiplied by to give one mile. Then the problem states

$$ny\alpha = 1760 \times 3 \times 12 \,.\, \alpha = (n + 64)\, x\alpha = (n + 40)(x + 11)\, \alpha\,;$$

$$\therefore \quad \frac{1}{x} - \frac{1}{x+11} = \frac{24}{1760 \times 3 \times 12} = \frac{1}{2640},$$

$$x^2 + 11x - 11 \times 2640 = 0\,;$$

$$\therefore \quad x = 165 \text{ or } -176.$$

Thus, P is 165 inches measured in the direction OA, or 176 measured in the opposite direction, and $n = 320$ or -424.

If we substitute the words "diminished by 11 inches" for "increased by 11," the solution is complex. To interpret the complex solution, we take α', β' to represent an inch drawn in the direction OB inclined at an angle to OA. With the four fundamental units α, α', β, β', the length of P will be denoted by $x\alpha$, where x is a complex number; similarly, y and n will be complex numbers, and the problem is to find complex numbers to satisfy

$$ny\alpha = 1760 \times 3 \times 12\alpha = (n + 64)\, x\alpha = (n + 40)\,(x - 11)\, \alpha\,;$$

$$\therefore \quad \frac{1}{x} - \frac{1}{x-11} = \frac{1}{2640},$$

$$x^2 - 11x + 29040 = 0,$$

$$x = \tfrac{11}{2}(1 \pm i\sqrt{959}).$$

And $n = -52 \mp 12\sqrt{959} \,.\, i$ gives us two definite operations $= n + 64$ which, when performed on the quantities $\tfrac{11}{2}(1 \pm i\sqrt{959})\,\alpha$ respectively, give one mile.

Briefly, to summarise further work with complex numbers, we develop the properties of the absolutely convergent series

$$1 + z + \frac{z^2}{1\,.\,2} + \frac{z^3}{1\,.\,2\,.\,3} + \&c.,$$

which series we call e^z, so that $e^z \,.\, e^{z'} = e^{z+z'}$. Thus $e^{x+iy} = e^x(\cos y + i \sin y)$. We define $\log(x + iy)$ as being such that

$$e^{\log(x+iy)} = x + iy = r(\cos\theta + i\sin\theta) = e^{\log r + i\theta},$$

so that $\log(x + iy) = \log r + i\theta$, and has an infinite number of values, as θ may be replaced by $\theta \pm 2k\pi$. We define z^p, where z and p may both be complex, to be $e^{p\log z}$, and so is many-valued. If p is of the form $\pm\frac{m}{n}$, where m and n are integers, it has the n values found before. Taking one of the values of z^p corresponding to $\theta \pm 2k\pi$, and varying

$$z = x + iy = r(\cos\theta + i\sin\theta) = e^{\log r + i(\theta \pm 2k\pi)},$$

$$\frac{dz^p}{dz} = \text{limit of } \frac{e^{p\{\log(r+dr)+i(\theta+d\theta\pm 2k\pi)\}} - e^{p\{\log r+i(\theta\pm 2k\pi)\}}}{e^{\log r+dr+i(\theta+d\theta\pm 2k\pi)} - e^{\log r+i(\theta\pm 2k\pi)}}$$

$$= \text{limit of } \frac{e^{p\{\log r+i(\theta\pm 2k\pi)\}}\left\{e^{p\{\log(r+dr)-\log r+id\theta\}} - 1\right\}}{e^{\log r+i(\theta\pm 2k\pi)}\left\{e^{\log(r+dr)-\log r+id\theta} - 1\right\}}$$

$$= \text{limit of } \frac{z^p\left\{e^{p\left\{\log\left(1+\frac{dr}{r}\right)+id\theta\right\}} - 1\right\}}{z\left\{e^{\log\left(1+\frac{dr}{r}\right)+id\theta} - 1\right\}}$$

$$= \text{limit of } \frac{z^{p-1}\left\{e^{p\left(\frac{dr}{r}+id\theta\right)} - 1\right\}}{e^{\left(\frac{dr}{r}+id\theta\right)} - 1} = \text{limit of } \frac{z^{p-1}\left\{1+p\left(\frac{dr}{r}+id\theta\right)-1\right\}}{1+\frac{dr}{r}+id\theta-1}$$

$$= pz^{p-1}.$$

Finally, as an example of a way in which this mathematical game may be visibly played—for of course it may generally be played only on paper when the units α', β' are of any different kind whatsoever from α, β—take 4 measuring vessels $ABA'B'$ arranged in the cyclical order $AA'BB'$, and pour any quantities of water into them. We lay down that the position of the game at any time is given by stating the difference of the quantities of water in A and B and stating which is in excess, and making a like statement for A' and B'. Then what is meant by a number 2 or + 2 operating on the quantities, is the same as doubling the quantity in every vessel; $2i$ means that the quantity in every vessel is to be doubled and transferred to the vessel next to each, say on the left; $3i^2$ or -3 means that the quantities are trebled and transferred to the vessels second in order on the left or to each opposite vessel, $4i^3$ or $-4i$ means that the quantities are quadrupled and transferred to the third vessel on the left or the first on the right, $2+3i$ means that the original quantities are to be doubled, and also that they are to be trebled and transferred to the vessels on the left, and so on. Now we have proved that the final position of the game after any number of such orders have been carried out depends only on the original position, that is on the excesses and the vessels containing the excesses, and indeed that this is so is obvious; that any order implied by $x+iy$ can be carried out by a repetition of any one of n orders each repeated n times, and we have shown how to find these orders or operations. Some problems are obvious, thus the order $+1$ may be effected by repeating twice the order $+1$ or the order -1, or by repeating 4 times any one of the orders $+1$, -1, $+i$, $-i$ and by the repetition 4 times of no other order.

Again by consideration of the variation of the argument of any rational integral function of z of degree n, when the point which represents z by the numbers giving the lengths of its rectangular coordinates is made to describe a closed curve, we can prove that the function may be expressed and uniquely expressed in the form $(z + \gamma_1)(z + \gamma_2)(z + \gamma_3)$, &c., or thrown into the form of n factors. So any order $z^n + a_1z^{n-1} + a_2z^{n-2} +$ &c., with respect to the distribution of water in the four vessels can be uniquely carried out by n consecutive orders $z + \gamma_1$, $z + \gamma_2$, &c., when z is arbitrary.

NOTE.

The conception of $\sqrt{-1}$ as a geometrical operator signifying rotation through a right angle was introduced by Argand in 1806. I have shown that it is not necessary to restrict the angle to a right angle, and note that such a conception of $\sqrt{-1}$ is limited to geometry. Finding other modes of introducing i unsatisfactory—for instance, in Harnack's Introduction to the Calculus, "i is called the imaginary unit and operations with it are defined"—I have ventured in this paper to show that numbers both real and complex have a practical concrete meaning, hoping to help mathematicians who have no inclination for the study of abstract logic to satisfy themselves that the processes they make use of have a definite meaning. Those who prefer a more abstract treatment of the subject may be referred to Bertrand Russell's "Principles of Mathematics," vol. i (Cam. Univ. Press, 1903). Those who are satisfied with the treatment of the real variable may in most simple processes, at all events with the complex variable, derive the required result by treating i as a variable parameter: see "The Hypothetic Variable," by R. A. P. Rogers, *Hermathena,* vol. xiv, 1906. I regard in this paper all numbers as operators on a fundamental unit, but I also have ventured to regard them as adjectives, because ordinary numbers are such grammatically. When we speak of 5 tons of hay, 5 is an adjective. When we further qualify the 5 tons by specifying whether it is hay that has been bought or sold, the symbol which signifies all this is an adjective. When we further extend the relations of a ton of hay, I still call the operator $x + iy$ a complex adjective, following the same extension of terminology according to which we call it a complex number.

IV.

ON DOUBLET DISTRIBUTIONS IN POTENTIAL THEORY.

By J. G. LEATHEM.

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1. In the study of Potential Theory there is a tendency to regard doublet-distributions as of little practical importance except in so far as they are relevant to the theory of magnetism. When the student has gone through the investigation of the force in cavities of various shapes cut in magnetized matter, and the discontinuity of the potential due to a double-sheet, he hears little more of doublet-distributions. As a matter of fact such distributions present themselves, if only as interpretations of purely mathematical expressions, in the formulation of other physical problems which are susceptible of treatment by the analysis of potential theory ; but it is perhaps the view of many that it is unprofitable to reformulate problems on the subject of whose solution the mathematician feels that he is not likely to be able, with the weapons at present available to him, to add to the existing body of exact knowledge.

The present writer, confessing at the outset that he has little to offer in the way of new results, nevertheless thinks it worth while to fill a gap in the current presentations of potential theory by examining some of the properties of doublet-distributions corresponding to familiar properties of ordinary surface and volume densities. In doing this it has seemed useful, for suggestion and illustration, to indicate how, in the case of the application of the theory to the motion of a liquid, the fundamental problem presents itself simply as a double-sheet problem, and to study the matter in this aspect. Though in hydrodynamics the ground has been too thoroughly explored to leave any hope of obtaining fresh exact results by old methods, there is always a chance that a new and concise formulation of a standard problem may put some student on the track of an approximate solution of practical importance. Considering how simple is the fundamental property of liquid flow, the failure of the mathematician to obtain (except in the very simplest cases) even roughly approximate specifications of the flow corresponding to boundaries of given form and motion, is a striking exemplification of the limitations of modern analysis.

A surface concentration of doublets may or may not be such that the moment in an element of area is normal to the surface. In the former case we have what is generally called a double-sheet, whose strength is the normal moment per area. The possibility of the latter case leads to the conception of a tangential doublet distribution in a surface, in which the moment in an element of area is tangential to the surface, and the strength is a tangential vector. It will be worth while to inquire later into the properties of a tangential distribution, but the double-sheet and its bearing on applications of potential theory will be considered first.

3. *Uniqueness Theorems for a Double-Sheet.*—Let S be a closed surface, and let τ_1, τ_2 be the strengths of two double-sheets in the surface S which separately produce the same field of potential in all space outside S; then τ_1 and τ_2 can differ only by a constant. For if we put $\tau_1 - \tau_2 = \tau$, we see by superposition that a double-sheet of strength τ produces zero potential in the region outside S; thus τ produces no normal force outside S, and as normal force is continuous in crossing a double-sheet, there is no normal force just inside S, and therefore no force at all. So τ produces constant potential inside S and, as the discontinuity of potential in crossing S is $4\pi\tau$, τ must be a constant. That this constant is not necessarily zero is corroborated by the well-known fact that a double-sheet of uniform strength in a closed surface produces zero potential at outside points.

If S be a closed surface, and τ_1, τ_2 the strengths of two double-sheets in the surface S which separately produce the same field of potential in the space inside S, then must $\tau_1 = \tau_2$. For if we put $\tau_1 - \tau_2 = \tau$ a double-sheet of strength τ produces zero potential in the inside region, so there is no normal force just inside and therefore no normal force just outside. Thus there is no force and therefore constant potential outside, so the discontinuity of potential $4\pi\tau$ must be constant. But it is known that a double-sheet of uniform strength τ produces potential $\pm 4\pi\tau$ at points inside, and as the potential inside is known to be zero we must have $\tau = 0$, i.e. $\tau_1 = \tau_2$.

4. *Notation.*—It will make for brevity to introduce a special notation. Let $V(p, q, r, s)$ stand for the potential at a variable point P due to a combination of gravitational distributions of different kinds represented symbolically by the letters p, q, r, s. Thus if we have a surface density σ, a volume density ρ, a double-sheet of strength τ, and particles typified by m, the potential due to all these simultaneously at a point P is denoted by $V(\sigma, \rho, \tau, m)$.

In general we shall have to do with a surface S which divides space into two regions; one of these we shall call the "relevant" region, and we shall distinguish the potential and other functions associated with this region by the suffix $(_1)$; the other we shall call the "irrelevant" region, and distinguish its potential, etc., by the suffix ($_0$). We shall take the standard direction of a normal to S as from the relevant into the irrelevant region, and we shall treat the strength τ of a double-sheet in S as positive when the axis of the doublet element from negative to positive points towards the irrelevant region.

5. *The Double-Sheet Potential in Hydrodynamics.*—The problem of determining for a given region that irrotational liquid motion which corresponds to a prescribed motion of the boundary is usually attacked by a search for a function ϕ, the velocity potential, which satisfies Laplace's Equation $\Delta\phi = 0$ at all points in the region (save where there are prescribed singularities), and has at the boundary a prescribed normal gradient. Alternatively, however, the specification of the motion may be regarded as depending on the theoretically (if not practically) more simple problem of determining the surface value $\bar{\phi}$ of the velocity potential. A knowledge of ϕ alone would give the dynamically most important function of the motion, namely the kinetic energy; and it is, in any case, easy to deduce from a known $\bar{\phi}$ the general form of ϕ.

Let the boundary consist of a surface S which divides space into two regions; of these regions one is occupied by liquid, and we shall call it the relevant region; the other, though important mathematically, is not physically significant, and will be called the irrelevant region.

Let W be the normal velocity of the boundary, a prescribed function, reckoned as positive when towards the irrelevant region. Let it be supposed that there are sources in the liquid, the strength m of a source being measured by the total time-rate of outflow across a small sphere surrounding it, so that the velocity potential at small distance ε has its most important part of the form $-m/4\pi\varepsilon$. There may also be equal and opposite sources combined as doublets of moment typified by μ.

For purposes of integration let each source or doublet be surrounded by a small sphere of radius ε, and let $d\sigma$ be an element of area on the surface of such a sphere; let dn be an element of inward drawn normal, so that $dn = -d\varepsilon$.

Take any point P in the irrelevant region, and let r denote distance measured from P. Apply Green's Theorem[1] to the part of the relevant region outside the ε spheres, using the functions ϕ and r^{-1}. This gives

$$\int \frac{1}{r}\frac{\partial\phi}{\partial n}\,dS + \Sigma\int\frac{1}{r}\frac{\partial\phi}{\partial n}\,d\sigma - \int\frac{1}{r}\,\Delta\phi\,dv$$
$$= \int\phi\,\frac{\partial}{\partial n}\left(\frac{1}{r}\right)dS + \Sigma\int\phi\,\frac{\partial}{\partial n}\left(\frac{1}{r}\right)d\sigma - \int\phi\Delta\left(\frac{1}{r}\right)dv, \qquad (1)$$

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[1] Leathem, Volume and Surface Integrals used in Physics, Cambridge Mathematical Tracts, No. 1, § 18.

in which we note that the subjects of volume integration vanish, and that, on the surface S, $\partial\phi/\partial n = W$, and $\phi = \bar{\phi}$.

For a sphere surrounding a source $d\sigma = \varepsilon^2 d\omega$, where $d\omega$ is an element of solid angle, and

$$\int \frac{1}{r}\frac{\partial\phi}{\partial n}\,d\sigma \to -\frac{m}{4\pi r}\int \frac{1}{\varepsilon^2}\,d\sigma \to -\frac{m}{r},$$

where r is now measured from P to the source; also

$$\int \phi\,\frac{\partial}{\partial n}\left(\frac{1}{r}\right)d\sigma \to -\frac{m}{4\pi}\int \frac{\partial}{\partial n}\left(\frac{1}{r}\right)\frac{1}{\varepsilon}\,d\sigma \to 0.$$

For a doublet ϕ tends, at a distance ε, to the form $-(\mu/4\pi\varepsilon^2)\cos\theta$, where θ is the angle which ε makes with the axis. On the sphere r^{-1} may be replaced by $r^{-1} - r^{-2}\varepsilon\cos\theta'$, where r is now measured from P to the doublet, and θ' is the angle which ε makes with the direction of r. Thus

$$\begin{aligned}\int \frac{1}{r}\frac{\partial\phi}{\partial n}\,d\sigma &\to -\frac{2\mu}{4\pi}\int\left(\frac{1}{r} - \frac{\varepsilon}{r^2}\cos\theta'\right)\frac{\cos\theta}{\varepsilon}\,d\omega \\ &= \frac{2\mu}{4\pi r^2}\int \cos\theta'\cos\theta\,d\omega \\ &= \frac{2}{3}\frac{\mu}{r^2}\cos\chi,\end{aligned}$$

where χ is the angle which the axis of the doublet makes with the direction of r. Also

$$\begin{aligned}\int \phi\,\frac{\partial}{\partial n}\left(\frac{1}{r}\right)d\sigma &\to -\int \frac{\mu\cos\theta}{4\pi\varepsilon^2}\frac{\partial}{\partial\varepsilon}\left(\frac{\varepsilon\cos\theta'}{r^2}\right)d\sigma \\ &= -\frac{\mu}{4\pi r^2}\int\cos\theta\cos\theta' d\omega \\ &= -\frac{1}{3}\frac{\mu}{r^2}\cos\chi.\end{aligned}$$

Thus the limit form, for vanishing of all the ε's, of equation (1) is

$$\int \bar{\phi}\,\frac{\partial}{\partial n}\left(\frac{1}{r}\right)dS = \int \frac{W}{r}\,dS - \Sigma\frac{m}{r} + \Sigma\frac{\mu}{r^2}\cos\chi. \tag{2}$$

The left-hand side is the gravitation potential at P due to a double-sheet in S of strength $\bar{\phi}$, and the right-hand side is the combined potential at P due to a surface density W in S, particles of mass $-m$ at the sources, and gravitation doublets of moment $-\mu$ at the liquid doublets. So the result is

$$V_0(\bar{\phi}) = V_0(W, -m, -\mu). \tag{3}$$

6. In the above it has been tacitly assumed that the region of integration is finite. Modifications may be necessary if the relevant region extends to infinity.

If the relevant region is externally unbounded in all directions the form of ϕ at great distance R from a definite origin O may be arranged in powers of R, and it is known[1] that the only terms which can occur are spherical solid harmonics of positive or negative integral orders. The following terms might be present,

$$vR \cos \theta + C + M/4\pi R - M' \cos \theta'/4\pi R^2,$$

where v, C, M, M' are constants, and θ and θ' are angles measured from fixed directions. Terms of a greater order of magnitude would correspond to cases of no practical interest. Of the above terms the first corresponds to what is usually called "uniform motion at infinity," the second has no physical significance, the third represents a source of strength M at infinity, and the fourth is introduced in order to show that it and terms of lower order do not affect the final result.

In applying Green's Theorem as above we have to bound the region of integration externally by a sphere with centre O and radius R. And we must add to the right-hand side of equations (2) and (3) the limit (if any), for $R \rightarrow \infty$, of

$$\int \left\{ \frac{1}{r} \frac{\partial}{\partial R} - \frac{\partial}{\partial R} \left(\frac{1}{r} \right) \right\} \left\{ vR \cos \theta + C + \frac{M}{4\pi R} - \frac{M' \cos \theta'}{4\pi R^2} \right\} dS,$$

taken over the sphere R; here it is allowable to substitute $R^{-1} + OP \cos \lambda \, R^{-2}$ for r^{-1}, where λ is the angle between OP and R.

It is to be noted that the combination, in one, of the two integrals of the types $\int r^{-1} \partial \phi / \partial n \, dS$ and $\int \phi \partial r^{-1} / \partial n dS$ gets over the difficulty of non-convergence or semi-convergence which might seem to be unfairly evaded by the choice of a specially simple form for the outer boundary. For if we take an alternative outer boundary S' of any shape, lying completely outside the R sphere, and apply Green's Theorem to the functions r^{-1} and ψ in the space between the two, we see that

$$\int (r^{-1} \partial \psi / \partial n - \psi \partial r^{-1} / \partial n) \, dS$$

has the same value for both surfaces provided $\Delta \psi = 0$ in the region of integration. And each term in the second factor under the integral which we are studying is a legitimate value of ψ, so the spherical boundary gives results which are not special, but general.

Let us consider each term separately.

The term in v yields $3 OPv \int \cos \lambda \cos \theta \, d\omega$, which $= 4\pi \, OPv \cos \Theta$ where Θ is the angle between OP and the direction of the stream at infinity.

The term in C yields $4\pi C$.

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[1] Thomson and Tait, Natural Philosophy, edition of 1890, vol. i, p. 181.

Of the terms in M and M' each separately yields zero.

When no term of higher order than that in M occurs in the expansion of ϕ the motion is of the kind which is commonly described by the statement that the liquid is at rest at infinity. For such motions we see that equations (2) and (3) hold good. It is only when there is uniform flow at infinity that these formulae require modification.

7. *Determination of* $\bar{\phi}$.—Formula (3), modified if necessary for flow at infinity, yields an implicit determination of $\bar{\phi}$, unique to the extent set out in the theorems of § 3. The hydrodynamical problem is thus thrown back on that of converting this implicit determination into an explicit one, in fact on the problem of finding the strength of a double-sheet in the surface S which shall produce a given potential field in the irrelevant region.

In passing one wonders whether the problem of finding this surface-function ϕ, exactly or approximately, might not be more hopefully attacked by a study of the geometry of the surface and of functions and integrals associated with it than by a quest for a function of position in space which shall satisfy Laplace's equation and other conditions.

8. *Continuity.*—It must be noted that the data of the problem are not entirely arbitrary, since continuity of liquid flow requires that a certain equality be satisfied by the strengths of the sources, namely

$$\int W dS = \Sigma m \qquad (4)$$

If the relevant region extend to infinity in all directions the condition is slightly different, being in fact that the outward flow across an outer surface S' large enough to enclose S and all the sources, together with the outward motion following the motion of the boundary S, shall equal the output of all the sources; this gives

$$\int W dS + \int \partial\phi/\partial n \, dS' = \Sigma m.$$

S' may be taken to be the sphere R, and in the S' integral we may put for ϕ the terms set out in § 6. It then appears that the only term which contributes to the integral is $M/4\pi R$, which yields $-M$. So our continuity condition becomes

$$\int W dS = M + \Sigma m. \qquad (5)$$

If M is among the data it must comply with this condition; if it is among the quaesita this condition serves to determine it.

9. It is of course clear that if S extends to infinity, so that the relevant region extends to infinity but not in all directions, the preceding results may require considerable modification. But there is no real difficulty in dealing with any particular case.

10. *Derivation of ϕ from $\bar{\phi}$.*—Assuming $\bar{\phi}$ to have been determined, we can get an expression for ϕ by precisely the same sort of application of Green's Theorem as is employed in § 5, with only this modification that the point P from which r is measured is to be taken in the relevant region.

To avoid an infinity in the subject of the volume integration an additional boundary must be introduced, namely a sphere σ' of radius η surrounding the point P. This involves the introduction of additional terms in equation (1), namely $-\int \eta^{-1}\, \partial\phi/\partial\eta \, d\sigma'$ on the left-hand side, and $-\int \phi \, \partial\eta^{-1}/\partial\eta \, d\sigma'$ on the right-hand side. The limits of these for $\eta \rightarrow 0$ are respectively zero and $4\pi\phi_P$, where ϕ_P means the value of ϕ at the point P.

Consequently we get, instead of formula (2),

$$\int \bar{\phi} \frac{\partial}{\partial n}\left(\frac{1}{r}\right) dS + 4\pi\phi_P = \int \frac{W}{r}\, dS - \Sigma \frac{m}{r} + \Sigma \frac{\mu}{r^2} \cos\chi, \tag{6}$$

with an extra term, if necessary, on the right-hand side for flow at infinity. In the potential notation this may be written

$$4\pi\phi = - V_1(\bar{\phi}) + V_1(W, -m, -\mu). \tag{7}$$

11. It is worth remarking that in the application of Green's Theorem in § 5, if for r^{-1} there were substituted any function ψ which satisfies $\Delta\psi = 0$ at all points of the relevant region, a result very like that of formula (2), but rather more general, would be obtained.

The integrals on the sphere σ surrounding a doublet would require somewhat careful treatment; thus, for ψ we should write

$$\psi + \varepsilon\left(l \frac{\partial\psi}{\partial x} + m \frac{\partial\psi}{\partial y} + n \frac{\partial\psi}{\partial z}\right),$$

where the values now refer to the centre, and l, m, n are the cosines of ε. Also, for ϕ we put

$$-(\mu/4\pi\varepsilon^2)(Ll + Mm + Nn),$$

where L, M, N are the cosines of the doublet. Consequently,

$$\int \psi \frac{\partial\phi}{\partial n}\, d\sigma \rightarrow -\frac{2\mu}{4\pi}\int \left\{\psi + \varepsilon\left(l \frac{\partial\psi}{\partial x} + m \frac{\partial\psi}{\partial y} + n \frac{\partial\psi}{\partial z}\right)\right\} \frac{Ll + Mm + Nn}{\varepsilon}\, d\omega$$

$$= -\frac{2}{3}\mu\left(L\frac{\partial\psi}{\partial x} + M\frac{\partial\psi}{\partial y} + N\frac{\partial\psi}{\partial z}\right),$$

and

$$\int \phi \frac{\partial\psi}{\partial n}\, d\sigma \rightarrow + \frac{\mu}{4\pi}\int \; l \frac{\partial\psi}{\partial x} + m \frac{\partial\psi}{\partial y} + n \frac{\partial\psi}{\partial z}\Big)(Ll + Mm + Nn)\, d\omega$$

$$= \frac{1}{3}\mu\left(L\frac{\partial\psi}{\partial x} + M\frac{\partial\psi}{\partial y} + N\frac{\partial\psi}{\partial z}\right).$$

So the final result is

$$\int \phi \frac{\partial \psi}{\partial n} dS = \int W\psi \, dS - \Sigma m\psi - \Sigma\mu \left(L\frac{\partial \psi}{\partial x} + M\frac{\partial \psi}{\partial y} + N\frac{\partial \psi}{\partial z} \right). \qquad (8)$$

12. It is known[1] that the potential of a double-sheet of strength τ at a point in the sheet is definite, and that it differs by $\pm 2\pi\tau$ from the limit of the potential at a point which moves up to the sheet from either side. Consequently if we let the point P from which the r of formula (2) is measured move up to the surface S we get the limit formula

$$2\pi\bar{\phi}_P + \int \phi \frac{\partial}{\partial n}\left(\frac{1}{r}\right) dS = \int \frac{W}{r} dS - \Sigma\frac{m}{r} + \Sigma\frac{m}{r^2}\cos\chi, \qquad (9)$$

the surface integrals being known to be convergent.

Combining this with (8), assuming ψ to have no singularity on the surface S, we get

$$2\pi\bar{\phi}_P + \int \bar{\phi} \frac{\partial}{\partial n}\left(\frac{1}{r} + \psi\right) dS = \int W\left(\frac{1}{r} + \psi\right) dS - \Sigma m\left(\frac{1}{r} + \psi\right)$$

$$- \Sigma\mu\left(L\frac{\partial}{\partial x} + M\frac{\partial}{\partial y} + N\frac{\partial}{\partial z}\right)\left(\frac{1}{r} + \psi\right). \qquad (10)$$

In the absence of sources and doublets we can deduce a formula for the kinetic energy T, namely,

$$2T = \int \bar{\phi}' W' dS' = \frac{1}{2\pi}\iint W' W\left(\frac{1}{r} + \psi\right) dS\, dS' - \frac{1}{2\pi}\iint W'\bar{\phi}\frac{\partial}{\partial n}\left(\frac{1}{r} + \psi\right) dS\, dS', \qquad (11)$$

these being integrals taken twice over the surface S.

It is conceivable that, for a particular form of S, some happy choice of ψ might make it possible to evaluate the integrals in (10) or (11) either accurately or approximately.

13. *Approximate form of ϕ at great distance.*—Returning to the terms set out in § 6 as possibly representing the most important part of the velocity potential at great distance from S, and thinking in particular of the motion in liquid extending to infinity due solely to the motion in it of a rigid body whose surface is the boundary S, we see that the approximate form of ϕ at great distance R from a definite origin O is $-M'\cos\theta'/4\pi R^2$, or

$$-(AL + BM + CN)/4\pi R^2, \qquad (12)$$

where L, M, N are the direction cosines of R. This shows that the motion is to this approximation the same as would be due to a doublet at the origin

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[1] Leathem, l.c., § 34.

with component moments A, B, C. A first approximation to the determination of the liquid motion would consist in an evaluation of A, B, C. We shall show how the value of A depends on that of $\bar{\phi}$.

Apply Green's Theorem to the functions ϕ and x in the region bounded internally by S and externally by the sphere S' with centre at the origin and radius R. Since in this region $\Delta\phi = 0$, and $\Delta x = 0$, the volume integrals vanish, and we have

$$\int \phi \frac{\partial}{\partial R}(RL)\, dS' + \int \bar{\phi} \frac{\partial x}{\partial n}\, dS = \int RL \frac{\partial \phi}{\partial R}\, dS' + \int x \frac{\partial \phi}{\partial n}\, dS.$$

Now

$$\int \left\{ \phi \frac{\partial}{\partial R}(RL) - RL \frac{\partial \phi}{\partial R} \right\} dS' = \int L \left(\phi - R \frac{\partial \phi}{\partial R} \right) dS'$$

$$= - \frac{3}{4\pi} \int L(AL + BM + CN + \Omega)\, d\omega,$$

(where Ω consists of negative powers of R multiplied by surface-harmonics of integral orders greater than unity)

$$= - A.$$

Also, at S, $\partial x/\partial n = l$, when l, m, n are the cosines of the normal drawn into the irrelevant region. Hence

$$A = - \int (xW - l\bar{\phi})\, dS. \qquad (13)$$

14. *Relation between doublet-effect at infinity and applied impulse.*—The formula (13) suggests consideration of the case in which the surface S is a massless thin rigid shell having liquid inside as well as outside. Let ϕ' be the velocity potential of the motion of the liquid inside the shell, and let dn continue to represent the element of normal drawn away from the region of ϕ and therefore into the region of ϕ'. Apply Green's Theorem to the functions ϕ' and x in the space enclosed by S; we get

$$\int x\partial\phi'/\partial n dS = \int \phi' \partial x/dn dS = \int l\phi' dS,$$

or

$$\int x W dS = \int l\bar{\phi}' dS.$$

Substituting in (13) we get

$$A = - \int l(\bar{\phi}' - \bar{\phi})\, dS. \qquad (14)$$

Now it is known that if the liquid motion were suddenly set up from rest, as by the application of an impulsive forcive to the shell, the impulsive liquid pressure set up would be $-\phi$. Consequently $-\int l\phi dS$ is the x component of resultant impulsive pressure on the shell from without, and $\int l\phi' dS$ is the corresponding component of impulsive pressure from within. So the right-hand side of (14) represents minus the x component of the resultant of the impulsive pressure on S from both sides. Hence if X be the component of the impulse applied from without to the shell S which would produce the motion, our result is simply

$$A = X. \tag{15}$$

The simplicity of this result, independent as it is of the size, form, and position of S, and of all impulsive couples, is remarkable.

An alternative statement of the same result may be got by considering, instead of a rigid shell, a rigid body of the same density as the liquid, bounded by the surface S. For this case we put

$$W = l(u - y\omega_3 + z\omega_2) + m(v - z\omega_1 + x\omega_3) + n(w - x\omega_2 + y\omega_1),$$

where $(u, v, w, \omega_1, \omega_2, \omega_3)$ is the velocity system of the rigid body referred to the origin as base-point. It is then clear that

$$\int xWdS = -\iiint (u - y\omega_2 + z\omega_2)\, dx\, dy\, dz$$

taken through the volume of the solid. Thus, in fact, $\int xWdS$ is minus the x component of momentum of the solid of unit density. The component X of the impulse necessary to set up the motion of solid and liquid has to supply the x momentum of the solid and to counterbalance the x component of pressure of the liquid, and so in this case also the equality (13) is equivalent to

$$A = X.$$

15. *Approximate form, at great distance, of the potential due to a double-sheet.*—Returning from the hydrodynamical illustration to pure potential theory, let us inquire into the approximate form at great distance of the potential due to a double-sheet of variable strength τ. A formula giving the approximate form of the potential due to a system of positive gravitating matter is well known, and it is natural to look for a corresponding expression for doublet distributions.

If we take any origin and let (ξ, η, ζ) be the coordinates of a point of the double-sheet and (l, m, n) the cosines of the normal, the potential V at a point distant R from the origin in the direction (L, M, N) is

$$V = \int \tau r^{-3} \Sigma l(LR - \xi)\, dS, \tag{16}$$

where r is the distance from dS to the point (LR, MR, NR).

If R is very great we may get an approximate value of r^{-3} by a binomial expansion thus—

$$r^2 = R^2 - 2R\,\Sigma(L\xi) + \Sigma\xi^2,$$

and therefore

$$r^{-3} = R^{-3}\{1 - 2R^{-1}\,\Sigma(L\xi) + R^{-2}\,\Sigma\xi^2\}^{-3/2},$$

$$= R^{-3}\{1 + 3R^{-1}\,\Sigma(L\xi) + \text{smaller terms}\}.$$

Consequently, if we neglect terms of a higher order of smallness than R^{-3},

$$V = R^{-2}\int \tau (Ll + Mm + Nn)\, dS$$
$$+ R^{-3}\int \tau \{3 (Ll + Mm + Nn) (L\xi + M\eta + N\zeta) - (l\xi + m\eta + n\zeta)\}\, dS, \quad (16)$$

in which formula we notice in passing the parallelism between the second term and the expression for the mutual energy of two magnets.

Formula (16) is equivalent to

$$V = R^{-2} (pL + qM + rN) + R^{-3} \{(a - \tfrac{1}{2}b - \tfrac{1}{2}c)\, L^2 + (b - \tfrac{1}{2}c - \tfrac{1}{2}a)\, M^2$$
$$+ (c - \tfrac{1}{2}a - \tfrac{1}{2}b)\, N^2 + 3fMN + 3gNL + 3hLM\} \quad (17)$$

where

$$(p, q, r) \equiv \int \tau (l, m, n)\, dS \quad (18)$$

and

$$(a, b, c, f, g, h) \equiv \int \tau \{2l\xi,\ 2m\eta,\ 2n\zeta,\ (m\zeta + n\eta),\ (n\xi + l\zeta),\ (l\eta + m\xi)\}\, dS). \quad (19)$$

It is clear that, of these constants for the double-sheet, (p, q, r) are independent of the choice of origin. Let us call (a, b, c) the moments of inertia and (f, g, h) the products of inertia of the double-sheet with respect to the coordinate planes, and let us examine how the values of the moments and products depend on the positions of these planes.

First let us change the origin, putting $\xi + \xi_0$ for ξ, &c., and accenting the corresponding symbols for moments and products. Then

$$a' = 2\int \tau l\, (\xi + \xi_0)\, dS = 2\xi_0 p + a, \quad (20)$$

$$f' = \int \tau \{m (\zeta + \zeta_0) + n (\eta + \eta_0)\}\, dS = \zeta_0 q + \eta_0 r + f. \quad (21)$$

These equalities are analogous to the theorems of parallel axes for ordinary moments and products of inertia, but they do not indicate that any particular origin has minimum properties analogous to those of the centre of gravity.

If instead of changing the origin we take orthogonal axes of coordinates in new directions, namely those whose cosines are respectively $(\lambda_1, \mu_1, \nu_1)$, $(\lambda_2, \mu_2, \nu_2)$, $(\lambda_3, \mu_3, \nu_3)$, we must write $l\lambda_1 + m\mu_1 + n\nu_1$ for l, $\xi\lambda_1 + \eta\mu_1 + \zeta\nu_1$ for ξ, and similarly for other cosines and coordinates. We thus get

$$a' = a\lambda_1^2 + b\mu_1^2 + c\nu_1^2 + 2f\mu_1\nu_1 + 2g\nu_1\lambda_1 + 2h\lambda_1\mu_1, \quad (20)$$

$$f' = a\lambda_2\lambda_3 + b\mu_2\mu_3 + c\nu_2\nu_3 + (\mu_2\nu_3 + \nu_2\mu_3) f + (\nu_2\lambda_3 + \lambda_2\nu_3)\, g$$
$$+ (\lambda_2\mu_3 + \mu_2\lambda_3)\, h. \quad (21)$$

These relations are of the same form as those which hold good for ordinary moments and products of inertia. Consequently it is possible to choose, for any origin, such a set of orthogonal coordinate planes (principal planes) as shall make the products vanish. For such planes the nine terms of formula (17) reduce to six.

It is of course clear that the discussion of this Article applies to any distribution of doublets, the surface integrals being replaced by sums for isolated doublets, and by volume integrals for polarised matter in bulk.

It will be noticed that the special moments and products of inertia here introduced are derivable from the ordinary moments and products of inertia for unpolarised matter, $\sum m\xi^2$ and $\sum m\eta\zeta$, &c., by replacing each m by the operator $\alpha\partial/\partial\xi + \beta\partial/\partial\eta + \gamma\partial/\partial\zeta$ corresponding to a doublet whose component moments are (α, β, γ).

15*a*. With a view to illustrating the utility of the formulae of the preceding Article, let us carry a stage further the approximation for the hydrodynamical case discussed in §§ 13 and 14. The method there employed can be extended without difficulty to terms of a higher order of smallness, but the following is more concise.

Considering two simultaneous liquid motions, one outside S and specified by ϕ, the other inside S and specified by ϕ', we take a point P outside S and note that at P for the former motion equation (7) is applicable, while for the latter motion an equation corresponding to equation (3) holds good

Remembering, however, that W and W' are in opposite senses so that $W + W' = 0$, and that the double-sheets $\overline{\phi}$ and $\overline{\phi}'$ also have their strengths reckoned positive in opposite senses, we change our conventions so as to make the outward sense of the normal to S the positive sense in both cases; so we get

$$4\pi\phi = V'(\overline{\phi}) - V(W'), \tag{21a}$$

$$0 = -V(\overline{\phi}') + V(W'), \tag{21b}$$

whence, on adding,

$$4\pi\phi = V(\overline{\phi} - \overline{\phi}'). \tag{21c}$$

Thus the velocity potential is equal to the gravitation potential due to a double-sheet of strength $(\overline{\phi} - \overline{\phi'})/4\pi$.

At great distance, therefore, ϕ is given approximately by formula (17), provided $(\overline{\phi} - \overline{\phi'})/4\pi$ be substituted for τ in formulae (18) and (19).

The dynamical significance of (p, q, r) in this connexion has already been discussed. It is clear that a, b, c, f, g, h, are likewise simply expressible in terms of the impulsive pressure, but not in terms of the impulsive forcive from without.

An alternative expression, not involving $\overline{\phi}'$, may, of course, be got by using formula (21*a*) and taking the approximations to $\mathrm{V}\,(\overline{\phi}/4\pi)$ and $\mathrm{V}\,(W'/4\pi)$, the latter by the known formula for an unpolarised distribution, the former by formula (17).

16. *Kelvin's Inversion Theory applied to doublets.*—It is a well-known theorem, due to Liouville,[1] that the most general conformal space-transfor-

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[1] Journal de Mathématiques, t. xv, 1850, p. 103.

mation can be made up by combining uniform magnification, rigid body displacement, and inversion, the last of which is the only operation involving analytical difficulty in its details. It may therefore be of interest to examine how doublet distributions and their fields fit into the method of inversion, and incidentally to consider the illustration from hydrodynamics suggested by the similarity already indicated between the double-sheet problem and the problem of liquid motion.

The method of inversion of potential fields is set out in Thomson and Tait's *Natural Philosophy*, §§ 515, 516. A centre O and radius k of inversion being chosen, r and r' being the distances of a point Q and its inverse Q' from O, dl, dS, dv being elements of length, area, and volume in one configuration, and dl', dS', dv' corresponding elements in the inverse configuration, it is known that

$$dl' = \frac{r'^2}{k^2}\,dl, \qquad dS' = \frac{r'^4}{k^4}\,dS, \qquad dv' = \frac{r'^6}{k^6}\,dv. \tag{22}$$

If, further, a particle of mass m placed at a point A produce a potential V at a point P, and a particle of mass $m' = mr'/k$ placed at the point A' inverse of A produce potential V' at the point P' inverse of P, then $V' = Vk/R'$, where r, r', R, R' are the radii vectores from O to A, A', P, P' respectively.

The particles typified by m and m' can be generalized into surface densities σ, σ', and volume densities ρ, ρ', related to one another by the laws

$$\sigma' = \sigma k^3/r'^3, \qquad \rho' = \rho k^5/r'^5, \tag{23}$$

and for these distributions the law of potential correspondence $V' = Vk/R'$ still holds.

17.—It is clearly legitimate to extend the same sort of correspondence to doublets, but the result is less simple. A doublet of strength μ situated at Q, with its axis inclined at an angle χ to OQ, is the limit of particles $(-m, +m)$ at a distance dl apart where $mdl \rightarrow \mu$ for $dl \rightarrow 0$. The inverses of these are particles

$$-m' = -mr'/k, \qquad m' + dm' = m(r' + dr')/k,$$

at a distance dl' apart, where $dl' = (r'^2/k^2)\,dl$ and dl' makes an angle $\pi - \chi$ with OQ'.

Now passing to the limit for $dl \rightarrow 0$ we get at Q' not only the doublet

$$\mu' = \lim m'dl' = \mu r'^3/k^3, \tag{24}$$

but also a particle of mass ν' where

$$\begin{aligned}\nu' &= \lim mdr'/k = \lim(-dl' \cos\chi/k)(m'k/r') = -(\mu'/r')\cos\chi \\ &= -(\mu r'^2/k^3)\cos\chi = -(\mu k/r^2)\cos\chi.\end{aligned} \tag{25}$$

From this it is but a step to the idea of corresponding surface distributions, namely an original distribution consisting of a double sheet of strength $\tau = \mu\, dS$ and an inverse distribution consisting of a double sheet of strength $\tau' = \mu'\, dS'$ together with a surface density $\varpi' = -\mu' \cos\chi/r'dS'$; that is to say

$$\tau' = \tau k/r',$$

$$\varpi = -\tau k \cos\chi/r'^2. \tag{27}$$

Here τ and τ' are regarded as of the same sign when in the corresponding senses of normals to the inverse surfaces, that is when they make supplementary angles with r.

18. *Hydrodynamical Illustration of Inversion.*—Let us now consider the hydrodynamical system described in § 5 for which the formulae (3) and (7) hold good. We have a surface S separating a relevant from an irrelevant region, and in the relevant region liquid sources and doublets; and corresponding to these we have a gravitation system comprising a surface density W, a double-sheet $\bar\phi$, particles m, and doublets μ.

If we invert all this we get a surface S' separating a relevant from an irrelevant region, and in the relevant region we have particles typified by $m' = mr'/k$ and $\nu' = -\mu(r'^2/k^2)\cos\chi$, doublets $\mu' = \mu r'^3/k^3$, a surface density $W' = Wk^2/r'^3 - \bar\phi\, k/r'^2 \cos\chi$, and a double-sheet of strength $\bar\varphi' = \bar\varphi k/r'$. These satisfy the relation analogous to (3)

$$V'_0(\bar\phi') = V'_0(W', -m', -\mu'), \tag{28}$$

since each side is kR'^{-1} times the corresponding side of equation (3) at the corresponding point. Further, for the relevant region, there is a function φ' (namely kR'^{-1} times φ at the corresponding point) such that

$$4\pi\varphi' = -V'_1(\bar\phi') + V'_1(W', -m', -\mu'). \tag{29}$$

It follows that φ' specifies a liquid motion corresponding to a normal velocity W' of the boundary S'.

19. The taking of the centre of inversion in either of the relevant regions, with the consequent extension of the inverse relevant region to infinity, may give rise to peculiarities in φ or φ' requiring special examination.

If O is in the relevant region of the original motion, and is not a point of singularity of φ, then at a small distance R from O the approximate form of φ is $\varphi_0 - fR$ where f is a spherical surface harmonic of order unity. Consequently in the inverse region the approximate form of ϕ' for great values of R' is $\varphi' = kR'^{-1}(\varphi_0 - fk^2 R'^{-1})$, and so the inverse system has a "source at infinity" of strength $M' = 4\pi k\phi_0$. Conversely if the original motion has a "source at infinity" of strength M the value of φ' at O in the inverse system is $\varphi'_0 = M/4\pi k$.

If O is situated at a source in the original system so that, near O, ϕ approximates to the form $-m_0/4\pi R$, then in the inverse system, for great values of R', ϕ' approximates to the value $\phi'_\infty = (-m_0/4\pi R)(k/R') = -m_0/4\pi k$, a constant. Conversely if, for great values of R, ϕ approximates to a constant value ϕ_∞, there is a source $m_0' = -4\pi k\phi_\infty$ at O in the inverse system.

If O is situated at a doublet μ_0 in the original motion, so that ϕ approximates near O to the form $-(\mu_0/4\pi)R^{-2}f$, the most important part of ϕ' for great values of R' is $-(\mu_0/4\pi)k^{-3}R'f$, so that there is 'uniform flow at infinity' of velocity $v' = -(\mu_0/4\pi)k^{-3}$. Conversely uniform flow v at infinity in the original motion gives a doublet $\mu_0' = -4\pi k^3 v$ at the origin in the inverse motion.

20. The possible occurrence of a constant in the limiting analytical form of ϕ at infinity is seen to play a perhaps unexpectedly important part in determining the nature of the inverse system. This is not really surprising when one gets accustomed to the fact that the inverse of a field of constant potential (corresponding to liquid at rest) is a field of potential corresponding to flow from a source. In the original motion we can add to ϕ any constant we please, making the constant ϕ_∞ zero or whatever else we like, without changing the motion. In the inverse motion this gives us at the point O a source of arbitrary strength, which may be adjusted to satisfy some special requirement.

21. *The Continuity Condition.*—Though the general theory of the inversion method leaves no room for doubt that the inverse motion is a possible motion, namely that it satisfies a continuity condition of the type of formula (5), it is nevertheless worth while to inquire how the equality in this form is obtained directly by the formulae of correspondence. Let us therefore take each term of the continuity condition of the inverse motion, namely

$$\int W'dS' = [M'] + \Sigma m' + \Sigma \nu' + [m'_0], \tag{30}$$

and express it in terms of the data of the original distribution. It is to be remarked that the term M' is present only if the centre of inversion O is in the relevant region of the original motion, and the term m_0' is present only if O is in the relevant region of the inverse motion.

Now

$$W'dS' = (Wr^3/k^3 - \overline{\phi}r^2 \cos\chi/k^3)(k^4/r^4)\,dS,$$

$$M' = 4\pi k\phi_0, \qquad \Sigma m' = \Sigma mk/r,$$

$$\Sigma\nu' = -\Sigma(\mu k/r^2)\cos\chi, \qquad m_0' = -4\pi k\phi_\infty\,;$$

so equation (30), on division through by k, is the same as

$$\int Wr^{-1}dS - \int \overline{\phi}\cos\chi\, r^{-2}\,dS = [4\pi\varphi_0] + \Sigma mr^{-1} - \Sigma\mu r^{-2}\cos\chi - [4\pi\phi_\infty]. \tag{31}$$

If O is in the irrelevant region of the original motion the first term in brackets is absent, and (31) is identical with equation (2), the term $-4\pi\phi_x$ (if present) corresponding to the $4\pi C$ of § 6. If O is in the relevant region of the original motion the first term in brackets must be retained, and (31) is now identical with equation (6).

Thus it appears that the continuity condition of the inverse motion is identical with relation (3), the relation which determines $\bar{\phi}$, or with relation (7), the relation which specifies ϕ in terms of $\bar{\phi}$, according as the centre of inversion is taken in the irrelevant or the relevant region of the original motion. This pair of alternative identities in the inversion transformation is rather remarkable.

22. *Surface Distribution of Tangential Doublet.*—In the most general surface distribution of doublets the moment in an element of surface dS has components $(\alpha dS, \beta dS, \gamma dS)$ where (α, β, γ) are functions of position on the surface. If (ξ, η, ζ) are the coordinates of dS the potential at a point $P\ (x, y, z)$ is

$$V = \int \{\alpha(x - \xi) + \beta(y - \eta) + \gamma(z - \zeta)\}\, r^{-3}\, dS. \tag{32}$$

If (l, m, n) be the cosines of the normal at dS, and if at all points on S

$$\alpha l + \beta m + \gamma n = 0, \tag{33}$$

then the doublet distribution is one of tangential moment.

It is clear from the form of V that, if P be in the surface S or be made to approach a limit position O in the surface, questions of convergence arise with respect to the integrals representing the potential and the components of attraction.

23. *Limits of potential and force for a point approaching the surface.*—Applying the standard tests[1] we consider first the potential V, and we notice that the potential V_0 at O is a surface integral whose subject of integration tends to infinity at O like $r^{-2} \cos \theta$, where θ is the angle between r and a fixed direction in the surface. This points to a semi-convergence, namely convergence to a value which depends on the shape of the limiting cavity round O. In fact V_0 is the sum of the x, y, z components of attraction at O of ordinary surface densities α, β, γ, respectively, (say $X(\alpha)$, $Y(\beta)$, $Z(\gamma)$), and it is known that each of these is generally semi-convergent.

The limit of V for $P \rightarrow O$ is the sum of the limits of the above-named attraction components at P. Now a tangential attraction at P due to an ordinary surface density tends to a limit which is the corresponding attraction at O for a circular cavity, but a normal attraction tends to a limit which differs from the corresponding attraction at O by 2π times the surface density.

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[1] Leathem, l.c., section viii.

Hence $X(\alpha) \rightarrow X_0(\alpha) \pm 2\pi\alpha_0 l$, where $X_0(\alpha)$ corresponds to a circular cavity. Therefore

$$V = X(\alpha) + Y(\beta) + Z(\gamma),$$
$$\rightarrow X_0(\alpha) + Y_0(\beta) + Z_0(\gamma) \pm 2\pi(\alpha_0 l + \beta_0 m + \gamma_0 n).$$

ut $X_0(\alpha) + Y_0(\beta) + Z_0(\gamma) = (V_0)$, where (V_0) is the value of V_0 for a circular cavity; and $\alpha_0 l + \beta_0 m + \gamma_0 n = 0$. Hence

$$V \rightarrow (V_0) \tag{34}$$

This holds, on whichever side of S the point P is taken.

Thus it appears that, while V at a point in the surface is only conditionally definite inasmuch as it is represented by a semi-convergent integral, yet the limit of the value of V for a point approaching the surface is definite and is the same for approach from either side of the surface, being in fact the value of the above-mentioned semi-convergent integral for a vanishing circular cavity.

It will be noticed that these properties of the potential due to a surface distribution of tangential doublet correspond to the properties of the tangential force due to an unpolarised surface distribution of definite surface density.[1]

24. We may get further information by employing for our surface integrals a method of integration by parts analogous to that commonly employed in the study of the field of a solid magnet,

Consider an area of the surface S bounded by a curve s, and let us suppose it possible to choose a set of curvilinear orthogonal coordinates (p, q) in the surface S such that in the area enclosed by s both p and q are one-valued functions of position, there being no curves of the families $p = \text{const.}$, $q = \text{const.}$ which are closed curves lying wholly in the area enclosed by s. Let the element of arc ds be given by

$$ds^2 = P^2 dp^2 + Q^2 dq^2,$$

and let (λ, μ) be the cosines of the angles which the outward normal to s at any point makes with the normals to the curves $p = \text{const.}$, $q = \text{const.}$, through the same point, all these normals being drawn in the tangent plane to the surface. If ds be measured round the boundary in the sense corresponding to rotation through a right angle from the direction of p increasing to the direction of q increasing,

$$\lambda = Q dq/ds, \qquad \mu = -P dp/ds.$$

Let f, g be any functions of position on the surface which have definite differential coefficients with respect to p and q at all points of S and s, and in

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[1] Leathem, l.c. § 32.

the following formulæ let the line integral be taken round the complete boundary and the area integrals over the whole of the enclosed area; then

$$\begin{aligned}\int(\lambda f + \mu g)\, ds &= \int(fQdq - gPdp) \\ &= \iint\left\{\frac{\partial}{\partial p}(Qf) + \frac{\partial}{\partial q}(Pg)\right\} dpdq \\ &= \iint\frac{1}{PQ}\left\{\frac{\partial}{\partial p}(Qf) + \frac{\partial}{\partial q}(Pg)\right\} dS. \qquad (35)\end{aligned}$$

This is, of course, Stokes' Theorem. Its presentation in this form brings out the fact that

$$\frac{1}{PQ}\left\{\frac{\partial}{\partial p}(Qf) + \frac{\partial}{\partial q}(Pg)\right\}$$

is independent of the choice of coordinates, being from one point of view the divergence of the tangential vector represented by (f, g), say div (f, g), and from another point of view the normal component of the curl of any vector whose tangential part is represented by $(-g, f)$.

In the formula (35) let us put $f = Ar^{-1}$, $g = Br^{-1}$, where r is distance from P, and (A, B) are the components in the directions of p and q of the density of tangential doublet-moment. We get

$$\begin{aligned}\int\frac{\lambda A + \mu B}{r}\, ds &= \iint\frac{1}{PQ}\left\{\frac{\partial}{\partial p}\left(Q\frac{A}{r}\right) + \frac{\partial}{\partial q}\left(P\frac{B}{r}\right)\right\} dS \\ &= \iint\frac{1}{PQ}\left\{\frac{\partial}{\partial p}(QA) + \frac{\partial}{\partial q}(PB)\right\}\frac{1}{r}\, dS, \\ &\quad + \iint\left(\frac{A}{P}\frac{\partial}{\partial p} + \frac{B}{Q}\frac{\partial}{\partial q}\right)\frac{1}{r}\, dS, \ldots \qquad (36)\end{aligned}$$

of which the last term is clearly the potential at P. Hence we have

$$V = -\int r^{-1}\,\text{div}\,(A, B)\, dS + \int r^{-1}(\lambda A + \mu B)\, ds, \ldots \qquad (37)$$

which shows that the tangential doublet distribution produces the same field of potential as an ordinary surface density $-$ div (A, B) and a line density $(\lambda A + \mu B)$ in the boundary edge.

If P is not in the surface, and if the surface is a closed surface of one sheet, there is no boundary edge. The formula (37) can be applied separately to the two portions into which the surface is divided by a closed curve drawn upon it. For these two portions the cosines (λ, μ) are of opposite sign, and so the two line integrals add up to zero. Thus the tangential doublet distribution produces the same potential at points not in the surface as a surface density $-$ div (A, B).

From this it follows that the limits of the potential and of the force components, whether normal or tangential, at P, for $P \rightarrow O$, where O is a point in the surface, are the same as in the well-known case of an ordinary surface density, so that no special discussion of these is called for.

25. *Potential and force at a point in the surface.*—For a point O, however, which is situated in the surface S, the equivalence of the tangential doublet distribution and the surface density $-\operatorname{div}(A, B)$ does not hold good. For O must be surrounded by a vanishing cavity, and the limit of the line integral round the edge of the cavity is not necessarily negligible.

Thus if we represent the potential at O due to the surface density $\sigma = -\operatorname{div}(A, B)$ by $V_0(\sigma)$, which potential we know to be independent of the mode of vanishing of the cavity, and if $V_0(A, B)$ stand for the potential at O of the tangential doublet distribution, which we know is not independent of the mode of vanishing of the cavity, we have

$$V_0(A, B) = V_0(\sigma) + \text{Lim}\,\omega \tag{38}$$

where

$$\omega = \int r^{-1}(\lambda A + \mu B)\,ds, \tag{39}$$

the line integral being taken round the edge of the cavity, and it being remembered that (λ, μ) correspond to the normal drawn inwards to the cavity.

It is readily seen that if the cavity be of any form which is symmetrical about the line through O perpendicular to the direction of the resultant I of (A, B), $\omega \rightarrow 0$. For cavities of this class $V_0(A, B) = V_0(\sigma)$.

But if, for example, we take a cavity which vanishes in the form of a rectangle with sides parallel and perpendicular to I, the former tending to infinite smallness in comparison with the latter, and O being on the shorter central line and dividing it in the definite ratio $\theta : 1$, it is easily calculated that $\omega \rightarrow \pm 2I \log \theta$. So Lim ω does not vanish for all cavities, and therefore there is not complete equivalence as regards potential between the I distribution and the σ distribution.

26. Passing to the consideration of the normal attraction N at O, we note that when there is a cavity round O

$$N(A, B) = N(\sigma) + \omega,$$

where ω is the normal attraction at O due to the line density $\lambda A + \mu B$ in the contour; and we remember that $N(\sigma)$ tends to a definite limit $N_0(\sigma)$ as the contour closes in round O in any manner. Thus

$$N_0(A, B) = N_0(\sigma) + \text{Lim}\,\omega. \tag{40}$$

If O is a point at which the surface S is free from singularity, and if z be the distance of ds from the tangent plane at O, z is approximately $\frac{1}{2}r^2\rho^{-1}$ where

ρ is the radius of curvature of the normal section of the surface. Thus the normal attraction of ds at O is of the order of $Idszr^{-3}$ or $Ids\rho^{-1}r^{-1}$, so that the normal attraction of the whole contour at O may be of the order of $I\rho^{-1}$, and therefore does not tend to vanishing merely on account of the particular power of r which it involves. This suggests semi-convergence.

Taking θ to be the angle which r makes with one of the principal planes of curvature, and (A, B) as the components of I in and perpendicular to this plane,

$$\rho^{-1} = \rho_1^{-1} \cos^2 \theta + \rho_2^{-1} \sin^2 \theta,$$

where ρ_1 and ρ_2 are principal radii of curvature; thus

$$\omega = \tfrac{1}{2} \int (A\lambda + B\mu) r^{-1} (\rho_1^{-1} \cos^2\theta + \rho_2^{-1} \sin^2\theta)\, ds, \qquad (41)$$

a sufficient approximation being got by taking the integral round the projection of the contour on the tangent plane. If this projection be a circle with centre at O, $\lambda = -\cos\theta$, $\mu = -\sin\theta$, $ds = rd\theta$, and $\omega = 0$. But for other forms of contour the value and limit of ω may well be different from zero.

27. A tangential component X of attraction at 0 satisfies the equation

$$X(A, B) = X(\sigma) + \omega',$$

where ω' is the attraction-component at 0 due to the usual line-density. We know that $X(\sigma)$ tends to a limit which depends on the shape of the vanishing cavity, say $X_0(\sigma)$; and so

$$X_0(A, B) = X_0(\sigma) + \operatorname{Lim} \omega', \qquad (41)$$

where

$$\omega' = \int (A\lambda + B\mu) r^{-2} \cos\theta\, ds.$$

The order in r of the subject of integration indicates that in general ω' tends to infinity as the cavity tends to vanishing, though in certain cases symmetry of the cavity may make ω' of a lower order in r^{-1} than appears from the general formula. In such cases ω' may tend to a definite limit value, in the calculation of which, however, it would be necessary to take account of the difference between the values of A and B at 0 and at ds.

28. It is, of course, clear that if div $(A, B) = 0$ the tangential doublet distribution in a closed surface produces zero potential and zero force at all points not in the surface. At points in the surface, however, the above reasoning shows that the effect of such a doublet distribution is not necessarily null.

V.

THE ELECTRICAL CONDUCTIVITY OF POWDERS IN THIN LAYERS.

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1. THE experiments described in this paper refer to thin layers of powders so formed that they can be charged and discharged as one plate of a condenser.

The layers were formed in the following manner. A metal plate *P* (fig. 1, plan and elevation) was covered with a thin coating of paraffin wax *W*, one or two millimetres thick, and a small quantity of the conducting powder was spread on the smooth surface of the wax and lightly rubbed with a pad of cotton wool. Tinfoil terminals T_1 and T_2 were fixed so as to make good connexion with the powder.

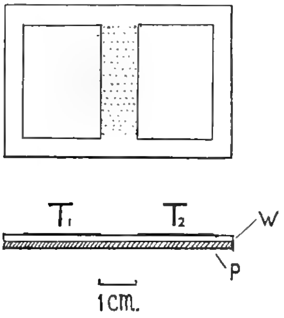

FIG. 1.

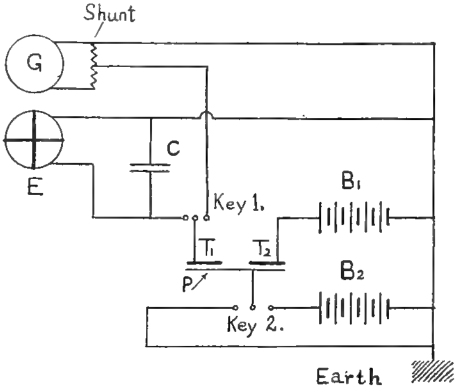

FIG. 2.

Powdered graphite was used for the earlier experiments, but later we used a bronze metal powder, and all the curves given in the paper refer to experiments in which this powder was employed.

The conductivity of the layer was measured between the terminals T_1 and T_2, the battery B_1 (fig. 2) being employed for this purpose, and either the galvanometer G or the electrometer E with extra capacity C, being in use through key *1*, according to the conductivity of the layer under examination. Sometimes, also, the conductivity was obtained by observing the drop of potential along a standard megohm. The E.M.F. employed in battery B_1 was usually two volts, but in later experiments larger voltages were used. The plate P was insulated, and could be raised to a high potential by battery B_2 or earthed through key 2, the tinfoil terminals being to earth during the charging and discharging of plate P.

2. The first observations were made with graphite layers, and a typical experiment is as follows:—The powder was rubbed on the paraffin surface until, with a capacity of 10^{-9} farad, the electrometer charged at the rate of 60 scale divisions per minute, the E.M.F. of battery B_1 being 2 volts. This corresponded to a current of $3 \cdot 3 \times 10^{-12}$ ampere, the electrometer having a sensitiveness of 3000 divisions per volt. The resistance of the powder layer was therefore 6×10^{12} ohms. The plate P was then charged to a high potential—400 volts in this experiment—and discharged, and the conductivity again measured. The current was now 3×10^{-8} ampere, so that the conductivity was 100,000 times its original values. Even larger relative increases of conductivity can be obtained if the initial conductivity of the layer is very small.

This remarkable increase of conductivity suggests the coherer effect. The conductivity is not, however, always destroyed by tapping, as in the case of the coherer. When the layer is formed of graphite on a paraffin surface, even vigorous tapping does not reduce the conductivity; but in the case of some other powders—bronze metal, for example—very vigorous tapping does destroy the conductivity. We shall see later other reasons for distinguishing the effect from a simple coherer action.

3. Several experiments have been carried out with a view to making clearer the nature of the effect, and these we shall briefly describe. It may be mentioned that the direction of the applied electric force between the powder and the metal plate is immaterial. It should also be mentioned that throughout these experiments care was taken not to include effects due to residual charge, which in most cases were negligible in comparison with the main effect.

Other powders than graphite were tried, and the effect could be obtained with any powder which gave slight conductivity when spread over the paraffin in a very thin layer. One powder in particular, a bronze or Dutch metal powder, was found to act very well, and was used for many of the subsequent observations. With this powder greater relative increases of conductivity were obtained than with the graphite. With this powder the conductivity could be destroyed by sharp tapping.

Layers of lead peroxide were specially tested, as this substance is usually quoted as one that acts as an anti-coherer. With this substance we obtained an increase of conductivity after the application of the transverse field, provided the layer was very thin, but a decrease of conductivity with thicker layers. This suggests that the effect we are studying is distinct from the ordinary coherer effect, and has its seat not in the body of the powder, but at the surface of separation between the powder and the insulator.

Another experiment leading to the same conclusion was as follows. A layer was formed as usual on the paraffin surface, and a metal plate mounted parallel to it in air. When the electric field was applied between this plate and the layer, a very slight increase of conductivity took place; but when the field was applied between the powder and the plate embedded in the paraffin, the usual great increase of conductivity occurred.

4. The rate at which the increased conductivity disappears was also investigated. In the case of graphite layers the decrease of conductivity is slow, and months would be necessary before the conductivity would return to approximately its original value. In the case of layers of bronze metal powder the rate of decrease is more rapid. Some such layers regained almost their original resistance in half an hour, but two or three hours were more usual. The rate of decay was carefully studied for bronze layers; but it was somewhat irregular and did not follow any simple law. Afterwards, when some of the experiments were being repeated with the layers in a dry atmosphere, we found that the rate of decay of the conductivity did approximately obey a very simple law. The layer formed in the usual way was placed in a closed vessel with a drying substance ($P_2 O_5$), and after standing for some hours the transverse electric field was momentarily applied, and measurements of the conductivity made at intervals afterwards. In the absence of moisture the increased conductivity remained for a longer period. When ordinary undried air was admitted into the vessel containing the layer, the conductivity began to fall more rapidly. The curves (fig. 3), p. 54, show the results of plotting the logarithms of the conductivity against the time, the curves *A* and *B* referring to two different layers. The vessel was opened and the layer exposed to the undried air of the room at the time indicated by the arrows. In the case of layer *B* we obtain a straight line in the dry atmosphere showing that the conductivity decreases exponentially with the time. For the layer *A* the rate of fall is more rapid at first, but the curve is approximating to a straight line before the admission of the moisture. The more rapid decay of conductivity after the admission of the moist air, and especially the suddenness with which it begins, are very striking.

5. A number of experiments were carried out bearing on the intensity

and method of application of the transverse electric field required to produce the increase of conductivity.

In the first place, we tested the effect of repeated applications and removals of the field. It was found that after a number of applications and removals the conductivity reached a maximum, and further applications produced no further increase. The number of applications required to produce the maximum effect depended on the electric field used and to some extent on the nature of the layer.

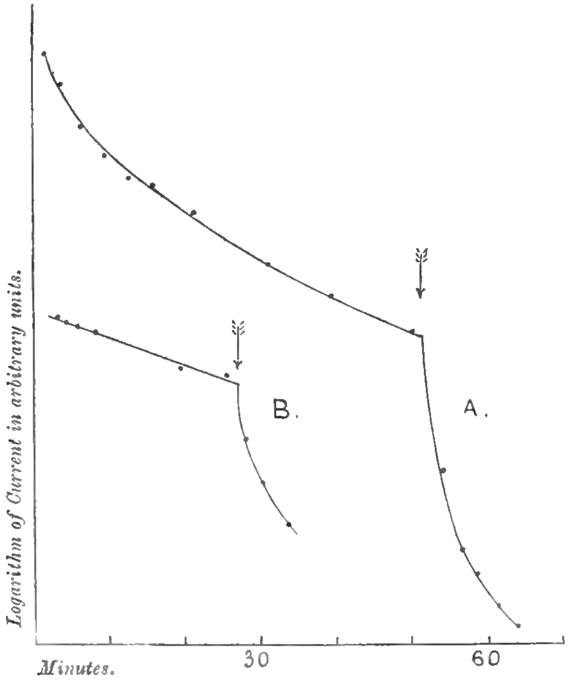

Fig. 3.

The intensity of transverse field required to produce the effect was investigated. A layer was formed, and its conductivity measured; a small transverse field was then applied and removed a sufficient number of times to produce the maximum effect and the conductivity again measured. A larger field was then applied and removed in the same way, and so on, the conductivity current between the tinfoil terminals being always that given by an E.M.F. of 2 volts. Curves *A* and *B* (fig. 4) were plotted in this way for two layers, one of which *A* had a thickness of paraffin beneath the powder layer of 1·05 mms., and the other *B* a thickness of 2·19 mms. The ordinates show the ratio of the increased conductivity to the original conductivity and the abscissae the transverse voltage. Even small voltages produce an effect, but the rapid increase of conductivity commences at about 100 volts for the layer with a thickness of paraffin of 1·05 mms., and at about 220 volts for the layer with a thickness of 2·19 mms. It has been noticed that a layer which had been exposed to a large transverse field, and had lost most of its conductivity with time, was more sensitive when the field was again applied. Small fields produced a greater effect, and the very rapid increase of conductivity occurred at lower voltages than at the first application.

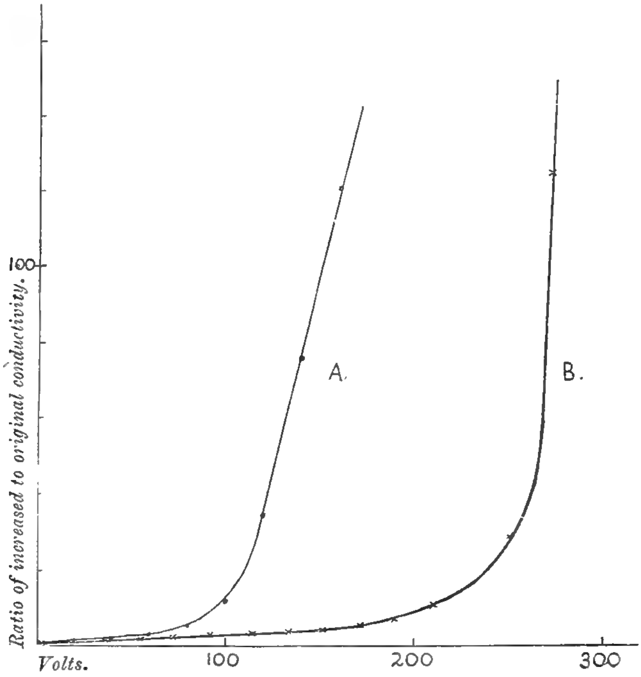

Fig. 4.

Experiments were then made to test whether the great increase of conductivity produced by the application of a strong electric field would take place if the field were applied gradually in a number of small successive steps. By means of a potential divider of 100 coils of 100 ohms each in series, an electromotive force of 200 volts was applied to a layer in steps of 4 volts, and gradually removed in the same way. Practically no increase of conductivity took place. When the 200 volts were applied at once and removed in the usual way, an enormous increase of conductivity occurred. The sudden application or removal of the E.M.F. is therefore essential in order to produce the increase of conductivity.

6. In all the experiments described above the E.M.F. applied along the layer between the tinfoil strips for the purpose of measuring the conductivity

has been confined to a few volts. We shall now give the results of experiments showing how the current varies with the E.M.F., both in the case of fresh layers and of layers which have had their conductivity greatly increased by the application of the transverse field. When measuring the current for larger voltages, it was necessary to examine in the first place whether the application of such fields along the layer produced an increase of conductivity which would persist after the removal of the field—whether, in fact, the same effect would take place as when the field was applied transversely through the dielectric. It was found that the electromotive forces used in measuring the current—up to 200 volts—produced no such effect, the current being the same whether the E.M.F. was applied suddenly or in small steps. There is, however, one exception to this statement. It was pointed out in section 5 that a layer which had been exposed to a large transverse field, and which had been given time to lose most of its increased conductivity, was specially sensitive when again exposed to a transverse field. We now found that such a layer was sensitive also to fields applied along the layer, and the sudden application of, say, 200 volts along the layer, gave a greater current than the same E.M.F. applied in small steps.

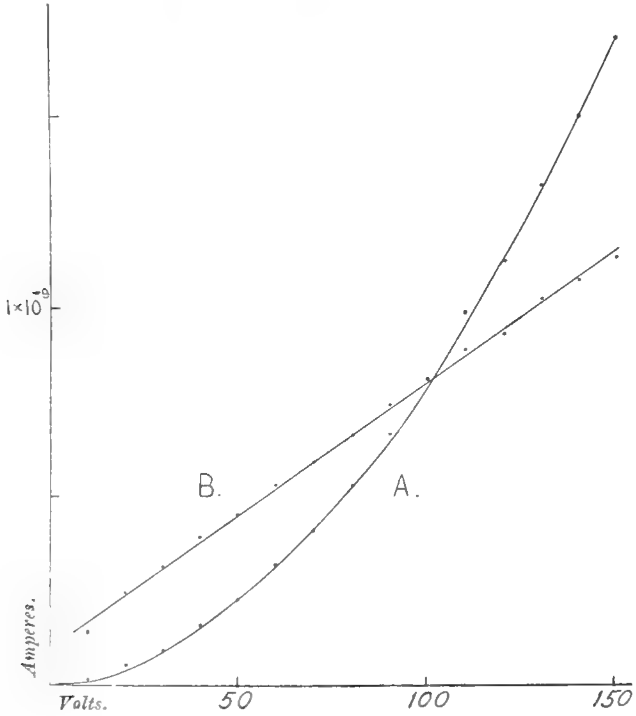

Fig. 5.

The relation between current and E.M.F. is shown in fig. 5, curve *A*, for a freshly formed layer not exposed to any transverse field. The curve is expressed very accurately by the equation

$$C = aV + bV^2,$$

where C is the current and V the electromotive force. Curve B is obtained by plotting the ratio C/V against V, and is very accurately a straight line.

Fig. 6.

Fig. 6 refers to a layer the conductivity of which had been very greatly increased by the continued application and removal of a large transverse field; in fact, the transverse field was continuously applied and removed during the observations. For the greater part of the range the curve is a straight line, and may be expressed in the form

$$C = k(V - v).$$

The current is proportional to the excess of the E.M.F. above a certain value.

The above curves figs. 5 and 6 are typical of the results obtained for all the layers we have tested, but different layers show differences of detail which we are not now entering upon.

We have tried how the conductivity is affected by allowing a current to flow through the layer; in particular we have tried whether the conductivity of a layer which has been exposed to a transverse field would fall off any more rapidly if a current were kept flowing between the tinfoil strips. When there is a large E.M.F. between the tinfoil strips, small sparks form over the layer; and when this happens, the resistance soon becomes infinite. An inspection of the layer shows, however, that it is broken where the sparks occur, and the increase of resistance is not due directly to an electrical action. When the E.M.F. is much less than that which produces sparking, the passage of the current does not produce an increased rate of fall of conductivity. For an E.M.F. near to that which produces visible sparking there is a more rapid decrease of conductivity when the current is flowing, but the source of the action is somewhat uncertain.

7. The explanation of the effects described above is by no means clear, and there are many further experiments that should be tried before a full theory is attempted. Some conceptions as to the nature of the effects may, however, be formed from the results we have described.

The relation between current and E.M.F. for a powder layer which has not been subjected to the transverse field,

$$C = aV + bV^2,$$

is of the type which applies to cases where the ionisation is confined to a surface, and ions of one sign are drawn away from the surface by the electric field. This type of relation holds when electrons are produced at one plate by ultraviolet light, and drawn across to a parallel plate by an electric field, and an identical relation has been verified for the current between terminals in a hot gas. In the case of the thin layers of powders we may perhaps imagine that the grains of powder are surrounded by conducting films which do not extend from grain to grain, and that the conductivity is due to the electrons drawn across the intervening narrow spaces by the electric field.

When the layer of powder has been subjected to the transverse field, a very great increase of conductivity takes place, and the current-E.M.F. curve is of a new form, viz.,

$$C = k(V - v).$$

This new form could be explained if we imagine the conducting films to have spread so as to bridge over the gaps between the grains of powder.

We have stated early in the paper that the effect studied is not due to simple coherer action. For that opinion there is much evidence, including the results with lead peroxide and the large voltages we use as compared with those necessary in the case of the coherer. At the same time it is necessary to remember that there is no satisfactory theory of the action of the coherer, and it may well be that the coherer action and the effect we are studying are different manifestations of the same type of phenomenon.

We have pleasure in thanking Mr. Coghlan, M.SC., for carrying out many of the observations.

VI.

ON AN INTEGRAL EQUATION PROPOSED BY ABEL, AND OTHER FUNCTIONAL EQUATIONS RELATED TO IT.[*]

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1. The integral equation, in the form in which Abel proposed it, is as follows:—

$$\int f(x)\,\phi(ax)\,dx = \psi(a),$$

where f and ψ are known, and ϕ is to be found. The limits of integration are constants. Abel gave the equation as a generalization of the problem of the isochrone, stating that he had solved it, but did not give the solution. We will first take the limits of integration to be 0 and 1, and write the equation thus—

$$\int_0^1 G(t)\,f(tx)\,dt = g(x).$$

Here G and g are known, while f is unknown. This becomes, on integration by parts,

$$G(1)\,\phi(x) - \int_0^1 G'(t)\,\phi(tx)\,dt = xg(x),$$

where

$$\phi(x) = \int_0^x f(x)\,dx.$$

Supposing $G(1) \neq 0$, we may write

$$\phi(x) = \psi(x) + \int_0^1 K(t)\,\phi(tx)\,dt.\dagger$$

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[*] See the author's *Thèse de Doctorat* (Paris, 1913), since published in the *Annales de Toulouse* (1914). A brief history of the question is there given, and a proof of the *existence* of solutions.

[†] The substitution $tx = y$ brings this equation to Volterra's form with a kernel

$$\frac{1}{x}\,K\left(\frac{y}{x}\right),$$

which is not limited in the neighbourhood we are considering, i.e. that of $x = 0$. Still, the equation can be solved by iteration when $\psi(x)$ is limited and $|K(t)| < 1$.

I have discovered the following formula for the solution of this equation :—

$$\phi(x) = I(x) = \frac{1}{2\pi i}\int_D \frac{x^a \int_0^a y^{-1-a}\psi(y)\,dy}{1 - \int_0^1 t^a K(t)\,dt}\,da.$$

To explain this formula, which holds good for $0 < x < a$: we suppose that $|\psi(x)|$ is less than Mx^γ, M being a constant and $\gamma > -1$, and that $K(t)$ is integrable for $o \leq t \leq 1$. Putting $a = \eta + i\theta$, we suppose that D is an infinite straight line in the a-plane parallel to the θ-axis, not passing through any root of the equation

$$1 - \int_0^1 t^a K(t)\,dt = 0,$$

and lying between the lines $\eta = -1$ and $\eta = \gamma$. It can be shown, with certain very general assumptions about the nature of $K(t)$, that the roots of the equation

$$1 - \int_0^1 t^a K(t)\,dt = 0$$

are finite in number, and that the integral

$$\int_0^1 t^a K(t)\,dt$$

tends towards zero with $\frac{1}{|a|}$, so long as a remains to the right of the line $\eta = -1$.* The integral along D is not to be taken arbitrarily, but equal portions of D must be measured above and below the η-axis, and the limit found when these equal lengths tend to infinity.

2. Supposing that this limit exists, we will prove that $I(x)$ satisfies the equation

$$\phi(x) = \psi(x) + \int_0^1 K(t)\,\phi(tx)\,dt.$$

Take the length of the equal portions of D to be ξ, and call their united length $D\xi$. Then

$$I(x) = \underset{\xi=\infty}{\mathrm{Lt}}\, I(x,\xi) = \underset{\xi=\infty}{\mathrm{Lt}}\, \frac{1}{2\pi i}\int_{D\xi} \frac{x^a \int_0^a y^{-1-a}\psi(y)dy}{1 - \int_0^1 t^a K(t)dt}\,da.$$

We find easily

$$I(x,\xi) - \int_0^1 K(t)\,I(tx,\xi)\,dt$$

$$= \frac{1}{2\pi i}\int_{D\xi}\left[x^a \int_0^a y^{-1-a}\psi(y)\,dy\right]da.$$

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[*] See *Thèse de Doctorat*, pp. 74–79.

As ξ tends towards infinity, the left-hand side of this equation approaches the limit

$$I(x) - \int_0^1 K(t)\, I(tx)\, dt.$$

Suppose D to be the line $\eta = \delta$, where $-1 < \delta < \gamma$; then the limit of the right-hand side is equal to

$$\underset{\xi=\infty}{\mathrm{Lt}}\ \frac{1}{2\pi i}\int_{-\xi}^{+\xi}\left[x^{\delta+i\theta}\int_0^a y^{-1-\delta-i\theta}\,\psi(y)\,dy\right] i\,d\theta,$$

which, when we put $y = xe^{-\tau}$, becomes

$$\underset{\xi=\infty}{\mathrm{Lt}}\ \frac{1}{2\pi}\int_{-\xi}^{+\xi} d\theta \int_{\log\frac{x}{a}}^{+\infty} d\tau \left[e^{\tau(\delta+i\theta)}\,\psi(xe^{-\tau})\right]$$

This is a case of Fourier's integral. Integrating first with regard to θ, we find

$$\underset{\xi=\infty}{\mathrm{Lt}}\ \frac{1}{2\pi}\int_{\log\frac{x}{a}}^{+\infty} \frac{e^{i\tau\xi} - e^{-i\tau\xi}}{i\tau}\, e^{\tau\delta}\,\psi(xe^{-\tau})\, d\tau$$

$$= \underset{\xi=\infty}{\mathrm{Lt.}}\ \frac{1}{\pi}\int_{\log\frac{x}{a}}^{+\infty} \frac{\sin \tau\xi}{\tau}\, e^{\tau\delta}\,\psi(xe^{-\tau})\, d\tau.$$

For $0 < x < a$, $\log\frac{x}{a}$ is negative; also the value of $e^{\tau\delta}\,\psi(xe^{-\tau})$ for $\tau = 0$ is $\psi(x)$. The function $|\, e^{\tau\delta}\,\psi(xe^{-\tau})\,|$ is absolutely integrable even when the upper limit is $+\infty$, since we have, for very great values of τ,

$$|\, e^{\tau\delta}\,\psi(xe^{-\tau})\,| < Me^{\tau\delta}(xe^{-\tau})^{\gamma} = Mx^{\gamma}\, e^{\tau(\delta-\gamma)},$$

and $\delta - \gamma$ is a negative quantity. Hence we have

$$I(x) - \int_0^1 K(t)\, I(tx)\, dt = \psi(x),$$

which shows that $\phi(x) = I(x)$ is a solution.

3. We must now consider if the expression $I(x)$ has a meaning or not. We have

$$\frac{1}{1 - \int_0^1 t^{a} K(t)\, dt} = \sum_{p=0}^{m-1}\left[\int_0^1 t^{a} K(t)\, dt\right]^p + \frac{\left[\int_0^1 t^{a} K(t)\, dt\right]^m}{1 - \int_0^1 t^{a} K(t)\, dt},$$

and we will prove that the integral

$$I_p \equiv \frac{1}{2\pi i}\int \left[\int_0^1 t^{a} K(t)\, dt\right]^p \left[x^{a}\int_0^a y^{-1-a}\,\psi(y)\,dy\right] da$$

is equal to the expression

$$\psi_p(x) \equiv \int_0^1 \ldots \int_0^1 K(t_1)\, K(t_2) \ldots K(t_p)\, \psi(t_1 t_2 \ldots t_p x)\, dt_1\, dt_2 \ldots dt_p.$$

For

$$I_p = \underset{\xi=\infty}{\mathrm{Lt}} \frac{1}{2\pi} \int_{-\xi}^{+\xi} \left[\int_0^1 t^{\delta+i\theta} K(t)\, dt\right]^p \left[x^{\delta+i\theta} \int_0^a y^{-1-\delta-i\theta} \psi(y)\, dy\right] d\theta$$

$$= \underset{\xi=\infty}{\mathrm{Lt}} \frac{1}{2\pi} \int_{-\xi}^{+\xi} \left[\int_0^1 \ldots \int_0^1 \left(t_1 t_2 \ldots t_p\right)^{\delta+i\theta} K(t_1) \ldots K(t_p)\, dt_1 \ldots dt_p\right]$$

$$\left[x^{\delta+i\theta} \int_0^a y^{-1-\delta-i\theta} \psi(y)\, dy\right] d\theta$$

$$= \underset{\xi=\infty}{\mathrm{Lt}} \frac{1}{2\pi} \int_{-\xi}^{+\xi} d\theta \int_0^a \frac{dy}{y} \psi(y) \int_0^1 \ldots \int_0^1 \left(\frac{t_1 t_2 \ldots t_p x}{y}\right)^{\delta+i\theta} K(t_1) \ldots K(t_p) dt_1 \ldots dt_p.$$

The transformation

$$y = t_1 t_2 \ldots t_p x e^{-\tau}$$

gives us

$$I_p = \underset{\xi=\infty}{\mathrm{Lt}} \frac{1}{2\pi} \int_{-\xi}^{+\xi} d\theta \int_0^1 \ldots \int_0^1 dt_1 \ldots dt_p K(t_1) \ldots K(t_p)$$

$$\int_{\log \frac{t_1 t_2 \ldots t_p x}{a}}^{+\infty} e^{\tau(\delta+i\theta)} \psi(t_1 t_2 \ldots t_p x e^{-\tau})\, d\tau.$$

We may prove as before that the function $e^{\tau\delta}\psi(t_1 t_2 \ldots t_p x e^{-\tau})$ remains absolutely integrable as τ approaches ∞. Integrating first with regard to θ we get

$$I_p = \underset{\xi=\infty}{\mathrm{Lt}} \frac{1}{\pi} \int_0^1 \ldots \int_0^1 dt_1 \ldots dt_p K(t_1) \ldots K(t_p) \int_{\log \frac{t_1 t_2 \ldots t_p x}{a}}^{+8} \frac{\sin \tau\xi}{\tau} e^{\delta\tau} \psi(t_1 t_2 \ldots t_p x e^{-\tau}) d\tau.$$

There is here a difficulty concerning the neighbourhood of the values $t_1 = 0$, $t_2 = 0$, . . . $t_n = 0$, which give $-\infty$ in the lower limit, because the function $e^{\tau\delta}\psi(t_1 t_2 \ldots t_p x e^{-\tau})$ is not absolutely integrable in this direction. Taking b a constant negative quantity we see that

$$\underset{\xi=\infty}{\mathrm{Lt}} \frac{1}{\pi} \int_0^1 \ldots \int_0^1 dt_1 \ldots dt_p K(t_1) \ldots K(t_p) \int_b^{+\infty} \frac{\sin \tau\xi}{\tau} c^{\tau\delta} \psi(t_1 t_2 \ldots t_p x e^{-\tau}) d\tau$$

is equal to

$$\int_0^1 \ldots \int_0^1 K(t_1) \ldots K(t_p) \psi(t_1 t_2 \ldots t_p x) dt_1 \ldots dt_p = \psi_p(x).$$

Putting $t_1 t_2 \ldots t_p x = \rho$, we have now to consider the integral

$$J \equiv \int_{\log \frac{\rho}{a}}^{b} \frac{\sin \tau\xi}{\tau} e^{\tau\delta} \psi(\rho e^{-\tau}) d\tau.$$

Put $\lambda = \frac{\pi}{\xi}$, and suppose $-(s-1)\lambda > b > -s\lambda$, and $-q\lambda > \log \frac{\rho}{a} > -(q+1)\lambda$,

s and q being positive integers. We have

$$\left| \int_{-s\lambda}^{b} \frac{\sin \tau\xi}{\tau} e^{\delta\tau} \psi(\rho e^{-\tau}) d\tau \right| < \frac{\lambda M}{|b|} \rho^{\gamma} e^{b(\delta-\gamma)}$$

and

$$\left| \int_{\log\frac{\rho}{a}}^{-q\lambda} \frac{\sin \tau\xi}{\tau} e^{\tau\delta} \psi(\rho e^{-\tau}) d\tau \right| < \frac{M\rho^{\gamma}}{q\lambda} \int_{\log\frac{\rho}{a}}^{-q\lambda} e^{\tau(\delta-\gamma)} d\tau.$$

that is to say, less than

$$\frac{M\rho^{\gamma}}{q\lambda} \left[\frac{e^{(\delta-\gamma)\log\frac{\rho}{a}} - e^{-q\lambda(\delta-\gamma)}}{\gamma - \delta} \right]$$

$$= \frac{M\rho^{\delta} a^{\gamma-\delta}}{q\lambda(\gamma-\delta)} \left[1 - e^{(\gamma-\delta)\left(\log\frac{\rho}{a} + q\lambda\right)} \right]$$

$$< \frac{\varepsilon M\rho^{\delta} a^{\gamma-\delta}}{q\lambda(\gamma-\delta)},$$

where ε is a quantity which tends towards zero with λ.

The integral

$$\int_{-q\lambda}^{-s\lambda} \frac{\sin \tau\xi}{\tau} e^{\tau\delta} \psi(\rho e^{-\tau}) d\tau$$

breaks up into a number of sums like the following

$$\int_{-(r+1)\lambda}^{-r\lambda} + \int_{-r\lambda}^{-(r-1)\lambda},$$

with the possible exception of an extra term

$$\int_{-(s+1)\lambda}^{-s\lambda} \frac{\sin \tau\xi}{\tau} e^{\tau\delta} \psi(\rho e^{-\tau}) \delta\tau,$$

which is less in absolute value than

$$\frac{\lambda M}{|b|} \rho^{\gamma} e^{b(\delta-\gamma)}.$$

Putting $\tau + \lambda$ instead of τ in the second of the above pair of integrals we see that their sum is equal to

$$\int_{-(r+1)\lambda}^{-r\lambda} \sin \tau\xi \left[\frac{e^{\tau\delta}\psi(\rho e^{-\tau})}{\tau} - \frac{e^{(\tau+\lambda)\delta}\psi(\rho e^{-\tau-\lambda})}{\tau+\lambda} \right] d\tau;$$

hence the sum of all the pairs is less in alsolute value than

$$\int_{\log\frac{\rho}{a}}^{b} \left| \frac{e^{\tau\delta}\psi(\rho e^{-\tau})}{\tau} - \frac{e^{(\tau+\lambda)\delta}\psi(\rho e^{-\tau-\lambda})}{\tau+\lambda} \right| d\tau$$

$$= \rho^{\gamma} \int_{\log\frac{\rho}{a}}^{b} e^{\tau(\delta-\gamma)} \mid \theta(\tau) - e^{\lambda(\delta-\gamma)} \theta(\tau+\lambda) \mid d\tau,$$

where $\theta(\tau)$ is a function which is finite and continuous for all values of τ. As λ diminishes, this integral can be made less than

$$\varepsilon' \rho^{\gamma} \int_{\log \frac{\rho}{a}}^{b} e^{\tau(\delta-\gamma)}\, d\tau = \varepsilon' \left[\frac{\rho^{\gamma} e^{b(\delta-\gamma)} - \rho^{\delta} a^{\gamma-\delta}}{\delta - \gamma} \right],$$

where ε' is arbitrarily small.

Taking all these results together, we see that the integral

$$\frac{1}{\pi} \int_0^1 \dots \int_0^1 dt_1 \dots dt_p\, K(t_1) \dots K(t_p) \int_{\log \frac{t_1 t_2 \dots t_p x}{a}}^{b} \frac{\sin \tau\xi}{\tau} e^{\tau\delta}\, \psi(t_1 t_2 \dots t_p x e^{-\tau})\, d\tau$$

tends towards zero with $\frac{1}{\xi}$.

Hence we have $$I_p = \psi_p(x).^{*}$$

4. It remains to prove that m can be taken such that the remainder

$$R_m(x) = \frac{1}{2\pi\iota} \int_D \frac{\left[\int_0^1 t^a K(t)\, dt \right]^m x^a \int_0^a y^{-1-a} \psi(y)\, dy}{1 - \int_0^1 t^a K(t)\, dt}\, da$$

has a meaning. As we have said, the integral

$$\int_0^1 t^a K(t)\, dt \quad \text{tends towards zero with} \quad \frac{1}{|a|};$$

and since the line D does not pass through any root of the equation

$$1 - \int_0^1 t^a K(t)\, dt = 0,$$

the expression

$$\left| \frac{1}{1 - \int_0^1 t^a K(t)\, dt} \right|$$

is of limited magnitude all along D. Also the expression

$$\left| x^a \int_0^a y^{-1-a} \psi(y)\, dy \right|$$

is less than $$M x^{\delta} \int_0^a y^{-1-\delta+\gamma}\, dy = \frac{M x^{\delta} a^{\gamma-\delta}}{\gamma - \delta}.$$

Hence it suffices that m be taken such that the integral

$$Q = \int_D \left| \int_0^1 t^a K(t)\, dt \right|^m |da|$$

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* When the equation can be solved by iteration, the solution is evidently

$$\phi(x) = \psi(x) + \psi_1(x) + \dots + \psi_p(x) + \dots$$

has a meaning. Let us take m an even number, equal to $2r$. We have

$$\left|\int_0^1 t^{\delta+i\theta} K(t)\,dt\right|^2 = \left[\int_0^1 t^{\delta}\cos(\theta\log t)\,K(t)\,dt\right]^2$$

$$+\left[\int_0^1 t^{\delta}\sin(\theta\log t)\,K(t)\,dt\right]^2$$

$$= \left[\int_0^\infty e^{-u(1+\delta)}K(e^{-u})\cos\theta u\,du\right]^2 + \left[\int_0^\infty e^{-u(1+\delta)}K(e^{-u})\sin\theta u\,du\right]^2.$$

If $K(t)$ remains finite for $0 \leq t \leq 1$, we can show that Q has a meaning for $m = 2$. Putting

$$e^{-u(1+\delta)}K(e^{-u}) = P(u),$$

we have

$$\operatorname*{Lt}_{\xi=\infty}\int_{-\xi}^{+\xi}\left[\int_0^\infty P(u)\cos\theta u\,du\right]^2 d\theta$$

$$= \operatorname*{Lt}_{\xi=\infty}\int_{-\xi}^{+\xi}\left[\int_0^\infty\int_0^\infty P(u)\,P(v)\cos\theta u\cos\theta v\,du\,dv\right]d\theta$$

$$= \tfrac{1}{2}\operatorname*{Lt}_{\xi=\infty}\int_{-\xi}^{+\xi}\left[\int_0^\infty\int_0^\infty P(u)\,P(v)\left\{\cos\theta(u+v)+\cos\theta(u-v)\right\}du\,dv\right]d\theta$$

$$= \operatorname*{Lt}_{\xi=\infty}\int_0^\infty\int_0^\infty P(u)\,P(v)\frac{\sin\xi(u+v)}{u+v}\,du\,dv,$$

$$+ \operatorname*{Lt}_{\xi=\infty}\int_0^\infty\int_0^\infty P(u)\,P(v)\frac{\sin\xi(u-v)}{u-v}\,du\,dv,$$

since the function P is absolutely integrable from 0 to ∞.

Putting $u = u$, $u + v = w$, we have

$$\operatorname*{Lt}_{\xi=\infty}\int_0^\infty\int_0^\infty P(u)\,P(v)\frac{\sin\xi(u+v)}{u+v}\,du\,dv.$$

$$= \operatorname*{Lt}_{\xi=\infty}\int_0^\infty dw\,\frac{\sin\xi w}{w}\int_0^w P(u)\,P(w-u)\,du,$$

$$= \operatorname*{Lt}_{\xi=\infty}\int_0^\infty\frac{\sin\xi w}{w}F(w)\,dw, \quad \text{where } F(0) = 0$$

$$= 0.$$

Similarly, putting $v = v$, $u - v = w$, we have

$$\operatorname*{Lt}_{\xi=\infty}\int_0^\infty\int_0^\infty P(u)\,P(v)\frac{\sin\xi(u-v)}{u-v}\,du\,dv$$

$$= \operatorname*{Lt}_{\xi=\infty}\int_{-\infty}^{+\infty} dw\,\frac{\sin\xi w}{w}\int_0^\infty P(v)\,P(v+w)\,dv$$

$$= \pi\int_0^\infty [P(v)]^2 dv,$$

Hence

$$\underset{\xi=\infty}{\mathrm{Lt}}\int_{-\xi}^{+\xi}\left[\int_0^\infty P(u)\cos\theta u\,du\right]^2 d\theta = \pi\int_0^\infty\left[P(v)\right]^2 dv,$$

and, by similar reasoning

$$= \underset{\xi=\infty}{\mathrm{Lt}}\int_{-\xi}^{+\xi}\left[\int_0^\infty P(u)\sin\theta u\,du\right]^2 d\theta.$$

This result holds good even though $P(v)$ becomes infinite at certain points, provided that $[P(v)]^2$ is integrable from 0 to ∞; which is the same as saying that $K(t)$ may become infinite, provided that $[K(t)]^2$ is integrable between 0 and 1. When this is not so, we must examine the general case $r > 1$.

We have

$$Q = \int_D \left|\int_0^1 t^a K(t)\,dt\right|^{2r} |\,da\,|$$

$$= \underset{\xi=\infty}{\mathrm{Lt}}\int_{-\xi}^{+\xi}\left\{\left[\int_0^\infty P(u)\cos\theta u\,du\right]^2 + \left[\int_0^\infty P(u)\sin\theta u\,du\right]^2\right\}^r d\theta.$$

The general term of this expression is

$$\underset{\xi=\infty}{\mathrm{Lt}}\ \frac{r!}{q!\ s!}\int_{-\xi}^{+\xi}\left[\int_0^\infty P(u)\cos\theta u\,du\right]^{2q}\left[\int_0^\infty P(u)\sin\theta u\,du\right]^{2s} d\theta,$$

where $q + s = r$; this, omitting a constant numerical factor, is the same as

$$\underset{\xi=\infty}{\mathrm{Lt}}\int_{-\xi}^{+\xi}\left[\int_0^\infty\cdots\int_0^\infty P(u_1)\ldots P(u_{2q})\,P(u_{2q+1})\ldots P(u_{2r})\cos\theta u_1\ldots\cos\theta u_{2q}\right.$$
$$\left.\sin\theta u_{2q+1}\ldots\sin\theta u_{2r}\,du_1\ldots du_{2r}\right]d\theta.$$

The product of an even number of cosines or sines may be resolved into a sum of cosines; hence this integral breaks up into others of the form

$$\underset{\xi=\infty}{\mathrm{Lt}}\int_{-\xi}^{+\xi}\left[\int_0^\infty\cdots\int_0^\infty P(u_1)\ldots P(u_m)\right.$$
$$\left.\cos\theta(u_1\ldots + u_p - u_{p+1} - \ldots - u_m)\,du_1\ldots du_m\right]d\xi$$

which is the same, omitting a factor 2, as the following :—

$$\underset{\xi=\infty}{\mathrm{Lt}}\int_0^\infty\cdots\int_0^\infty P(u_1)\ldots P(u_m)\ \frac{\sin\xi(u_1 + \ldots + u_p - u_{p+1} - \ldots u_m)}{u_2 + \ldots + u_p - u_{p+1} - \ldots - u_m}\,du_1\ldots du_m.$$

Now, putting

$$u_1 = v_1,\ u_1 + u_2 = v_2,\ \ldots\ u_1 + \ldots + u_p = v_p$$

$$u_{p+1} = v_{p+1},\ u_{p+1} + u_{p+2} = v_{p+2},\ \ldots\ u_{p+1} + \ldots + u_m = v_m,$$

we obtain

$$\underset{\xi=\infty}{\mathrm{Lt}}\int_0^\infty\int_0^\infty\left[\begin{array}{l}\dfrac{\sin\xi(v_p-v_m)}{v_p-v_m}\,dv_p\,dv_m\displaystyle\int_0^{v_p}P(v_p-v_{p-1})\,dv_{p-1}\int_0^{v_{p-1}}P(v_{p-1}-v_{p-2})\,dv_{p-2}\\ \displaystyle\ldots\int_0^{v_2}P(v_2-v_1)\,dv_1\int_0^{v_m}P(v_m-v_{m-1})\,dv_{m-1}\ldots\int_0^{v_{p+2}}P(v_{p+2}-v_{p+1})\,dv_{p+1}\end{array}\right]$$

$$=\underset{\xi=\infty}{\mathrm{Lt}}\int_0^\infty\int_0^\infty\frac{\sin\xi(v_p-v_m)}{v_p-v_m}S(v_p)\,T(v_m)\,dv_p\,dv_m.$$

This, by reasoning similar to that already employed, is equal to

$$\pi\int_0^\infty S(u)\,T(u)\,du,$$

if this integral exists.

Now it is easy to see that if two functions $Y(t)$, $Z(t)$ are integrable in an interval (a, b), the function

$$W(v)=\int_a^v Y(v-u)\,Z(u)\,du$$

is finite in this interval, unless perhaps for such values as $v-u=u=\alpha$, i.e. $v=2\alpha$, when $Y(t)$, $Z(t)$ are both infinite for $t=\alpha$.

If $Y(t)$ becomes infinite like $\dfrac{1}{|t-\alpha|^\lambda}$, and $Z(t)$ like $\dfrac{1}{|t-\alpha|^\mu}$,

$$(0<\lambda<1,\ 0<\mu<1),$$

it can be easily proved that $W(t)$ becomes infinite for $t=2\alpha$ like

$$\frac{1}{|t-2\alpha|^{\lambda+\mu-1}}.$$

We name λ, μ, etc., orders of infinity.

By successive applications of this theorem we see that if the highest order of infinity of $P(u)$ or of $K(t)$ is λ, then the highest orders of $S(u)$ and $T(u)$ are $p\lambda-(p-1)$ and $q\lambda-(q-1)$ respectively, q being equal to $m-p$. Hence the highest order of infinity of $S(u)\,T(u)$ is $m\lambda-(m-2)$, and this function is integrable from 0 to ∞ if

$$m\lambda-(m-2)<1,$$

that is to say, if

$$m>\frac{1}{1-\lambda}.$$

Hence we have only to take $m=d$, the first even number satisfying this condition. It is then easy to show that the integral

$$Q\equiv\int_D\left|\int_0^1 t^{\alpha}K(t)\,dt\right|^m|d\alpha|$$

has a meaning for any $m\geq d$, even or odd.

The expression

$$\phi(x) = I(x) = \frac{1}{2\pi i}\int_D \frac{x^{\alpha}\int_0^a y^{-1-\alpha}\psi(y)\,dy}{1-\int_0^1 t^{\alpha}K(t)\,dt}\,d\alpha$$

is therefore a solution, in the interval $0 < x < a$, of the equation

$$\phi(x) = \psi(x) + \int_0^1 K(t)\,\phi(tx)\,dt.$$

We remark that to the hypotheses already made about $\psi(x)$ and $K(t)$ we must add that these functions are absolutely integrable and satisfy any of the ordinary conditions for development in Fourier series in the intervals $(0, a)$ and $(0, 1)$ respectively.

In order to have the general solution, we must add to $I(x)$ an expression of the form

$$H(x) = \frac{1}{2\pi i}\int_C \frac{x^{\alpha}\nu(\alpha)\,d\alpha}{1-\int_0^1 t^{\alpha}K(t)\,dt},$$

where C is a contour enclosing all the roots of the equation

$$1 - \int_0^1 t^{\alpha}K(t)\,dt = 0,$$

and lying entirely to the right of the line $\eta = -1$, while $\nu(\alpha)$ is a function which is holomorphous, but otherwise arbitrary.

5. The expression $H(x) + I(x)$ includes all the solutions of the integral equation which satisfy the same conditions as $\psi(x)$. To prove this, we have only to show that for any function $\phi(x)$ satisfying those conditions, the expression

$$R(x) = \frac{1}{2\pi i}\int_D \frac{x^{\alpha}\int_0^a y^{-1-\alpha}\left[\phi(y) - \int_0^1 K(t)\,\phi(ty)\,dt\right]dy}{1-\int_0^1 t^{\alpha}K(t)\,dt}\,d\alpha$$

differs from $\phi(x)$ only by an expression of the form $H(x)$.

We suppose that $\phi(x)$ is of the form $x^{\rho}\eta(x)$, where $\eta(x)$ remains less than a fixed number N for $0 \leq x \leq a$, and $\rho - \delta$ is positive. We can approximate to $\eta(x)$ by a polynomial $b_0 + b_1x + \ldots b_nx^n$, which we call $\eta_n(x)$. Putting $x^{\rho}\eta_n(x) = \phi_n(x)$, the difference $|\,\phi(x) - \phi_n(x)\,|$ can be made less than ϵx^{ρ}, where ϵ is arbitrarily small. We have

$$\begin{aligned} R(x) = {} & \frac{1}{2\pi i}\int_D x^{\alpha}\left[\int_0^a y^{-1-\alpha}\phi(y)\,dy\right]d\alpha \\ & + \frac{1}{2\pi i}\int_D \left\{1 + \left[\int_0^1 t^{\alpha}K(t)\,dt\right] + \ldots + \left[\int_0^1 t^{\alpha}K(t)\,dt\right]^{m-1}\right\} \\ & \qquad \left\{x^{\alpha}\int_0^a y^{-1-\alpha}\left[\phi(y)\int_0^1 t^{\alpha}K(t)\,dt - \int_0^1 K(t)\,\phi(ty)\,dt\right]dy\right\}d\alpha \\ & + \frac{1}{2\pi i}\int_D \frac{\left[\int_0^1 t^{\alpha}K(t)\,dt\right]^m \left\{x^{\alpha}\int_0^a y^{-1-\alpha}\left[\phi(y)\int_0^1 t^{\alpha}K(t)\,dt - \int_0^1 K(t)\,\phi(ty)\,dt\right]dy\right\}}{1-\int_0^1 t^{\alpha}K(t)\,dt}\,d\alpha. \end{aligned}$$

The first of these expressions is equal to $\phi(x)$. The second vanishes on account of the already proved relations

$$\frac{1}{2\pi i}\int_D \left[\int_0^1 t^\alpha K(t)\,dt\right]^r \left\{x^\alpha \int_0^a y^{-1-\alpha}\,\phi(y)\,dy\right\} d\alpha$$

$$= \int_0^1 \ldots \int_0^1 K(t_1)\,K(t_2)\ldots K(t_r)\,\phi(t_1 t_2 \ldots t_r x)\,dt_1 \ldots dt_r,$$

$$= \frac{1}{2\pi i}\int_D \left[\int_0^1 t^\alpha K(t)\,dt\right]^{r-1} \left\{x^\alpha \int_0^a y^{-1-\alpha}\left[\int_0^1 K(t)\,\phi(ty)\,dt\right] dy\right\} d\alpha.$$

For the last term, we know that we can take m such that the integral

$$\int_D \left|\int_0^1 t^\alpha K(t)\,dt\right|^m d\alpha$$

is less than a finite quantity Q. Then, if we call $R_n(x)$ the expression got by substituting $\phi_n(x)$ for $\phi(x)$ in $R(x)$, we have

$$R(x) - R_n(x) = \phi(x) - \phi_n(x) + J_n(x),$$

where

$$J_n(x) = \frac{1}{2\pi i}\int_D \frac{\left[\int_0^1 t^\alpha K(t)\,dt\right]^m \left\{x^\alpha \int_0^a y^{-1-\alpha}\left[\Big(\phi(y) - \phi_n(y)\Big)\int_0^1 t^\alpha K(t)\,dt - \int_0^1 K(t)\Big(\phi(ty) - \phi_n(ty)\Big)\,dt\right] dy\right\}}{1 - \int_0^1 t^\alpha K(t)\,dt}\, d\alpha.$$

We have

$$\left|\int_0^1 t^\alpha K(t)\,dt\right| \left|\phi(y) - \phi_n(y)\right| + \left|\int_0^1 K(t)\left\{\phi(ty) - \phi_n(ty)\right\} dt\right| < \epsilon' x^\rho,$$

where ϵ' can be made as small as we please. Hence, if we have on the line D,

$$\left|\frac{1}{1 - \int_0^1 t^\alpha K(t)\,dt}\right| < L,$$

then

$$|\,J_n(x)\,| < \frac{LQ\epsilon'}{2\pi} x^\delta \int_0^a y^{-1-\delta+\rho}\,dy$$

$$= \frac{LQ\epsilon' x^\delta a^{\rho-\delta}}{2\pi\,(\rho - \delta)}.$$

Hence $|\, R(x) - R_n(x) \,|$ may be made less than $\varepsilon'' x^{\delta}$, ε'' being arbitrarily small. But we have

$$R_n(x) = \frac{1}{2\pi i}\int_D \frac{x^{\alpha}\int_0^a y^{-1-\alpha+\rho}\left[\eta_n(y) - \int_0^1 t^{\rho} K(t)\eta_n(ty)dt\right]dy}{1 - \int_0^1 t^{\alpha} K(t)dt}\, da$$

$$= \frac{1}{2\pi i}\int_D \frac{x^{\alpha}}{1 - \int_0^1 t^{\alpha} K(t)dt}$$

$$\left[\frac{b_0\left(1 - \int_0^1 t^{\rho} K(t)dt\right)a^{\rho-\alpha}}{\rho - a} + \frac{b_1\left(1 - \int_0^1 t^{\rho+1} K(t)dt\right)a^{\rho-\alpha+1}}{\rho - a + 1} + \ldots + \frac{b_n\left(1 - \int_0^1 t^{\rho+n} K(t)dt\right)a^{\rho-\alpha+n}}{\rho - a + n}\right] da.$$

Now it is easy to show that the integral

$$\int \left|\frac{q^{\alpha}}{a}\right| \,|\, da \,|$$

taken on that part of the infinite circle which lies to the right of D is equal to zero, and hence that the integrals

$$\int \left| \frac{\left(\frac{x}{a}\right)^{\alpha}}{(\rho - a)\left[1 - \int_0^1 t^{a} K(t)dt\right.} \right| \,|\, da \,|, \ldots \int \left| \frac{\left(\frac{x}{a}\right)^{a}}{(\rho - a + n)\left[1 - \int t^{a} K(t)dt\right.} \right| da,$$

taken on the same part, are also equal to zero for $x < a$.

Hence in the expression for $R_n(x)$ we may substitute for D the closed contour consisting of D and this part of the infinite circle. The function to be integrated has poles in the interior of this contour, namely, the points

$$a = \rho, \quad \rho + 1, \quad \ldots \rho + n,$$

and the roots of the equation

$$1 - \int_0^1 t^{a} K(t)dt = 0.$$

We can take ρ such that none of the first set of poles coincides with the second. The direction of integration round the contour is clockwise, and we obtain

$$\begin{aligned} R_n(x) &= x^{\rho}(b_0 + b_1 x + \ldots + b_n x^n) + S_n(x) \\ &= \phi_n(x) + S_n(x), \end{aligned}$$

where $S_n(x)$ is an expression of the form

$$\Sigma_r\, x^{a_r}(A_{nr} + B_{nr}\log x + \ldots + N_{nr}(\log x)^s),$$

a_r being a root (of multiplicity $s+1$) of the equation

$$1 - \int_0^1 t^a K(t)\, dt = 0,$$

and the Σ extending to all the roots. Hence we can find an expression $S_n(x)$, containing a finite number of terms such that

$$|\, R(x) - \phi(x) - S_n(x) \,| < \varepsilon x^{\delta},$$

ε being arbitrarily small. But this is evidently impossible unless $R(x) - \phi(x)$ is itself of the form

$$\Sigma_r\, x^{a_r}(A_r + B_r \log x + \ldots + N_r(\log x)^s),$$

which is the same as saying that $R(x) - \phi(x)$ is of the form $H(x)$. We have proved therefore that the expression

$$\frac{1}{2\pi i}\int_C \frac{x^a\, \nu(a)}{1 - \int_0^1 t^a K(t)\, dt}\, da + \frac{1}{2\pi i}\int_D \frac{x^a \int_0^a y^{-1-a}\, \psi(y)\, dy}{1 - \int_0^1 t^a K(t)\, dt}\, da$$

includes all the solutions of the equation

$$\phi(x) = \psi(x) + \int_0^1 K(t)\, \phi(tx)\, dt.$$

This expression contains linearly as many arbitrary constants as there are roots (each counted to its degree of multiplicity) of the equation

$$1 - \int_0^1 t^a K(t)\, dt = 0.$$

6. The equation of Abel

$$\int_0^1 G(t) f(tx)\, dt = g(x)$$

is the same as

$$\phi(x) = \frac{xg(x)}{G(1)} + \int_0^1 \frac{G'(t)}{G(1)}\, \phi(tx)\, dt,$$

where $\phi(x) = \int_0^x f(x)\,dx$, and $G(1) \neq 0$. From this we obtain

$$\phi(x) = \frac{1}{2\pi i}\int_C \frac{x^\alpha\,\nu(\alpha)/G(1)}{1 - \int_0^1 t^\alpha \frac{G'(t)}{G(1)}\,dt}\,d\alpha + \frac{1}{2\pi i}\int_D \frac{x^\alpha \int_0^\alpha y^{-1-\alpha}\frac{yg(y)}{G(1)}\,dy}{1 - \int_0^1 t^\alpha \frac{G'(t)}{G(1)}\,dt}\,d\alpha.$$

Here, on account of the nature of $\phi(x)$, C and D must lie to the right of the axis of imaginary quantities, and from consideration of the second integral we see that D must also lie to the left of the line $\eta = 1 + \gamma$, supposing that $g(x)$ is of the form $x^\gamma \rho(x)$, $\rho(x)$ being always finite for $0 \leq x \leq a$. (We put as before $\alpha = \eta + i\theta$.) Integrating by parts in the denominator, we get

$$f(x) = \frac{d\phi}{dx} = \frac{1}{2\pi i}\int_C \frac{x^{\alpha-1}\,\nu(\alpha)}{\int_0^1 t^{\alpha-1} G(t)\,dt}\,d\alpha + \frac{1}{2\pi i}\frac{d}{dx}\int_D \frac{x^\alpha \int_0^a y^{-\alpha} g(y)\,dy}{\alpha \int_0^1 t^{\alpha-1} G(t)\,dt}\,d\alpha.$$

In this expression we may write $\alpha + 1$ instead of α, supposing at the same time that C lies to the right of the line $\eta = -1$, and D between the lines $\eta = -1$ and $\eta = \gamma$; then we have

$$f(x) = \frac{1}{2\pi i}\int_C \frac{x^\alpha\,\nu(\alpha)}{\int_0^1 t^\alpha\, G(t)\,dt}\,d\alpha + \frac{1}{2\pi i}\frac{d}{dx}\int_D \frac{x^{\alpha+1}\int_0^a y^{-\alpha-1} g(y)\,dy}{(\alpha+1)\int_0^1 t^\alpha\, G(t)\,dt}\,d\alpha.$$

In general, if we have $G(1) = G'(1) = \ldots = G^{(n-1)}(1) = 0$, and $G^{(n)}(1) \neq 0$ after repeated integrations by parts our equation becomes

$$G^{(n)}(1)\,\phi(x) = (-1)^n x^{n+1} g(x) + \int_0^1 G^{(n+1)}(t)\,\phi(tx)\,dt,$$

where
$$\phi(x) = \int_0^x \ldots \int_0^x f(x)\,dx,$$

the integrations being $n + 1$ in number. From this we obtain

$$\phi(x) = \frac{1}{2\pi i}\int_C \frac{x^\alpha\,\nu(\alpha)}{G^{(n)}(1) - \int_0^1 t^\alpha G^{(n+1)}(t)\,dt}\,d\alpha$$

$$+ \frac{1}{2\pi i}\int_D \frac{(-1)^n x^\alpha \int_0^a y^{-\alpha+n} g(y)\,dy}{G^{(n)}(1) - \int_0^1 t^\alpha G^{(n+1)}(t)\,dt}\,d\alpha,$$

where C lies wholly to the right of the line $\eta = n$, and D between the lines $\eta = n$ and $\eta = n + 1 + \gamma$. We get after $n + 1$ differentiations

$$f(x) = \frac{1}{2\pi i}\int_C \frac{\alpha(\alpha-1)\ldots(\alpha-n)\,x^{\alpha-n-1}\nu(\alpha)}{G^{(n)}(1) - \int_0^1 t^\alpha G^{(n+1)}(t)\,dt}\,d\alpha$$

$$+\frac{d^{n+1}}{dx^{n+1}}\,\frac{1}{2\pi i}\int_D \frac{(-1)^n x^\alpha \int_0^\alpha y^{-\alpha+n} g(y)\,dy}{G^{(n)}(1) - \int_0^1 t^\alpha G^{(n+1)}(t)\,dt}\,d\alpha.$$

Integrating by parts, we find that the denominator is equal to

$$(-1)^n\alpha(\alpha-1)\ldots(\alpha-n)\int_0^1 t^{\alpha-n-1} G(t)\,dt.$$

Writing $\alpha + n + 1$ instead of α, and supposing that C lies to the right of the line $\eta = -1$, and D between the lines $\eta = -1$ and $\eta = \gamma$, we find

$$f(x) = \frac{1}{2\pi i}\int_C \frac{x^\alpha \nu(\alpha)}{\int_0^1 t^\alpha G(t)\,dt}$$

$$+\frac{1}{2\pi i}\,\frac{d^{n+1}}{dx^{n+1}}\int_D \frac{x^{\alpha+n+1}\int_0^\alpha y^{-\alpha-1} g(y)\,dy}{(\alpha+1)(\alpha+2)\ldots(\alpha+n+1)\int_0^1 t^\alpha G(t)\,dt}\,d\alpha.$$

Of course we suppose in all these cases that C encloses all the roots of the equation

$$\int_0^1 t^\alpha G(t)\,dt = 0,$$

and that D does not pass through any of those roots.

7. The equation we have solved is not so general as that of Abel, namely,

$$\int_k^l f(x)\,\phi(ax)\,dx = \psi(a).$$

Supposing $|l| > |k|$, by putting lx instead of x, and $\frac{a}{l}$ instead of a, we can reduce this equation to the form

$$\int_\mu^1 f(x)\,\phi(ax)\,dx = \psi(a)$$

where $|\mu| < 1$. Keeping to our notation, we write it

$$\int_\mu^1 G(t) f(tx)\,dt = g(x).$$

We will further suppose $0 < \mu < 1$. Integrating by parts as before, and dividing by $G(1)$, which we suppose not equal to zero, we obtain an equation of the form

$$\phi(x) - \lambda \phi(\mu x) = \psi(x) + \int_{\mu}^{1} K(t) \phi(tx)\, dt,$$

where λ is a constant. A solution of this equation is given by the formula

$$\phi(x) = \frac{1}{2\pi i} \int_D \frac{x^a \int_0^a y^{-1-a} \psi(y)\, dy}{1 - \lambda\mu^a - \int_{\mu}^{1} t^a K(t)\, dt} .$$

This is evident by the method we have formerly used, if the convergence of the integral can be proved. Putting

$$U(a) = \frac{\int_{\mu}^{1} t^a K(t)\, dt}{1 - \lambda\mu^a},$$

we get

$$\phi(x) = \zeta_0(x) + \zeta_1(x) + \ldots + \zeta_{m-1}(x) + \phi_m(x),$$

where

$$\zeta_r(x) = \frac{1}{2\pi i} \int_D \frac{x^a [U(a)]^r \int_0^a y^{-1-a} \psi(y) dy}{1 - \lambda\mu^a}\, da,$$

and

$$\phi_m(x) = \frac{1}{2\pi i} \int_D \frac{x^a [U(a)]^m \int_0^a y^{-1-a} \psi(y) dy}{1 - \lambda\mu^a - \int_{\mu}^{1} t^a K(t) dt}\, da.$$

We must see that D does not pass through any root of the equations

$$1 - \lambda\mu^a = 0, \quad 1 - \lambda\mu^a - \int_{\mu}^{1} t^a K(t) dt = 0.$$

We can prove exactly as before that for any $m \geqq$ a certain N, $\phi_m(x)$ has a meaning.

The integrals $\zeta_r(x)$ demand some discussion. Let us begin with the case $r = 0$, i.e., with the integral

$$\zeta_0(x) = \frac{1}{2\pi i} \operatorname{Lt}_{D_n = \infty} \int_{D_n} \frac{x^a \int_0^a y^{-1-a} \psi(y) dy}{1 - \lambda\mu^a}\, da.$$

We have $| \psi(x) | < Mx^{\gamma}$; let us suppose that $| \lambda\mu^{\gamma} | < 1$; then we can take the line D left of the line $\eta = \gamma$, so as to have on D the inequality

$$| \lambda\mu^a | < 1.$$

This gives us

$$\frac{1}{2\pi i}\int_{D_n}\frac{x^{\alpha}\int_{0}^{a} y^{-1-\alpha}\psi(y)dy}{1-\lambda\mu^{\alpha}}\,d\alpha$$

$$=\sum_{r=0}^{r=\infty}\frac{1}{2\pi i}\int_{D_n}\lambda^{r}(\mu^{r}x)^{\alpha}\left[\int_{0}^{a} y^{-1-\alpha}\psi(y)dy\right]d\alpha.$$

Let us take the first integral of this series, namely,

$$\frac{1}{2\pi i}\int_{D_n} x^{\alpha}\left[\int_{0}^{a} y^{-1-\alpha}\,\psi\,(y)\,dy\right]\delta\alpha.$$

We have already shown, supposing 2ξ to be the length of D_n, that it is equal to

$$\frac{1}{2\pi}\int_{-\xi}^{+\xi} d\theta\int_{\log\frac{x}{a}}^{+\infty} d\tau\left[e^{\tau(\delta+i\theta)}\,\psi\,(xe^{-\tau})\right]$$

$$=\frac{1}{\pi}\int_{\log\frac{x}{a}}^{+\infty}\frac{\sin\xi\tau}{\tau}\,e^{\tau\delta}\,\psi\,(xe^{-\tau})\,dt$$

$$=\frac{x^{\gamma}}{\pi}\int_{\log\frac{x}{a}}^{+\infty}\frac{\sin\xi\tau}{\tau}\,e^{\tau(\delta-\gamma)}\,\rho\,(x,\tau)\,d\tau,$$

where $\rho\,(x,\tau)$ is limited for all values

$$0\leq x\leq a,\quad \log\frac{x}{a}\leq\tau\leq+\infty.$$

The quantity $\delta-\gamma$ is negative, hence

$$\frac{x^{\gamma}}{\pi}\int_{0}^{+\infty}\frac{\sin\xi\tau}{\tau}\,e^{\tau(\delta-\gamma)}\,\rho\,(x,\tau)\,d\tau = \tfrac{1}{2}x^{\gamma}[\rho\,(x,0)+\varepsilon]$$

$$=\tfrac{1}{2}\psi\,(x)+\tfrac{1}{2}\varepsilon x\,,$$

where ε approaches zero with $\frac{1}{\xi}$, independently of x.

The other part of the integral,

$$\frac{x^{\gamma}}{\pi}\int_{\log\frac{x}{a}}^{0}\frac{\sin\xi\tau}{\tau}\,e^{\tau(\delta-\gamma)}\,\rho\,(x,\tau)\,d\tau$$

presents difficulties as x approaches zero (for then $\log\frac{x}{a}\to-\infty$). We suppose, however, that $\psi\,(x)$ satisfies Dirichlet's conditions for $0\leq x\leq a$; then $\psi\,(xe^{-\tau})$ and $\rho\,(x,\tau)$ will always have a limited number of maxima and minima for $0 \geq \tau \geq \log \frac{x}{a}$. In this interval M is the maximum of $|\rho(x, \tau)|$, and $\left(\frac{x}{a}\right)^{\delta-\gamma}$ is the maximum of $e^{\tau(\delta-\gamma)}$. Hence this part of the integral is equal to

$$\tfrac{1}{2}\psi(x) + cx^{\gamma}\left(\frac{x}{a}\right)^{\delta-\gamma}\frac{M}{\xi},$$

where c is a finite constant independent of x. Hence we have

$$\frac{1}{2\pi i}\int_{D_n} x^a \left[\int_0 y^{-1-a}\psi(y)\,dy\right]da = \psi(x) + \epsilon' x^{\delta},$$

where ϵ' approaches zero with $\frac{1}{\xi}$, independently of x. And in general

$$\sum_{r=0}^{r=+\infty}\frac{1}{2\pi i}\int_{Dn}\lambda^r(\mu^r x)^a\left[\int_0^a y^{-1-a}\psi(y)\,dy\right]da$$

$$= \psi(x) + \lambda\psi(\mu x) + \ldots + \lambda^r\psi(\mu^r x) + \ldots$$
$$+ \epsilon' x^{\delta}\left[1 + \lambda\mu^{\delta} + \ldots + (\lambda\mu^{\delta})^r + \ldots\right],$$

which, as D_n becomes infinite, tends towards the convergent series

$$\psi(x) + \lambda\psi(\mu x) + \ldots + \lambda^r\psi(\mu^r x) + \ldots.$$

If, on the other hand, we have $|\lambda\mu^{\gamma}| \geq 1$, then will $|\lambda\mu^a|$ be > 1, and the expression

$$\frac{1}{2\pi i}\int_{Dn}\frac{x^a\int_0^a y^{-1-a}\psi(y)\,dy}{1-\lambda\mu^a}\,da$$

may be written as follows:—

$$\sum_{r=-1}^{r=-\infty}\frac{1}{2\pi i}\int_{D_n}\lambda^r(\mu^r x)^a\left[\int_0^a y^{-1-a}\psi(y)\,dy\right]da.$$

When x lies between a and μa, all these terms vanish in the limit, since every $\mu^r x$ is greater than a. And in general, when $\mu^s a > x > \mu^{s+1} a$, we have

$$\underset{D_n=\infty}{\mathrm{Lt}}\ \frac{1}{2\pi i}\int_{D_n}\frac{x^a\int_0^a y^{-1-a}\psi(y)\,dy}{1-\lambda\mu^a}\,da$$

$$= \lambda^{-1}\psi(\mu^{-1}x) + \lambda^{-2}\psi(\mu^{-2}x) + \ldots + \lambda^{-s}\psi(\mu^{-s}x).$$

This function is discontinuous at the points μa, $\mu^2 a$, etc.

We remark incidentally that the expression

$$\frac{1}{2\pi i}\int_{D}\frac{x^a\int_0^a y^{-1-a}\psi(y)\,dy}{1-\lambda\mu^a}\,da$$

gives a solution of the equation for $\phi(x)$,

$$\phi(x) = \psi(x) + \lambda\phi(\mu x).$$

We can prove in a similar manner that the integrals

$$\zeta_r(x) = \frac{1}{2\pi i}\int_D \frac{x^\alpha\,[U(\alpha)]^r\int_0^a y^{-1-\alpha}\,\psi(y)\,dy}{1-\lambda\mu^\alpha}\,d\alpha$$

have a meaning when $r > 0$. Hence the formula

$$\phi(x) = \frac{1}{2\pi i}\int_D \frac{x^\alpha\int_0^a y^{-1-\alpha}\,\psi(y)\,dy}{1-\lambda\mu^\alpha-\int_\mu^1 t^\alpha K(t)\,dt}\,d\alpha$$

gives a solution of the equation

$$\phi(x) - \lambda\phi(\mu x) = \psi(x) + \int_\mu^1 K(t)\,\phi(tx)\,dt.$$

We can easily see, as in the case $\mu = 0$, that a solution of the equation

$$\int_\mu^1 G(t)\,f(tx)\,dt = g(x), \quad (G(1) \neq 0),$$

is given by

$$f(x) = \frac{1}{2\pi i}\frac{d}{dx}\int_D \frac{x^{1+\alpha}\int_0^a y^{-1-\alpha}\,g(y)\,dy}{(1+\alpha)\int_\mu^1 t^\alpha\,G(t)\,dt}\,d\alpha.$$

8. The solution of the more general equation

$$\int_\mu^1 G(x,t)\,f(tx)\,dt = g(x)$$

can now be readily found by successive approximation. Setting

$$\phi(x) = \int^x f(x)\,dx,$$

and integrating by parts as before, we find an equation of the form

$$\phi(x) - h(x)\,\phi(\mu x) = \psi(x) + \int_\mu^1 K(x,t)\,\phi(tx)\,dt.$$

Let us first take the case $\mu = 0$, in which we have the equation

$$\phi(x) = \psi(x) + \int_0^1 K(x,t)\,\phi(tx)\,dt.$$

Setting $K(0,t) = K(t)$, and $K(x,t) - K(0,t) = \eta(x,t)$, we have

$$\phi(x) = \left[\psi(x) + \int_0^1 \eta(x,t)\,\phi(tx)\,dt\right] + \int_0^1 K(t)\,\phi(tx)\,dt,$$

from which we deduce $\phi(x) = \phi_0(x) + S\phi(x)$, where

$$\phi_0(x) = \frac{1}{2\pi i}\int_C \frac{x^\alpha\,\nu(\alpha)}{1-\int_0^1 t^\alpha K(t)\,dt}\,d\alpha + \frac{1}{2\pi i}\int_D \frac{x^\alpha\int_0^a y^{-1-\alpha}\,\psi(y)\,dy}{1-\int_0^1 t^\alpha K(t)\,dt}\,d\alpha,$$

and

$$S\phi(x) = \frac{1}{2\pi i}\int_D \frac{x^\alpha\int_0^a y^{-1-\alpha}\left[\int_0^1 \eta(y,t)\,\phi(ty)\,dt\right]d\alpha.}{1-\int_0^1 t^\alpha K(t)\,dt}\,d\alpha.$$

It can be shown that, when x is taken sufficiently small, the solution of this equation is given by the series

$$\phi(x) = \phi_0(x) + \phi_1(x) + \ldots + \phi_n(x) + \ldots,$$

where

$$\phi_n(x) = S\phi_{n-1}(x), \quad (n = 1, 2, 3 \ldots).$$

We can choose the line D and the domain of x such that

$$| \phi_0(x) | < Mx^{\delta},$$

M being a constant. For the convergence of the series

$$\phi_0(x) + \phi_1(x) + \ldots + \phi_n(x) + \ldots$$

it suffices to show that if $| \theta(x) | < Ax^{\delta}$. A being a constant, the domain of x may be chosen such that

$$| S\theta(x) | < qAx^{\delta},$$

where $0 < q < 1$.

We have

$$S\theta(x) = \frac{1}{2\pi i}\int_D \left\{ 1 + \int_0^1 t^{\alpha}K(t)\,dt + \ldots + \left[\int_0^1 t^{\alpha}K(t)\,dt\right]^{m-1} + \frac{\left[\int_0^1 t^{\alpha}K(t)\,dt\right]^m}{1 - \int_0^1 t^{\alpha}K(t)\,dt} \right\} \left\{ x^{\alpha}\int^{\alpha} y^{-1-\alpha}\left[\int_0^1 \eta(y, t)\,\theta(ty)\,dt\right]dy \right\} d\alpha$$

$$= H_0(x) + H_1(x) + \ldots + H_{m-1}(x)$$

$$+ \frac{1}{2\pi i}\int_D \frac{\left[\int_0^1 t^{\alpha}K(t)\,dt\right]^m x^{\alpha}\int_0^{\alpha} y^{-1-\alpha}\left[\int_0^1 \eta(y, t)\,\theta(ty)\,dt\right]dy}{1 - \int_0^1 t^{\alpha}K(t)\,dt}\,d\alpha,$$

where we have

$$H_0(x) = \int_0^1 \eta(x, t)\ \theta(tx)\,dt,$$

$$H_r(x) = \int_0^1 K(t)\,H_{r-1}(tx)\,dt, \quad (r = 1, 2, \ldots m - 1),$$

and m is taken great enough for the convergence of the integral

$$\int_D \left| \int_0^1 t^{\alpha} K(t)\,dt \right|^m | d\alpha |.$$

We have

$$\operatorname*{Lt}_{x=0} \eta(x, t) = 0;$$

hence we can take x small enough to have

$$\left| H_0(x) + H_1(x) + \ldots + H_{m-1}(x) \right| < \frac{q}{2} Ax^{\delta}.$$

We have also

$$\left| \frac{1}{2\pi i} \int_D \frac{\left[\int_0^1 t^\alpha K(t)\, dt\right]^m x^\alpha \int_0^a y^{-1-\alpha} \left[\int_0^1 \eta(y, t)\, \theta(ty)\, dt\right] dy}{1 - \int_0^1 t^\alpha K(t)\, dt}\, d\alpha \right|$$

$$< \left[\frac{x^\delta}{2\pi} \int_0^a y^{-1-\delta} \left\{ \int_0^1 \left| \eta(y, t)\, \theta(ty) \right| dt \right\} dy \right] \times \int_D \frac{\left| \int_0^1 t^\alpha K(t)\, dt \right|^m}{\left| 1 - \int_0^1 t^\alpha K(t)\, dt \right|} \left| d\alpha \right|,$$

which can also be made less than $\frac{q}{2} A x^\delta$, by choosing x sufficiently small. Hence $| S\theta(x) |$ can be made less than qAx^δ, and the convergence of the series assured.

The more general equation

$$\phi(x) - h(x)\, \phi(\mu x) = \psi(x) + \int_\mu^1 K(x, t)\, \phi(tx)\, dt$$

is the same as the following

$$\phi(x) - \lambda\phi(\mu x) = \left[\psi(x) + w(x)\, \phi(\mu x) + \int_\mu^1 \eta(x, t)\, \phi(tx)\, dt\right]$$
$$+ \int_\mu^1 K(t)\, \phi(tx)\, dt,$$

where $\lambda = h(o)$, $w(x) = h(x) - h(o)$; this equation can be solved by a series in a similar manner.

9. I gave in my thesis some methods for showing the existence of solutions of all the types of equations treated in this paper. These methods largely depended on the approximation to the kernel $K(t)$ by a polynomial, from which a differential equation was deduced and solutions found by successive approximation. The procedure was long and troublesome, and did not apply to similar functional equations involving multiple integrals. The new formulae can be extended to those cases. Let us take, for example, the equation

$$\int_0^1 \int_0^1 G(t, \tau) f(tx, \tau y)\, dt\, d\tau = g(x, y).$$

Putting $\chi(x, y) = \int_0^x f(x, y)\, dx$, multiplying by x, and integrating by parts with regard to t, we obtain

$$\int_0^1 \left[G(1, \tau)\, \chi(x, \tau y) - \int_0^1 \frac{\partial}{\partial t} G(t, \tau)\, \chi(tx, \tau y)\, dt \right] d\tau = xg(x, y).$$

Now, putting

$$\phi(x, y) = \int_0^y \chi(x, y)\, dy = \int_0^x \int_0^y f(x, y)\, dx\, dy,$$

multiplying by y, and integrating by parts with regard to τ, we get

$$G(1, 1)\, \phi(x, y) - \int_0^1 \frac{\partial}{\partial \tau} G(1, \tau)\, \phi(x, \tau y) d\tau - \int_0^1 \frac{\partial}{\partial t} G(t, 1)\, \phi(tx, y)\, dt$$

$$+ \int_0^1 \int_0^1 \frac{\partial^2}{\partial t\, \partial \tau} G(t, \tau)\, \phi(tx, \tau y) dt\, d\tau) = xy\, g(x, y).$$

Supposing $G(1, 1) \neq 0$, this equation reduces to one of the form

$$\phi(x, y) = \psi(x, y) + \int_0^1 k(t)\, \phi(tx, y)\, dt + \int_0^1 \mathrm{K}(\tau)\, \phi(x, \tau y)\, dt$$

$$+ \int_0^1 \int_0^1 K(t, \tau)\, \phi(tx, \tau y)\, dt\, d\tau.$$

By analogy we can at once write down a solution as follows:—

$$\phi(x, y) = -\frac{1}{4\pi^2} \int_D \int_\Delta \frac{x^\alpha y^\beta \int_0^a \int_0^b u^{-1-\alpha} v^{-1-\beta} \psi(u, v)\, du\, dv}{1 - \int_0^1 t^\alpha k(t)\, dt - \int_0^1 \tau^\alpha \mathrm{K}(\tau) d\tau - \int_0^1 \int_0^1 t^\alpha \tau^\beta K(t, \tau)\, dt\, d\tau} d\alpha\, d\beta.$$

To explain this formula, we suppose that

$$| \psi(x, y) | < M x^\rho y^\sigma,$$

M being a constant, $\rho > -1$, $\sigma > -1$, $0 < x < a$, $0 < y < b$. Putting

$$\alpha = \xi_1 + i\eta_1, \quad \beta = \xi_2 + i\eta_2,$$

we suppose that D is the infinite straight line $\xi_1 = \delta_1$ in the plane of α, and Δ the line $\xi_2 = \delta_2$ in the plane of β; also $-1 < \delta_1 < \rho$, $-1 < \delta_2 < \sigma$. The integrals on D and Δ are taken in the same manner as the integral on D has been hitherto. We choose the line D so as not to pass through any of the roots of the equation

$$\overline{k}(\alpha) \equiv \int_0^1 t^\alpha k(t)\, dt = 1.$$

As before, with very general assumptions about $k(t)$, it may be proved that these roots are finite in number. The function $| 1 - \overline{k}(\alpha) |$ has then on the line D a minimum which is not zero; and when α is taken anywhere on this line, it may be proved in the same way that the roots of the equation to determine β

$$1 - \overline{k}(\alpha) - \overline{\mathrm{K}}(\beta) - \overline{K}(\alpha, \beta) = 0,$$

where

$$\overline{\mathrm{K}}(\beta) = \int_0^1 \tau^\beta\, \mathrm{K}(\tau)\, d\tau, \quad \overline{K}(\alpha, \beta) = \int_0^1 \int_0^1 t^\alpha\, \tau^\beta\, K(t, \tau)\, dt\, d\tau,$$

are finite in number. As α varies on D, these roots will describe a finite number of curves. We must draw the line Δ so as not to touch or pass through a multiple point of those curves, and also not to pass through any of the roots of the equation $1 - \bar{K}(\beta) = 0$. D and Δ being thus chosen, the function

$$F(\eta_1, \eta_2) \equiv \frac{1}{1 - \bar{k}(a) - \bar{K}(\beta) - \bar{K}(a, \beta)}$$

will have only isolated singularities of the first order in the plane of η_1, η_2; and the integral

$$\iint | F(\eta_1, \eta_2) | \, d\eta_2 \, d\eta_2$$

will have a meaning when taken over any finite area in this plane. This guarantees the convergence of the integral

$$U_n(x, y) = -\frac{1}{4\pi^2} \int_{D_n} \int_{\Delta_n} \frac{x^a y^\beta \int_0^a \int_0^b u^{-1-a} v^{-1-\beta} \psi(u, v) \, du \, dv}{1 - \bar{k}(a) - \bar{K}(\beta) - \bar{K}(a, \beta)} \, da \, d\beta,$$

for any D_n, Δ_n (which have the same meaning as D_n in former cases).

10. We will now prove that if

$$U(x, y) \equiv \underset{D_n, \Delta_n = \infty}{\mathrm{Lt}} U_n(x, y)$$

exists, then $U(x, y)$ is a solution of our equation. For we should have

$$\phi(x, y) - \int_0^1 k(t)\phi(tx, y)dt - \int_0^1 K(\tau)\phi(x, \tau y)d\tau - \int_0^1 \int_0^1 K(t, \tau)\phi(tx, \tau y)dtd\tau$$

$$= \underset{D_n, \Delta_n = \infty}{\mathrm{Lt}}$$

$$\left[U_n(x, y) - \int_0^1 k(t) U_n(tx, y)dt - \int_0^1 K(\tau) U_n(x, \tau y)d\tau - \int_0^1 \int_0^1 K(t, \tau) U_n(tx, \tau y)dt \, d\tau \right]$$

$$= \underset{D_n, \Delta_n = \infty}{\mathrm{Lt}} \; - \frac{1}{4\pi^2} \int_{D_n} \int_{\Delta_n} x^a y^\beta \left[\int_0^a \int_0^b u^{-1-a} v^{-1-\beta} \psi(u, v) du \, dv \right] da \, d\beta$$

$$= \underset{D_n, \Delta_n = \infty}{\mathrm{Lt}} \; - \frac{1}{4\pi^2} \int_{D_n} \int_{\Delta_n} \left[\int_{\log \frac{x}{a}}^{+\infty} \int_{\log \frac{y}{b}}^{+\infty} e^{\theta_1 a} e^{\theta_2 \beta} \psi(xe^{-\theta_1}, ye^{-\theta_2}) d\theta_1 d\theta_2 \right] da d\beta,$$

by use of the substitutions $u = xe^{-\theta_1}$, $v = ye^{-\theta_2}$. This last integral (when we integrate first with regard to a and β) is equal to

$$\underset{\eta_1, \eta_2 = \infty}{\mathrm{Lt}} \frac{1}{\pi^2} \int_{\log \frac{x}{a}}^{+\infty} \int_{\log \frac{y}{b}}^{+\infty} \frac{\sin \theta_1 \eta_1}{\theta_1} \frac{\sin \theta_2 \eta_2}{\theta_2} e^{\theta_1 \delta_1 + \theta_2 \delta_2} \psi(xe^{-\theta_1}, ye^{-\theta_2}) d\theta_1 d\theta_2,$$

which, by the theory of the double Fourier integral, is equal to

$$\left[e^{\theta_1 \delta_1 + \theta_2 \delta_2} \psi(xe^{-\theta_1}, ye^{-\theta_2} \right]_{\theta_1 = \theta_2 = 0} = \psi(x, y),$$

since the function

$$| e^{\theta_1 \delta_1 + \theta_2 \delta_2} \psi(xe^{-\theta_1}, ye^{-\theta_2}) |$$

remains integrable for $\theta_2 \rightarrow +\infty$ and $\theta_2 \rightarrow +\infty$.

11. We have still to establish the existence of $\mathrm{Lt}\,U_n(x, y)$. We suppose for simplicity, though it is not necessary, that the functions $k(t)$, $\kappa(\tau)$, $K(t, \tau)$ are finite in the domain $0 \leqq t \leqq 1$, $0 \leqq \tau < 1$. Then, as we have already proved, the integrals

$$\int_D \left| \bar{k}(a) \right|^2 | da | , \int_\Delta \left| \bar{\kappa}(\beta) \right|^2 | d\beta |$$

have a meaning; and the same may be proved in a similar manner for the integral

$$\int_D \int_\Delta | \overline{K}(a, \beta) |^2 | da | \; | d\beta | .$$

We have

$$\frac{1}{1 - \bar{k}(a) - \bar{\kappa}(\beta) - \overline{K}(a, \beta)} = \frac{1}{[1 - \bar{k}(a)][1 - \bar{\kappa}(\beta)] - \overline{R}(a, \beta)},$$

where

$$\overline{R}(a, \beta) = \bar{k}(a)\bar{\kappa}(\beta) + \overline{K}(a, \beta) = \int_0^1 \int_0^1 t^a \tau^\beta R(t, \tau)\, dt\, d\tau,$$

putting

$$R(t, \tau) = k(t) + \kappa(\tau) + K(t, \tau).$$

Hence

$$\frac{1}{1 - \bar{k}(a) - \bar{\kappa}(\beta) - \overline{K}(a, \beta)} = \frac{1}{[1 - \bar{k}(a)][1 - \bar{\kappa}(\beta)]} + \frac{\overline{R}(a, \beta)}{[1 - \bar{k}(a)]^2 [1 - \bar{\kappa}(\beta)]^2}$$
$$+ \frac{[\overline{R}(a, \beta)]^2}{[1 - \bar{k}(a)]^2 [1 - \bar{\kappa}(\beta)]^2 [1 - \bar{k}(a) - \bar{\kappa}(\beta) - \overline{K}(a, \beta)]} .$$

Now, putting

$$\bar{\psi}(a, \beta) = x^a y^\beta \int_0^a \int_0^b u^{-1-a} v^{-1-\beta} \psi(u, v)\, du\, dv,$$

we obtain, by former methods,

$$\int_\Delta \frac{\bar{\psi}(a, \beta)}{1 - \bar{\kappa}(\beta)} d\beta = x^a \int_0^a u^{-1-a} \theta(u, y)\, du,$$

$\theta(u, y)$ being a finite function. Hence

$$\int_D \int_\Delta \frac{\bar{\psi}(a, \beta)}{[1 - \bar{k}(a)][1 - \bar{\kappa}(\beta)]} da\, d\beta = \int_D \frac{x \int_0^a u^{-1-a} \theta(u, y)\, du}{1 - \bar{k}(a)} da,$$

which integral exists.

Again, since the integral

$$\int_D \int_\Delta | \overline{R}(a, \beta) |^2 | da | \; | d\beta |$$

has a meaning, there is no difficulty about the integral

$$\int_D \int_\Delta \frac{[\overline{R}(a, \beta)]^2 \bar{\psi}(a, \beta)\, da\, d\beta}{[1 - \bar{k}(a)]^2 [1 - \bar{\kappa}(\beta)]^2 [1 - \bar{k}(a) - \bar{\kappa}(\beta) - \overline{K}(a, \beta)]} .$$

Finally, the integral

$$\int_D \int_\Delta \frac{\bar{R}(\alpha, \beta)\, \bar{\psi}(\alpha, \beta)\, d\alpha\, d\beta}{[1 - \bar{k}(\alpha)]^2\, [1 - \bar{\kappa}(\beta)]^2}$$

is equal to

$$\int_0^1 \int_0^1 R(t, \tau)\, F(tx, ty)\, dt\, d\tau,$$

where we have

$$F(tx, \tau y) = \int_D \int_\Delta \frac{(tx)^\alpha (\tau y)^\beta \int_0^a \int_0^b u^{-1-\alpha} v^{-1-\beta} \psi(u, v)\, du\, dv}{[1 - k(\alpha)]^2\, [1 - \bar{\kappa}(\beta)]^2}\, d\alpha\, d\beta,$$

which is proved by the same method as before to be a finite function of tx and τy. Hence the existence of Lt $U_n(x, y)$ is established.

When the equation

$$\phi(x, y) = \psi(x, y) + \int_0^1 k(t)\, \phi(tx, y)\, dt + \int_0^1 \kappa(\tau)\, \phi(x, \tau y)\, d\tau + \int_0^1 \int_0^1 K(t, \tau)\, \phi(tx, \tau y)\, dt\, d\tau$$

is derived from the equation

$$\int_0^1 \int_0^1 G(t, \tau) f(tx, \tau y)\, dt\, d\tau = g(x, y),$$

then from the solution given for $\phi(x, y)$ we obtain by the same method as before

$$f(x, y) = -\frac{1}{4\pi^2} \frac{\delta^2}{\delta x\, \delta y} \int_D \int_\Delta \frac{x^{\alpha+1} y^{\beta+1} \int_0^a \int_0^b u^{-1-\alpha} v^{-1-\beta} g(u, v)\, du\, dv}{(\alpha + 1)(\beta + 1) \int_0^1 \int_0^1 t^\alpha \tau^\beta G(t, \tau)\, dt\, d\tau}\, d\alpha\, d\beta.$$

It is clear that to the solution for $\phi(x, y)$ we may add expressions of the form

$$x^\alpha \int_{C_1} \frac{p(\beta)\, y^\beta\, d\beta}{1 - \bar{k}(\alpha) - \bar{\kappa}(\beta) - \bar{K}(\alpha, \beta)},$$

$$y^\beta \int_{C_2} \frac{q(\alpha)\, x^\alpha\, d\alpha}{1 - \bar{k}(\alpha) - \kappa(\beta) - \bar{K}(\alpha, \beta)},$$

$$\int_{C_3} \int_{C_4} \frac{r(\alpha, \beta)\, x^\alpha y^\beta\, d\alpha\, d\beta}{1 - \bar{k}(\alpha) - \bar{\kappa}(\beta) - \bar{K}(\alpha, \beta)},$$

C_1, C_2, C_3, C_4 being any closed curves in the planes of α and β, and $p(\beta)$, $q(\alpha)$, and $r(\alpha, \beta)$ arbitrary holomorphous functions; α is arbitrary in the first expression, and β in the second. I have not been able to discover whether the addition of these expressions gives the complete solution. They are evidently solutions of the homogeneous equation

$$\phi(x, y) = \int_0^1 k(t)\, \phi(tx, y)\, dt + \int_0^1 \kappa(\tau)\, \phi(x, \tau y)\, d\tau + \int_0^1 \int_0^1 K(t, \tau)\, \phi(tx, \tau y)\, dt\, d\tau.$$

12. If in the equation

$$\int_0^1 G(t) f(tx)\, dt = g(x),$$

we set $t = e^{-\tau}$, $x = e^{-\xi}$, we get

$$\int_0^{+\infty} e^{-\tau} G(e^{-\tau}) f(e^{-(\tau+\xi)})\, d\tau = g(e^{-\xi}),$$

which may be written in the form

$$\int_0^\infty H(t) f(t + x)\, dt = h(x),$$

where $| H(t) |$ is integrable from 0 to ∞. We may also suppose that $| f(x) |$ and $| h(x) |$ are integrable from 0 to ∞; if they were not, we should merely have to multiply them by $e^{-\rho x}$ $(0 < \rho < 1)$, and to change $H(t)$ into $e^{\rho t} H(t)$.

Setting then

$$\phi(x) = \int_x^\infty f(x)\, dx,$$

we obtain, on integrating by parts,

$$H(0)\, \phi(x) + \int_0^\infty H'(t)\, \phi(t + x)\, dt = h(x),$$

which we may write, supposing $H(0) \neq 0$, as follows:—

$$\phi(x) + \int_0^\infty K(t)\, \phi(t + x)\, dt = \psi(x).$$

$K(t)$ and $\psi(x)$ are absolutely integrable from 0 to ∞, and we get as the solution for $0 < x < \infty$,

$$\phi(x) = \frac{1}{2\pi i} \int_D \frac{\int_0^x e^{\alpha(x-y)} \psi(y)\, dy}{1 + \int_0^\infty e^{\alpha t} K(t)\, dt}\, d\alpha,$$

to which may be added solutions like

$$e^{\beta x}(b_0 + b_1 x^2 + \ldots + b_s x^s),$$

where β is a root (of multiplicity $s + 1$) of the equation

$$1 + \int_0^\infty e^{\alpha t} K(t)\, dt = 0.$$

The solution of the equation

$$\int_0^\infty H(t) f(t + x)\, dt = h(x)$$

may now be found in the form

$$f(x) = \frac{1}{2\pi i} \frac{d}{dx} \int_D \frac{\int_0^x e^{\alpha(x-y)} h(y)\, dy}{\alpha \int_0^\infty e^{\alpha t} H(t)\, dt}\, d\alpha.$$

The extension to the equations

$$\int_l^\infty H(t) f(t+x)\, dt = h(x),$$

$$\int_0^\infty \int_0^\infty H(t, \tau) f(t+x, \tau+y)\, dt\, d\tau = h(x, y)$$

is obvious.*

The equations

$$\int_0^\infty H(x, t) f(t+x)\, dt = h(x),$$

$$\int_0^\infty \int_0^\infty H(x, y;\ t, \tau) f(t+x, \tau+y)\, dt\, d\tau = h(x, y),$$

etc., etc.,

may evidently be solved by successive approximation as before.

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[*] Some equations of the type just considered have been treated by Runge, *Mathematische Annalen* (1914). They occur in some modern physical problems.

VII.

A 3-DIMENSIONAL COMPLEX VARIABLE.

By S. B. KELLEHER, M.A.

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This paper aims at giving geometrical interpretation to some properties of the complex variable $x + y\theta + z\theta^2$, where $\theta^3 = 1$ but $1 + \theta + \theta^2$ is not zero. This variable has been already considered by de Morgan (Trans. Phil. Soc. Cambridge, viii (1849), p. 241), and in another form has been classified *Ib.* ($n = 3$) by Study, Nach. Gott. 1889, p. 237. The modulus employed is one which was used by de Morgan, and the results obtained show some analogy with propositions concerning the ordinary complex variable.

While the theorems concerning the differentiation and integration of 3-dimensional and n-dimensional variables are well known, it is possible that some of the geometrical results obtained have not appeared in print before.

I. If we call $P + Q + R$ the modulus of the expression $P + Q\theta + R\theta^2$ where θ is dealt with as an ordinary algebraical quantity subject only to the relation $\theta^3 = 1$, but such that $1 + \theta + \theta^2$ is not zero, it follows easily that if we take two such expressions as $P + Q\theta + R\theta^2$

(a) the modulus of the sum = the sum of the moduli,
(b) the modulus of the difference = the difference of the moduli,
(c) the modulus of the product = the product of the moduli,
(d) the modulus of the quotient = the quotient of the moduli.

II. This expression $P + Q\theta + R\theta^2$ where P, Q, R are functions of three independent variables x, y, z has a differential coefficient with respect to the variable $x + y\theta + z\theta^2$ provided

$$\left.\begin{aligned} \frac{dP}{dx} &= \frac{dQ}{dy} = \frac{dR}{dz} \\ \frac{dP}{dy} &= \frac{dQ}{dz} = \frac{dR}{dx} \\ \frac{dP}{dz} &= \frac{dQ}{dx} = \frac{dR}{dy} \end{aligned}\right\} \quad (A)$$

The sums, differences, products, and quotients of expressions which satisfy the conditions (A) are themselves expressions which satisfy the same conditions. Similar relations hold when we deal with expressions $P_1 + P_2\theta + \ldots P_n\,\theta^{n-1}$, where $\theta^n = 1$ but $1 + \theta + \theta^2 + \ldots \theta^{n-1}$ is not zero, and $P_1, P_2, \ldots P_n$ are functions of n independent variables $x_1, x_2, \ldots x_n$. The differential coefficient exists provided

$$\frac{dP_m}{dx_\mu} = \frac{dP_{m+k}}{dx_{\mu+k}}$$

for all values of m, μ, and k from one to n, n being subtracted from the suffix when the suffix exceeds n.

Likewise, if

$$(P_1 + P_2\theta + \ldots P_n\,\theta^{n-1})^{\frac{1}{p}} = P_1' + P_2'\,\theta + \ldots P_n'\,\theta^{n-1},$$

and if

$$\frac{dP_m}{dx_\mu} = \frac{dP_{m+k}}{dx_{\mu+k}}.$$

for all values of m, μ, k as above, then

$$\frac{dP'_m}{dx_\mu} = \frac{dP'_{m+k}}{dx_{\mu+k}}$$

III. It follows from II that, since

$$u \text{ or } x_1 + x_2\theta + \ldots x_n\,\theta^{n-1}$$

satisfies the conditions

$$\frac{dP_m}{dx_\mu} = \frac{dP_{m+k}}{dx_{\mu+k}},$$

any expression which can be formed with powers of u, positive or negative, integral or fractional, will be such that when written in the form

$$P_1 + P_2\,\theta + \ldots P_n\,\theta^{n-1},$$

the relations

$$\frac{dP_m}{dx_\mu} = \frac{dP_{m+k}}{dx_{\mu+k}}$$

will be satisfied.

Hence, when we consider the 3-dimensional variable, it follows that, when $f(x + y\theta + z\theta^2)$ is written in the form $P + Q\theta + R\theta^2$, and x, y, z are the distances of a point from three rectangular planes, the normals to the three surfaces P = const., Q = const., R = const., which pass through a point, make equal angles with one another and with the line $x = y = z$. For the cosine of the angle between the normals to P = const. and Q = const. is

$$\frac{\frac{dP}{dx}\frac{dQ}{dx} + \frac{dP}{dy}\frac{dQ}{dy} + \frac{dP}{dz}\frac{dQ}{dz}}{\sqrt{\left\{\left(\frac{dP}{dx}\right)^2 + \left(\frac{dP}{dy}\right)^2 + \left(\frac{dP}{dz}\right)^2\right\}\left\{\left(\frac{dQ}{dx}\right)^2 + \left(\frac{dQ}{dy}\right)^2 + \left(\frac{dQ}{dz}\right)^2\right\}}}$$

which by the conditions (A) is equal to the cosine of the angle between the normals to Q = const. and R = const., and to the cosine of the angle between the normals to R = const. and P = const.

Moreover, the cosine of the angle between the normal to P = const. and the line $x = y = z$ is

$$\frac{\sqrt{3}}{3}\,\frac{\dfrac{dP}{dx}+\dfrac{dP}{dy}+\dfrac{dP}{dz}}{\sqrt{\left(\dfrac{dP}{dx}\right)^2+\left(\dfrac{dP}{dy}\right)^2+\left(\dfrac{dP}{dz}\right)^2}},$$

which is equal to the similar expressions formed with the partial differentials of Q and R; hence, the three normals make the same angles with the line $x = y = z$.

Similar results hold when the axes are oblique, provided they make equal angles with one another.

IV. If we write

$$\int f(u)\,du \equiv \int (P_1 + P_2\theta + \ldots P_n\theta^{n-1})(dx_1 + \theta\,dx_2 + \ldots \theta^{n-1}dx_n),$$

$$= \int \{P_1dx_1 + P_2dx_n + \ldots P_ndx_2 + \theta(\quad) + \ldots \theta^{n-1}(P_1dx_n + \ldots P_ndx_1)\},$$

we see at once that the conditions

$$\frac{dP_m}{dx_\mu} = \frac{dP_{m+k}}{dx_{\mu+k}}$$

are the conditions that the term independent of θ under the integral sign, and the coefficients of the several powers of θ shall be perfect differentials.

It follows at once that in general the integral has a sense, provided that nowhere in the path of integration do the "P"s become infinite.

If the function to be integrated were of the form $\dfrac{\phi(u)}{u-u'}$, where $\phi(u)$ is finite for all finite values of u, and if we write

$$\frac{\phi(u)}{u-u'} \equiv \lambda_1 + \lambda_2\theta + \ldots \lambda_n\theta^{n-1}$$

we shall find on solving for the "λ"s from the equations arising from

$$\phi(u) \equiv P_1 + P_2\theta + \ldots P_n\theta^{n-1} = (\lambda_1 + \lambda_2\theta + \ldots \lambda_n\theta^{n-1})(x_1 - x_1' + \theta(x_2 - x_2') \\ + \ldots \theta^{n-1}(x_n - x_n'))$$

that all the "λ"s are fractions which have the denominator

$$\begin{vmatrix} x_1 - x_1', & x_2 - x_2', & x_n - x_n' \\ x_2 - x_2', & x_3 - x_3', & x_1 - x_1' \\ & & \\ x_n - x_n', & x_1 - x_1', & x_{n-1} - x_{n-1}' \end{vmatrix}$$

a circulant whose only real factor is $\Sigma(x_p - x_p')$ when n is odd and which has the additional real factor $\Sigma\,(-1)^p(x_p - x_p')$ when n is even.

Similarly, if the function to be integrated were

$$\frac{\phi\,(u)}{(u - u')\,(u - u'')\,\ldots\,(u - u^{(q)})}$$

the path of integration must in general avoid the parallel planes

$$\Sigma\,(x_1 - x_1') = 0, \quad \Sigma\,(x_1 - x_1'') = 0\ \ldots\ \Sigma\,(x_1 - x_1^{(q)}) = 0,$$

when n is odd, and in addition the planes

$$\Sigma\,(-1)^p(x_p - x_p') = 0, \quad \Sigma\,(-1)^p(x_p - x_p'') = 0\ \ldots\ \Sigma\,(-1)^p\,(x_p - x_p^{(q)}) = 0$$

when n is even.

In the case of three or any odd number of dimensions we may express the result by saying that the path of integration must pass through no point whose modulus is equal to that of any one of the points $u', u'', \ldots u^{(q)}$.

V. If we consider the case of three dimensions, and use rectangular coordinates, we see that the point θu is the point derived from u by rotating the vector from the origin to the point u through 120° about the line $x = y = z$. For multiplication by θ of $x + y\theta + z\theta^2$ gives us $z + x\theta + y\theta^2$; and if we call the points u and θu A and B respectively the projection of each on the line $x = y = z$ is the point

$$L = \frac{x + y + z}{3}\,(1 + \theta + \theta^2).$$

Hence from the equation

$$AB^2 = LA^2 + LB^2 - 2LA\,.\,LB\cos ALB$$

we find
$$\cos ALB = -\tfrac{1}{2},$$
$$\therefore\quad ALB = 120^\circ.$$

When we consider the case of n dimensions and regard $x_1, x_2, \ldots x_n$ as the perpendicular distances from the point $u = x_1 + x_2\theta + \ldots x_n\theta^{n-1}$ to n planes whose intersections are generators of a right circular cone, and such that each makes equal angles with the two adjacent to it, multiplication by θ is equivalent to rotation through $\frac{2\pi}{n}$ about the axis of the cone.

VI. If we write $\frac{1}{u - u'}$, in the form

$$-\frac{1}{u'}\left\{1 + \frac{u}{u'} + \ldots \frac{u^n}{u'^n} + \ldots\right\}$$

where u is the 3-dimensional variable, we may show that the infinite series is convergent in certain circumstances. For if we write

$$\frac{u}{u'} = \frac{x + y\theta + z\theta^2}{x' + y'\theta + z'\theta^2} = p + q\theta + r\theta^2,$$

it follows from par. I that if $\frac{u^n}{u'^n}$ is written in the form $P_n + Q_n\theta + R_n\theta^2$ the modulus of $P_n + Q\theta_n + R_n\theta^2$ is equal to $(p + q + r)^n$. Hence, when p, q, r are all positive and their sum less than unity, P_n, Q_n, R_n are all positive, and each is less than $(p + q + r)^n$, and therefore the infinite series $\Sigma\frac{u^n}{u'^n}$ or $\Sigma P_n + \theta\Sigma Q_n + \theta^2\Sigma R_n$ is less than $(1 + \theta + \theta^2)\,\Sigma(p + q + r)^n$ and is convergent.

But since $u = u'(p + q\theta + r\theta^2)$, it follows from par. V that if we consider the tetrahedron whose vertices are the points u', $\theta u'$, $\theta^2 u'$, and the origin, then if p, q, r are all positive, and their sum less than unity, the point u is a point inside the tetrahedron. Moreover, since any point inside the tetrahedron may be written $pu + q\theta u + r\theta^2 u$ where p, q, r are all positive, and their sum less than unity, it follows that the infinite series $\Sigma\frac{u^n}{u'^n}$ is convergent when the point u lies inside the tetrahedron.

It follows at once that the series will be convergent when the point lies inside the tetrahedron formed by the points $-u'$, $-\theta u'$, $-\theta^2 u'$, and the origin.

VII. If we write $\frac{1}{u - u'}$, in the form

$$\frac{1}{u}\left\{1 + \frac{u'}{u} + \ldots \frac{u'^n}{u^n} + \ldots\right\},$$

and write $\frac{u'}{u} = p' + q'\theta + r'\theta^2$ it follows, as in par. VI, that the infinite series is convergent when p', q', r' are all positive and their sum is less than unity, and in that case the point u' lies inside the tetrahedron whose vertices are the points u, θu, $\theta^2 u$ and the origin. Hence, if we denote by A, B, C the points u, θu, and $\theta^2 u$ respectively, and by O the origin, and if we rotate the line OA about the line $x = y = z$ through 120° so that u becomes θu, and then again through 120° so that θu becomes $\theta^2 u$, the point u' will lie inside the tetrahedron $OABC$. It follows that if we describe the right cone whose vertex is the origin and axis the line $x = y = z$, and the tangent of whose semivertical angle is twice the tangent of the angle made by the line joining u' to the origin with the line $x = y = z$, then the infinite series is convergent when the point u lies outside this cone and, since $\text{mod. } u = \dfrac{\text{mod. } u'}{p + q + r}$ and $p + q + r$ is less than unity, outside the space containing the origin and bounded by the planes $\text{mod. } u - \text{mod. } u' = 0$, and $\text{mod. } u + \text{mod. } u' = 0$.

It does not follow, however, that the series in par. VI, and that which has just been considered, are not convergent in other cases.

PROCEEDINGS

OF THE

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VOLUME XXXII

SECTION B.—BIOLOGICAL, GEOLOGICAL, AND CHEMICAL SCIENCE.

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PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY

PAPERS READ BEFORE THE ACADEMY

I.

ON UNSATURATED β-DIKETONES.—I.

By Prof. HUGH RYAN, D.Sc., and Rev. J. M. DUNLEA, B.Sc.

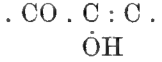
Read June 23. Published August 5, 1913.

It is a remarkable fact that, although most of the naturally occurring dyes are free from nitrogen and owe their tinctorial properties to unsaturated ketonic groups, yet, for many years, chemists in their synthetic work have confined themselves almost exclusively to the field of nitrogenous derivatives.

This neglect of the chemistry of natural bodies seems hardly justifiable, especially in view of its undoubted theoretical interest.

We have therefore undertaken a study of the unsaturated polyketones, with the object in the first place of synthesizing some of them, and in the next of determining the influence of different radicles upon their chromatic properties. In the present paper we are concerned mainly with diketones.

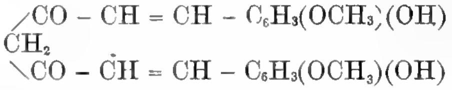
It has been shown by von Kostanecki and his co-workers that many of the yellow plant-dyes are derivatives of flavone or flavonol. For instance, from flavone we have the yellow chrysin, and from flavonol we have, similarly, quercetin. These, like many other plant-dyes, may be regarded as unsaturated ketones; flavonol, for instance, containing the grouping



$$.\,\mathrm{CO}\,.\,\underset{\dot{\mathrm{O}}\mathrm{H}}{\mathrm{C}} : \dot{\mathrm{C}}\,.$$

to which in conjunction with the ortho-hydroxyls it owes its tinctorial character.

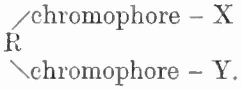
Alizarin, the best-known of the natural red colouring matters, contains two complex chromophores $- C = \underset{|}{C} - CO - \underset{|}{C} = C -$ together with ortho-hydroxyls, whilst the active principle of turmeric (curcumin), whose colour is intermediate between that of the red alizarin and the yellow flavone derivatives, has had the formula



$$\begin{array}{l} \diagup CO - CH = CH - C_6H_3(OCH_3)(OH) \\ CH_2 \\ \diagdown CO - CH = CH - C_6H_3(OCH_3)(OH) \end{array}$$

assigned to it by von Kostanecki.[1]

According to Werner[2] the position of the methylene group between two carbonyl groups will enable this substance to act as a mordant dye. Curcumin is also a substantive dye, and this latter property receives a plausible explanation from the structural analogy of the above formula with that of other well-known substantive dyes



$$\begin{array}{l} \diagup \text{chromophore} - X \\ R \\ \diagdown \text{chromophore} - Y. \end{array}$$

This formula also receives support from the facts that curcumin reacts with hydroxylamine hydrochloride to form an isoxazol, and on distillation with aqueous potash yields ferulic acid.

If this formula be correct, curcumin is a derivative of a typical unsaturated diketone

$$C_6H_5CH = CH - CO - CH_2 - CO - CH = CH \,.\, C_6H_5$$

di-cinnamylmethane which up to the present has not been prepared. Indeed, so far as we are aware, with the single exception of some derivatives of mesityloxide, such as mesityloxide-oxalic ester, obtained by Claisen,[3] no hormatic unsaturated diketones have hitherto been synthesized.

We have attempted the synthesis of compounds of this type by two different methods :—

1. The condensation in presence of metallic sodium or sodamide of the ester of an unsaturated acid, cinnamic, with a saturated ketone, and *vice versa*.

2. The condensation of an alkyl diketone with an aldehyde in presence of a dehydrating agent.

In the present paper we deal only with the first of these methods, and we may remark at the outset that, of the two condensing agents mentioned above, we found metallic sodium in the form of wire much more convenient to work with, and not inferior in yield to sodamide.

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[1] Ber. 43 (1910), p. 2163.

[2] Ber. 41 (1908), p. 1067.

[3] Annalen, 291, p. 122.

According to this method we found that although cinnamic ester condensed with acetone and acetophenone to form respectively cinnamyl-acetyl-methane, and cinnamyl-benzoyl-methane

$$C_6H_5CH : CH . COOC_2H_5 + CH_3 . CO . CH_3 = C_6H_5CH : CH . CO . CH_2 . CO . CH_3 + C_2H_5OH .$$

$$C_6H_5CH : CH . COOC_2H_5 + CH_3 . CO . C_6H_5 = C_6H_5CH : CH . CO . CH_2 . CO . C_6H_5 + C_2H_5OH,$$

yet we were unable to obtain the same compounds from benzylidene-acetone, with acetic or benzoic ester, e.g.

$$C_6H_5 . COOC_2H_5 + CH_3 . CO . CH : CH . C_6H_5 = C_6H_5CO . CH_2CO . CH : CH . C_6H_5 + C_2H_5OH$$

The condensation of the unsaturated ester with the saturated ketone proceeds normally, but the condensation of a saturated ester with an unsaturated ketone—an apparently analogous reaction—proceeds in quite a different and at present undetermined direction. Similarly the attempt to prepare the parent substance of curcumin, mentioned above, by the condensation of cinnamic ester with benzylidene-acetone led to the formation of no new crystalline product.

The two unsaturated diketones showed the usual reactions of such bodies, e.g., their alcoholic solutions were coloured by ferric chloride, and they were precipitated by carbon dioxide from their solutions in dilute alkali. They colour wool mordanted with iron alum a strong red, with dichromate a dark yellow, and with aluminium sulphate a faint yellow. Like the chalkones, they dissolve in concentrated sulphuric acid to orange-coloured solutions, and, like curcumin, they react with hydroxylamine hydrochloride to form isoxazols.

The question of condensation in the case of mixed alkyl ketones was also investigated. As examples we took methyl-ethyl-ketone and methyl-isopropyl-ketone. Both yield, with cinnamic ester, colourless crystalline products, closely resembling each other in their behaviour. In both cases alternate formulae are possible. Thus the diketone from cinnamic ester and ethyl-methyl-ketone may be either

$$C_6H_5CH : CH . CO . CH (CH_3) . CO . CH_3 \qquad \text{I.}$$

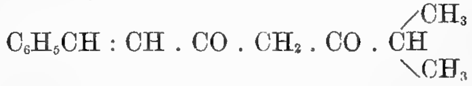
Or,

$$C_6H_5CH : CH . CO . CH_2 . CO . CH_2 . CH_3 \qquad \text{II.}$$

whilst that from cinnamic ester with methyl-isopropyl-ketone may be either

$$C_6H_5CH : CH . CO . C(CH_3)_2 . CO . CH_3 \qquad \text{I.}$$

Or,



$$C_6H_5CH : CH . CO . CH_2 . CO . CH\begin{matrix} \diagup CH_3 \\ \diagdown CH_3 \end{matrix} \qquad \text{II.}$$

The fact that both products were soluble in potash pointed to formulae II as correct; but, contrary to what one would expect from readily enolisable substances of such formulae, neither yielded in alcoholic solution a colouration with ferric chloride, nor did they colour concentrated sulphuric acid.

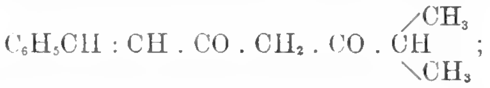
To decide the matter we methylated cinnamyl-acetyl-methane. In this way a substance was obtained having beyond all doubt the composition

$$C_6H_5CH : CH \,.\, CO \,.\, CH(CH_3) \,.\, CO \,.\, CH_3.$$

It differed materially from the compound obtained from methyl-ethyl-ketone. For instance, its melting-point was nearly 80° C. lower, it yielded a dark-green colouration with ferric chloride, it crystallized in long delicate needles of a light-yellow colour, whereas the methyl-ethyl-ketone compound crystallized in short, colourless prisms. Hence the only possible formula for the latter compound is

$$C_6H_5CH : CH \,.\, CO \,.\, CH_2 \,.\, CO \,.\, CH_2 \,.\, CH_3,$$

and from its close resemblance to the methyl-isopropyl derivative we may infer that the latter has the constitution



$$C_6H_5CH : CH \,.\, CO \,.\, CH_2 \,.\, CO \,.\, CH\begin{matrix}\diagup CH_3\\ \diagdown CH_3\end{matrix};$$

in other words, that in both cases condensation took place on the methyl-group.

The diketones obtained from ethyl-methyl-ketone and methyl-isopropyl-ketone vary in several points from those obtained from acetone and acetophenone: for instance, in their greatly diminished solubility in ether, in their almost complete insolubility in petroleum ether, in not being precipitated by carbon dioxide from their alkaline solutions, whilst their colouring power for wool mordanted with iron is hardly perceptible.

EXPERIMENTAL PART.

Cinnamyl-acetyl-methane, $C_6H_5 \,.\, CH : CH \,.\, CO \,.\, CH_2 \,.\, CO \,.\, CH_3$.

42 grms. of methyl cinnamate were dissolved in 17 c.c. of acetone, and 7·5 grms. of sodium wire were slowly added during the course of some hours, care being taken not to let the temperature of the mixture rise much above that of the laboratory. The mixture was kept continually shaken, and when it began to get too thick, absolute ether or petroleum ether was added, and the mixture vigorously stirred. It was then allowed to stand overnight. On the following morning more ether or petroleum ether was added

in sufficient quantity to form a layer over the water which was then added in order to dissolve the sodium salt of the diketone. By this means any sodium remaining unacted upon was prevented from reacting too vigorously with the water. When the sodium salt had fully dissolved, the aqueous solution was separated, washed a few times with ether, and a current of air was passed through it to remove the last traces of the ether. It was then cooled in ice and treated with carbon dioxide till complete precipitation of the diketone in the crystalline condition was effected.

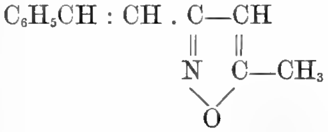
The latter was filtered off and recrystallized from dilute alcohol or from petroleum ether. The yield of pure substance was about 6 grms. M.P. 83–84° C.

0·2327 substance gave 0·6516 CO_2 and 0·1335 H_2O,

corresponding to	C 76·4	H 6·4.
$C_{12}H_{12}O_2$ requires	C 76·6	H 6·4.

Cinnamyl-acetyl-methane crystallizes in elongated needles of a faint yellow colour. It is readily soluble in alcohol, acetone, ether, or chloroform, less so in petroleum ether. It is insoluble in water, but soluble in aqueous potash, from which it is reprecipitated on acidification. Its alcoholic solution is coloured red by ferric chloride. In concentrated sulphuric acid the crystals dissolve to a yellow solution. It dyes wool mordanted with iron a bright red, with chromium a dark yellow, and with aluminium a light yellow colour.

Cinnamenyl-methyl-isoxazol



$$C_6H_5CH : CH . \begin{array}{l} C—CH \\ \| \quad\ \ \| \\ N \quad C—CH_3 \\ \ \diagdown \diagup \\ \ \ O \end{array}$$

A solution of 2 grms. of cinnamyl-acetyl-methane and 2 grms. of hydroxylamine hydrochloride in absolute alcohol was heated for several hours under a reflux condenser. The alcohol was then distilled off; the residue was mixed with water and extracted with ether. The ethereal solution was washed with dilute potash till the latter was colourless, then evaporated, and the isoxazol re-crystallized from dilute alcohol or from petroleum ether. The yield of pure substance was about 1 grm. M.P. 88° C.

0·1873 substance gave 0·5352 CO_2, and 0·1046 H_2O; 0·1639 gr. substance gave 10·6 c.c. of nitrogen at 14° C. and 767° mm.p.,

corresponding to	C 77·8,	H 6·2,	N 7·6.
$C_{12}H_{11}NO$ (isoxazol) requires	C 77·8,	H 5·9,	N 7·6.
$C_{12}H_{13}NO_2$ (monoxime) requires	C 70·9,	H 6·4,	N 6·8.
$C_{12}H_{14}N_2O_2$ (dioxime) requires	C 66·0,	H 6·4,	N 12·8.

Cinnamenyl-acetyl-isoxazol is insoluble in water and potash, readily soluble in alcohol or ether, and somewhat less so in petroleum ether. It crystallizes from alcohol in pearly plates, and from petroleum ether in colourless needles.

Cinnamyl-benzoyl-methane $C_6H_5CH : CH . CO . CH_2 . CO . C_6H_5$.

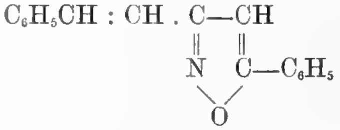
81·6 grms. of acetophenone were mixed with 105·6 grms. of ethyl cinnamate, and some ligroin was added as a solvent. During the course of several hours 48·6 grms. of sodamide, finely powdered under ligroin (or an equivalent quantity of metallic sodium), were added. The treatment adopted was similar to that employed in the case of cinnamyl-acetyl-methane described above, and a yield of about 10 grms. of a light yellow crystalline substance was obtained. It was recrystallized from methyl alcohol M.P. 109° C.

0·1712 substance gave 0·5126 CO_2, and 0·0896 H_2O,

corresponding to	C 81·6,	H 5·8.
$C_{17}H_{14}O_2$ requires	C 81·6,	H 5·6.

Cinnamyl-benzoyl-methane crystallizes in long needles, very soluble in ether, chloroform, or alcohol; less so in methyl alcohol or ligroin. Its alcoholic solution is coloured a greenish brown by ferric chloride. The crystals are coloured red by concentrated sulphuric acid, and gradually dissolve in it to a yellow solution. It colours wool mordanted with iron a reddish brown, and with chromium a dark yellow.

Cinnamenyl-phenyl-isoxazol



$$C_6H_5CH : CH . \overset{}{C}\text{—}CH \quad (N = C,\ C = C\text{—}C_6H_5,\ N\text{—}O\text{—}C)$$

A solution of 2·3 grms. of cinnamyl-benzoyl-methane and 3 grms. of hydroxylamine hydrochloride in absolute alcohol was heated under a reflux condenser for about 6 hours. When the alcohol had been distilled off and the ethereal extract washed with water and dilute potash, about 2 grms. of a solid were obtained, which, when recrystallized from alcohol, melted at 137–138° C.

0·2044 substance gave 0·6164 CO_2, and 0·1019 H_2O; 0·1845 substance gave 9·2 c.c. N at 15° C. and 750° mm.p.,

corresponding to	C 82·3,	H 5·5,	N 5·7.
$C_{17}H_{13}NO$ (isoxazol) requires	C 82·6,	H 5·3,	N 5·6.
$C_{17}H_{15}NO_2$ (monoxime) requires	C 77·0,	H 5·7,	N 5·2.
$C_{17}H_{16}N_2O_2$ (dioxime) requires	C 72·8,	H 5·7,	N 10·5.

Cinnamenyl-phenyl-isoxazol crystallizes in small, colourless needles insoluble in potash, sparingly soluble in ligroin, and readily soluble in alcohol, ether, or chloroform. Its alcoholic solution gives no colouration with ferric chloride.

Cinnamyl-propionyl-methane $C_6H_5CH : CH . CO . CH_2 . CO . CH_2CH_3$.

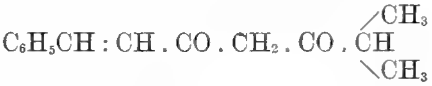
59 grms. of methyl cinnamate were dissolved in 27 grms. of ethyl-methyl-ketone, and 8·8 grms. of sodium wire were added under the same conditions as in the previous condensations.

When the aqueous extract was treated with carbon dioxide, only a small amount of oily matter separated (which in alcoholic solution gave a dark-brown colouration with ferric chloride, and may be the enol form of the above diketone). Subsequent acidification with acetic or hydrochloric acid precipitated a crystalline mass, which was filtered on the pump, washed with water, and recrystallized from dilute alcohol. The crystals, when heated, begin to give off a vapour at 130° C. The residue softens at 154° C., and melts to a yellow liquid about 161–163° C.

0·2310 substance gave 0·6551 CO_2, and 0·1482 H_2O,
corresponding to C 77·3, H 7·1.
$C_{13}H_{14}O_2$ requires C 77·2, H 6·9.

Cinnamyl-propionyl-methane crystallizes in small prisms, easily soluble in alcohol, much less so in ether or chloroform, almost insoluble in ligroin. Its alcoholic solution yields no colouration with ferric chloride. The diketone is soluble in potash, and can be reprecipitated by addition of acids. The crystals yield no colouration with concentrated sulphuric, but dissolve in it to a colourless solution.

Cinnamyl-isobutyryl-methane,



$$C_6H_5CH : CH . CO . CH_2 . CO . CH\left\langle\begin{array}{l}CH_3\\ CH_3\end{array}\right.$$

28 grammes of cinnamic methylester were dissolved in 15 grammes of methyl-isopropyl-ketone and 5 grammes of metallic sodium added under conditions similar to those described in the foregoing condensations. From the alkaline extract carbon dioxide precipitated only a small quantity of oily matter whose alcoholic solution gave a red colour with ferric chloride. When the oil had been removed by ether, acidification of the aqueous residue yielded a precipitate which was filtered off and recrystallized from alcohol. When heated the crystals emit a vapour at 145°; the residue softens at 165 and melts to a yellow liquid at 173–175° C.

0·3020 substance gave 0·8595 CO_2 and 0·2030 H_2O,
corresponding to C 77·6 H 7·4
$C_{14}H_{16}O_2$ requires C 77·7 H 7·5

Cinnamyl-isobutyryl-methane crystallizes in thin plates showing straight extinction, and therefore probably rhombic crystals, the angles between the pyramid faces being ±93°, and between the pyramid faces and prism ±137°. The crystals are very soluble in alcohol, less so in ether, and almost insoluble in ligroin. Its alcoholic solution yields no colouration with ferric chloride, nor are the crystals coloured by concentrated sulphuric acid, though they dissolve in it to a colourless solution.

Methyl-cinnamyl-acetyl-methane, $C_6H_5CH : CH . CO . CH(CH_3) . CO . CH_3$.

One gramme of sodium was dissolved in ethyl alcohol, and in this solution 9 grammes of cinnamyl-acetyl-methane were dissolved. An excess of methyl iodide was then added, and the mixture was boiled until the alkaline reaction had completely disappeared. The alcohol was removed and the residue treated with water and ether. The ethereal solution was washed with a little dilute potash, and then with a little dilute acid. When the ether had been distilled, the residue was recrystallized from alcohol or from petroleum ether, the yield being about 5 grammes. M. P. 88–89°C.

0·1786 substance gave 0·5060 CO_2 and 0·1129 H_2O,
corresponding to C 77·2 H 6·9.
$C_{13}H_{14}O_2$ requires C 77·2 H 7·0.

Methyl-cinnamyl acetyl-methane crystallizes in long needles of a light yellow colour. It is soluble in dilute potash as well as in the usual organic solvents. Its alcoholic solution yields a dark brown colouration with ferric chloride. In concentrated sulphuric acid the crystals turn red, and dissolve rapidly to a yellow solution. It colours wool mordanted with iron a weak brown.

II.

ON UNSATURATED β-DIKETONES.—II.

By HUGH RYAN, D.Sc., and JOSEPH ALGAR, M.Sc.

Read June 23. Published August 5, 1913.

The natural dye curcumin is supposed[1] to be an unsaturated β-diketone; and as compounds of this class are almost unknown, attempts were made by one of us, in conjunction with Rev. J. Dunlea, to prepare substances of the types:—

$$X.CH:CH.CO.CH_2.CO.Y \quad \text{and} \quad X.CH:CH.CO.CH_2.CO.CH:CH.X.$$

It was found[2] that the ester of an unsaturated acid condenses with a saturated ketone, in the presence of sodamide or metallic sodium, to give an unsaturated β-diketone. Thus, cinnamyl-benzoyl-methane was formed by the interaction of acetophenone and cinnamic ester:—

$$C_6H_5CH:CH.COOC_2H_5 + CH_3.CO.C_6H_5 = C_6H_5CH:CH.COCH_2.COC_6H_5 + C_2H_5OH.$$

An attempt to synthesize the symmetrical unsaturated diketone,

$$C_6H_5CH:CH.CO.CH_2.CO.CH:CH.C_6H_5,$$

by the action of sodium on a mixture of cinnamic ester and benzylidene-acetone:—

$$C_6H_5CH:CH.COOC_2H_5 + CH_3COCH:CH.C_6H_5$$
$$= C_6H_5CH:CH.CO.CH_2.COCH:CH.C_6H_5 + C_2H_5OH$$

was unsuccessful; and, indeed, we have not succeeded under any conditions in condensing an unsaturated ester with an unsaturated ketone to a crystallizable β-diketone. While a reaction undoubtedly occurred, we were unable to separate any crystalline compound, other than cinnamic acid, from the product, and consequently could not follow its course.

The abnormal behaviour of the substances cannot be due to the unsaturated nature of the ester, since Ryan and Dunlea (*loc. cit.*) have shown that an

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[1] Milobedzka, von Kostanecki and Lampe, Ber, xliii (1910), p. 2163.

[2] Ryan and Dunlea, Proc. Roy. Irish Acad., xxxii, Sect. B, p. 1.

unsaturated ester condenses normally with a saturated ketone. As benzoic ester does not condense, under the usual conditions required for similar reactions, with benzylidene-acetone to give the cinnamyl-benzoyl-methane of Ryan and Dunlea:—

$$C_6H_5CH : CH . COCH_3 + C_2H_5OOC . C_6H_5 = C_6H_5CH : CH . CO . CH_2 . CO . C_6H_5 + C_2H_5OH,$$

it is apparent that the main factor of the abnormality is the unsaturated nature of the mono-ketone.

We are at present unable to offer any explanation of the failure of the reaction to take the expected direction, and all the more since, as we shall see in the experimental part of this communication, unsaturated ketones, such as benzylidene-acetone and anisylidene-acetone, condense readily with oxalic ester to give good yields of the corresponding β-diketones:—

$$C_6H_5CH : CH . CO . CH_3 + CH_3OOC . COOCH_3 = C_6H_5CH : CH . CO . CH_2 . CO . COOCH_3 + CH_3OH.$$

When we had succeeded in condensing oxalic ester with an unsaturated ketone, we again tried, under various conditions, to condense benzoic ester with benzylidene-acetone, and failed to obtain cinnamyl-benzoyl-methane.

The unsaturated diketones derived from dimethyl oxalate, benzylidene acetone, and anisylidene-acetone respectively, give the reactions characteristic of the saturated β-diketones. For instance, hydroxylamine hydrochloride converts them into isoxazoles. Like the orthohydroxy ketones, their sodium derivatives are only sparingly soluble in alcohol, and their tinctorial properties are more pronounced than those of the corresponding diketones described in the previous communication.

Experimental Part.

Methyl-cinnamyl-pyruvate, $C_6H_5 . CH : CH . CO . CH_2 . CO . COOCH_3$.

15 grms. of benzylidene-acetone were mixed with 30 grms. of dimethyl oxalate, and heated in a dry, round flask until the mixture had melted: 2·5 grms. (slight excess) of fine sodium wire were then added, when an energetic reaction set in with separation of a deep red solid. During the first preparation a much larger excess of sodium was used; but it was found that this tended to hydrolyse the required ester: consequently in later preparations only a slight excess of sodium was employed. When the reaction had subsided, about 50 c.cs. anhydrous ether was added, and the stoppered flask was set aside for a few hours at the ordinary temperature. The excess

of sodium was removed by addition of moist ether; and the greater part of the dark red solid was dissolved in water. The ether solution was separated; and the alkaline residue was mixed with chloroform, and strongly acidified with hydrochloric acid. The chloroform solution was separated, and on evaporation left a residue which crystallized from diluted alcohol in light yellow needles, melting at 70° C.

An alcoholic solution of the substance gave a dark red colour with ferric chloride.

The yield was 15 grms.

0·2068 grm. substance gave 0·5103 grm. CO_2, and 0·0964 grm. H_2O, corresponding to C 67·29, H 5·2.

$C_{13}H_{12}O_4$ requires C 67·2, H 5·2.

Methyl-cinnamyl-pyruvate crystallizes in light yellow acicular prisms which are readily soluble in chloroform, ether, or benzene; insoluble in water or ligroin. Its alcoholic solution is yellow in colour and has a greenish fluorescence. A solution of it in aqueous potash has a yellow colour. Concentrated sulphuric acid dissolves the crystals, forming an orange-coloured solution.

When mordanted wool is boiled in a solution of the substance in dilute alcohol, the wool is dyed, the colour varying according to the mordant used. The following colours were obtained:—

Mordant.	*Colour of wool.*
Aluminium Sulphate.	Orange-yellow.
Potassium Dichromate.	Russet-brown.
Ferric Sulphate.	Reddish-brown.

Cinnamyl-pyruvic acid, $C_6H_5 . CH : CH . CO . CH_2 . CO . COOH$.

This compound was obtained in small quantity as a by-product in the preparation of the corresponding ester. It was also prepared in the following manner:—

1·16 grms. of methyl cinnamyl-pyruvate was dissolved in 20 c.cs. seminormal potash, and let stand at the ordinary temperature for 24 hours. The orange-coloured solution was shaken with ether; and the aqueous layer was acidified. The solid which separated was extracted with ether; and the ether solution was well shaken with dilute sodium carbonate several times. On acidifying the sodium carbonate solution a yellow precipitate was obtained, which was extracted with ether and recrystallized from dilute alcohol. It melted at 139°–140° C.

0·2158 grm. substance gave 0·5220 grm. CO_2 and 0·0948 grm. H_2O, corresponding to C 66·0, H 4·9.

$C_{12}H_{10}O_4$ requires C 66·0, H 4·6.

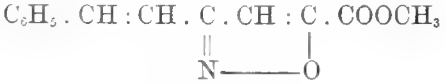
Cinnamyl-pyruvic acid crystallizes in light-yellow-coloured needles (somewhat darker in colour than the ester), which are slightly soluble in boiling water, insoluble in cold water and petroleum ether, and very readily soluble in ether, chloroform, acetone, or alcohol. It dissolves in cold dilute alkali or alkaline carbonate, and is acid in reaction towards phenol-phthalein. Concentrated sulphuric acid colours the crystals red, and forms with them an orange-coloured solution. An alcoholic solution of the acid gives a brownish-red colour with ferric chloride. The substance is odourless; but when its alkaline solution is warmed for a few minutes, the solution becomes turbid, and has a strong odour of benzylidene-acetone.

The following colours are given to mordanted wool when boiled in a dilute alcoholic solution of the substance:—

Mordant.	*Colour of wool.*
Aluminium Sulphate, ...	Orange-yellow.
Ferric Sulphate, ...	Deep reddish-brown.

[At the conclusion of the experimental part of this communication we have found that the ethyl ester of this acid was obtained by R. Schiff and L. Gigli [Ber. 31 (1898), p. 1308] by the action of an alcoholic solution of sodium ethylate on a mixture of diethyl oxalate and benzylidene-acetone.]

Methyl-γ-cinnamenyl-isoxazole-α-carboxylate.



$$\begin{array}{lclcl} C_6H_5 . CH : CH . & C & . CH : & C & . COOCH_3 \\ & \| & & | & \\ & N & \text{———} & O & \end{array}$$

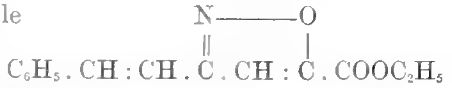
A solution of 1·5 grms. of methyl cinnamyl-pyruvate and 3 grms. of hydroxylamine hydrochloride in 50 c.cs. absolute alcohol was heated under a reflux condenser for about five hours. Boiling distilled water was added to the light-yellow-coloured solution until a slight permanent turbidity formed; the solution was then filtered and cooled. The colourless, crystalline solid which separated was re-crystallized from dilute alcohol. It melted at 111° C.

0·2017 grm. substance gave 0·5114 grm. CO_2, and 0·0998 grm. H_2O, corresponding to C 69·14 and H 5·49.

$C_{13}H_{11}NO_3$ requires C 68·1, H 4·84.

It was therefore evident that the compound formed in this preparation was not the above isoxazole.

Now, the isoxazole

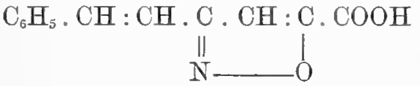


$$\begin{array}{lclcl} & N & \text{———} & O & \\ & \| & & | & \\ C_6H_5 . CH : CH . & C & . CH : & C & . COOC_2H_5 \end{array}$$

requires C 69·14, H 5·4, which agrees very well with the above analysis. The substance melting at 111° C. is therefore ethyl-γ-cinnamenyl-isoxazole-α-carboxylate, and is probably formed in the following manner:—Excess of hydroxylamine hydrochloride, when boiled with the methyl ester in an *ethyl alcohol* solution, is converted into the isoxazole of the acid, which is simultaneously esterified to the ethyl ester.

The compound which melts at 111° C. was boiled with potash until it had all dissolved; and the solution was acidified with hydrochloric acid. The white solid which was precipitated was filtered and re-crystallized from dilute alcohol. This compound melted at 190°–192° C., and on analysis gave the following results:—

0·1454 grm. of substance gave 0·3583 grm. CO_2 and 0·0601 grm. H_2O, corresponding to C 67·2, H 4·59. Also, 0·1745 grm. substance gave 10·1 c.c. N at 4·5° C. and 756 mm. pressure, corresponding to N 7·00.



$$\underbrace{C_6H_5 . CH : CH . \underset{\substack{\| \\ N}}{C} . CH : \underset{\substack{| \\ O}}{C}}_{N\text{———}O} . COOH$$

requires C 67·0, H 4·2, and N 6·51.

Methyl-γ-cinnamenyl-isoxazole-α-carboxylate was obtained in a later preparation when methyl alcohol was used as a solvent instead of ethyl alcohol. This compound crystallizes from dilute alcohol in long colourless needles, which melt at 142°–143° C.

0·1959 grm. of the substance gave 0·0878 grm. H_2O, and 0·4881 grm. CO_2, corresponding to C 67·95, H 4·97.

$C_{13}H_{11}NO_3$ requires C 68·1, H 4·84.

Methyl-α-β-Dibromo-β-phenyl-propionyl-pyruvate,

$C_6H_5 . CH\,Br . CH\,Br . CO . CH_2 . CO . COOCH_3$.

2·32 grms. of methyl cinnamyl-pyruvate were dissolved in 5 c.cs. chloroform, and a solution of 1·6 grms. of bromine in 5 c.cs. chloroform was added slowly. The red colour of the bromine disappeared immediately; and no hydrobromic acid was evolved. On evaporation of the chloroform in vacuo an oily residue was obtained, which was crystallized by dissolving in hot benzene and precipitating by addition of ligroin. It melted at 134° C. to a red liquid.

This compound crystallizes in nearly colourless prisms, which are insoluble in water, sparingly soluble in ligroin, soluble in carbon disulphide or ether, and readily soluble in chloroform or benzene. When warmed with dilute aqueous potash, it undergoes ketonic hydrolysis. Its alcoholic solution gives a bright red colour with ferric chloride.

0·1991 grm. of substance gave 0·2945 grm. of CO_2 and 0·0593 grm. H_2O, corresponding to C 40·3, H 3·3.

$C_{13}H_{12}Br_2O_4$ requires C 39·8, H 3·1.

Methyl-p-methoxy-benzylidene-acetone-oxalate,

$CH_3O . C_6H_4 . CH : CH . CO . CH_2 . CO . COOCH_3$.

A mixture of 18·8 grms. of p-methoxy-benzylidene-acetone with 30 grms. of dimethyl oxalate was heated until molten on the water-bath. 2·5 grms. of sodium wire were then added and the preparation was proceeded with as in the case of cinnamyl-pyruvic ester. The product, when recrystallized from absolute alcohol, melted at 127·5 C.

The yield was 13 grms.

0·2069 grm. of substance gave 0·4867 grm. of CO_2 and 0·1014 grm. H_2O, corresponding to C 64·1 and H 5·4.

$C_{14}H_{14}O_5$ requires C 64·1, H 5·4.

Methyl-p-methoxy-benzylidene-acetone-oxalate crystallizes from alcohol in yellow needles which are insoluble in water or petroleum ether, sparingly soluble in cold alcohol, readily soluble in hot alcohol, ether, chloroform, benzene, or acetone. Its solution in hot alcohol is yellow in colour, and gives a green fluorescence. It dissolves slowly in aqueous potash, giving an orange-coloured solution which decomposes on warming.

An alcoholic solution of the substance gives a greenish-brown colour with ferric chloride. The crystals dissolve in concentrated sulphuric acid, giving a blood-red solution from which by addition of water a yellow precipitate is obtained. Its sodium derivative is not very readily soluble in water. Mordanted wool is coloured by the substance in the following manner:—

Mordant.	*Colour.*
Aluminium Sulphate,	Orange-yellow.
Potassium Dichromate,	Saffron.
Stannous Chloride,	Orange.
Ferric Sulphate,	Olive-brown.

p-Methoxy-benzylidene-acetone oxalic acid,

$CH_3O . C_6H_4 . CH : CH . CO . CH_2 . CO . COOH$.

By letting a mixture of 1·31 grms. of methyl-p-methoxy-benzylidene-acetone oxalate with 20 c.cs. semi-normal potash stand for about 24 hours, solution slowly took place with separation of a small amount of a solid (anisylidene-acetone), which, after extraction with ether and recrystallization from dilute alcohol, melted at 72°–73° C., gave no colour with alcoholic ferric chloride, and formed an orange-coloured solution in concentrated sulphuric acid. The alkaline solution, which was coloured orange, was again extracted with ether, and the aqueous layer when acidified gave a yellow solid. The solid was dissolved in ether, and the solution was well shaken with dilute sodium carbonate until the ether was colourless. By addition of acid to the sodium carbonate solution, a bright yellow solid was precipitated; and this was extracted with ether and recrystallized from dilute alcohol. It melted at 150°–151° C., and on heating, or placing in a vacuum-desiccator, the yellow colour of the crystals changed to a deep orange owing to loss of water of crystallization. The substance was dried at 105° C. for analysis.

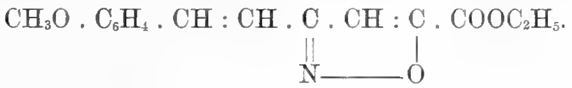
0·1981 grm. of substance gave 0·4582 grm. of CO_2 and 0·0872 grm. H_2O, corresponding to C 63·07, H 4·9.

$C_{13}H_{12}O_5$ requires C 62·9, H 4·9.

p-Methoxy-benzylidene-acetone oxalic acid in the hydrated state consists of bright yellow acicular crystals, and, when dehydrated, has a deep orange colour. While sparingly soluble in boiling water, it dissolves easily in dilute alkali or sodium carbonate. Its solution in alcohol has a yellow colour with a green fluorescence, and gives a greenish-brown colour with ferric chloride. It is soluble in benzene or ether and very readily soluble in chloroform. Its solution in concentrated sulphuric acid has a blood-red colour. Mordanted wool is coloured by it in the following manner:—

Mordant.	*Colour.*
Aluminium Sulphate, . .	Bright orange.
Ferric Sulphate, . . .	Dirty reddish-brown.

Ethyl-γ-p-Methoxy-cinnamenyl-isoxazole-α-carboxylate,



$$\begin{array}{l} CH_3O\,.\,C_6H_4\,.\,CH : CH\,.\,C\,.\,CH : C\,.\,COOC_2H_5. \\ \qquad\qquad\qquad\qquad\qquad\quad \| \qquad\qquad | \\ \qquad\qquad\qquad\qquad\qquad\quad N \text{———} O \end{array}$$

This compound was obtained in a reaction where it was expected that the isoxazole of the methyl ester would be formed. The reasons for its formation are similar to those already given for that of ethyl-γ-cinnamenyl-isoxazole-α-carboxylate.

A solution of 1 grm. of Methyl-p-methoxy-benzylidene-acetone oxalate and 2 grms. of hydroxylamine hydrochloride in absolute alcohol was heated under a reflux condenser for about three hours. The orange-coloured solution was diluted with hot water, boiled with animal charcoal and filtered. The colourless crystalline solid which separated on cooling the filtrate was recrystallized from dilute alcohol.

0·1727 grm. of substance gave 0·4155 grm. of CO_2 and 0·085 grm. H_2O, corresponding to C 65·61, H 5·46.

$C_{15}H_{15}NO_4$ requires C 65·9, H 5·53.

The isoxazole crystallizes in long colourless needles, which melt at 76°–77° C.

Methyl-α-β-Dibromo-β-p-methoxy-phenyl-propionyl-pyruvate.

$CH_3O . C_6H_4 . CHBr . CHBr . CO . CH_2 . CO . COOCH_3.$

5·24 grms. of p-methoxy-cinnamyl-pyruvic methyl ester were dissolved in about 20 c.cs. chloroform; and a solution of 3·2 grms. of bromine in 10 c.cs. chloroform was slowly added. The odour of the bromine disappeared immediately with evolution of a trace of hydrobromic acid. After standing about an hour in a stoppered flask, the chloroform was distilled off in vacuo; and the reddish oily residue was dissolved in a small amount of benzene. On addition of excess of ligroin, crystals of the dibromide were obtained. The compound was recrystallized several times in this manner, and was finally obtained as light-yellow-coloured needles, which melted with decomposition at 106°–108° C. Its alcoholic solution gave a bright red colour with ferric chloride.

0·2037 grm. of substance gave 0·0617 grm. of H_2O and 0·2991 grm. of CO_2, corresponding to C 40·04, H 3·36.

$C_{14}H_{14}Br_2O_5$ requires C 39·8 and H 3·4.

III.

THE CARBONIFEROUS VOLCANOES OF PHILIPSTOWN IN KING'S COUNTY.

By W. D. HAIGH, B.A., B.Sc., A.R.C.Sc.I.,

Demonstrator in Geology at the Royal College of Science for Ireland.

[Read April 27. Published July 2, 1914.]

About three miles to the north of Philipstown in King's County and close to the boundary of Meath, a number of small hills rise from the great central limestone plain and form a conspicuous feature over a very large area of this part of the country.

The chief of these is Croghan Hill, which, on approaching it from the south, stands out as a conical eminence rising with steep grassy slopes to a height of 769 feet above sea-level, and about 460 feet above the general level of the plain. It slopes more gently to the north for three-quarters of a mile before descending somewhat abruptly to the level of the plain beyond, and forms a pleasing contrast to the great area of brown bog-land which surrounds it. This forms a centre round which a group of minor hills are clustered, the whole occupying an area of approximately four square miles.

On reference to the one-inch Geological Survey map[1] of the district, it will be observed that the area is mapped as greenstone (diorite) and greenstone ash; and these rocks with a few bands of limestone extend over the greater part of the area. In the explanatory memoir of the district,[2] the greenstones are treated as intrusive; but the greenstone ash seems to be regarded as interstratified in the Carboniferous limestone, although, as is pointed out in the memoir, there is no direct proof of this, owing to the lack of a continuous section.

There are two main outcrops of these igneous rocks, separated from each other by a band of limestone. One includes Croghan Hill and the surrounding district to the south and east, while the other lies to the west and extends northwards, as a crescent-shaped band, round the base of the hill. A smaller

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[1] Geol. Surv. Ireland: Sheets 109 and 110.

[2] Geol. Surv. Ireland: Explanations to sheets 98, 99, 108 and 109, 1865, p. 18.

area occurs in the northern angle of the limestone band dividing the two main outcrops, about three-quarters of a mile north-north-east of the summit of the hill. About one and a half miles in a south-westerly direction basalt is seen overlying limestone in a quarry, half a mile north of Clonearl House in the Clonearl demesne.

Again, at Castle Barnagh, close to Philipstown, there is a small projecting knoll of intrusive rock.

Croghan Hill is a volcanic neck which rises through the Carboniferous limestone, and was the main vent through which the ash now covering a large portion of the area was ejected. It is now but the stump of what must have been a much higher and larger cone, while the ash covered a more extensive area than at present, but long continued denudation has worn it down to its present size, exposing to view the internal structure of the volcano, with its central pipe or vent now choked with intrusive material, round which lies the ash originally ejected through the vent. Croghan Hill, though the chief, is not the only vent in the district. It forms a centre round which a group of subsidiary vents have been opened, each of which probably remained active for a time, throwing out its ash and adding to that being deposited from the main vent. But towards the close, when the volcanic activity was subsiding and the explosive violence which gave rise to the ash had ceased, the lava welled up quietly from below, filling the vents and forming a plug of basalt. Such plugs being much harder and more resistant to weathering than the surrounding limestone, now stand out as low hills.

Although the basalt has welled up and choked the vents, there seems to have been no extensive outpouring of lava, as no sheets occur in the district. The basalt overlying the limestone in the Clonearl quarry is probably an intrusive sill which denudation has exposed. The limestone here dips at 15° to the east and is overlain directly by the basalt, which has a rude vertical columnar structure. No trace of ash is visible between the two, although the actual junction can be seen for some distance along a drain at the northern end of the quarry. The limestone, which is composed of dark shaly and cherty bands, has not been altered to any extent by the intrusion.

The ash and breccia comprising the greater part of the igneous material in the district is of a very uniform character. It has a greenish colour, and often contains fragments of chert and limestone embedded in it, and generally specks of pyrite can be seen. The fragmentary material is set in a calcareous ground mass. On weathering it sometimes shows a spheroidal structure, and lines of bedding were observed in one or two instances, but these were generally very obscure. This ash is well seen round the sides of

Croghan Hill in the projecting crags. The fragmentary material in the ash varies from the size of a walnut to dust so fine that it can only be observed with the aid of a microscope. It consists of angular and subangular pieces of pale grey vesicular pumice; the vesicles are often filled with calcite and a green chloritic mineral. In describing this ash Sir A. Geikie[1] says: "I am not aware of any other necks so homogeneously filled up with one type of pyroclastic material, and certainly there is no other example known in the British Isles of so large and uniform a mass of fragmentary pumice." The ash is very calcareous and in some parts might be described as an ashy limestone. It is hard to account for the presence of so much calcareous material in the ash, unless, as Sir A. Geikie suggests, the vents were opened on the floor of the carboniferous sea, when fine calcareous silt would find its way down into the interstices of the ash, and into the pores of the pumice. Although percolating water containing carbonate of lime in solution may have added to this, it does not seem likely that this process would in itself be adequate to so thoroughly saturate the ash.

The limestone directly underlying the ash, in the few sections visible, is a dark impure shaly rock, very similar lithologically to the "Calp" or "Middle limestone" so well developed in the neighbourhood of Dublin. The ash contains fragments of the limestone and chert embedded in it, and in a few instances pieces of basalt were found enclosed in the ash. Some of these limestone and chert fragments were distinctly angular, and had evidently been blown out of the vent when it was first opened, and thus became embedded in the accompanying ash. Other pieces are quite rounded and have all the appearance of water-worn pebbles and boulders. Similar rolled pebbles have been found in the volcanic area near Limerick, and in describing these Mr. J. R. Kilroe[2] says: "The more natural way of accounting for the circumstance is to attribute them to the action of waves on an exposed mass of basic lava, the results of attrition being then distributed over the neighbouring sea-floor, where ash was accumulating." The majority of the pebbles found in the Croghan Hill ash are not basalt, but chert and limestone, particularly chert.

If the ash was deposited directly on the dark, shaly limestone while the latter was accumulating on the sea-floor, the sea must have been a shallow one, and the vent, with its surrounding limestone, was probably a small volcanic island, against which the waves of this shallow sea beat, breaking down the limestone shore and finally eroding away the softer limestone,

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[1] "Ancient Volcanoes of Great Britain," vol. ii, 1897, p. 39.

[2] Memoirs Geol. Surv. Ireland, "Geology of the Country round Limerick," 1907, p. 39.

which left the more resistant chert to be entombed in the ash. This seems a possible explanation of the fact that the larger number of pebbles found in the ash are chert.

That the igneous material, which forms the necks, actually breaks through the Carboniferous limestone can be seen in several sections. In a quarry, about half a mile east of the summit of Croghan Hill, dark limestone with bands of shale and many crinoid stems occur. The limestone here is much disturbed, and the bedding is rather obscure; but it sometimes dips towards the centre of the hill, and sometimes a little east or west of it. The limestone strata are penetrated by a neck which rises a little further to the east, and close to the edge of the bog, showing clearly that the igneous material has been forced up through the limestone. Similarly, about three-quarters of a mile south-east of this point, near Barrysbrook House, the igneous material may again be seen breaking through the limestone. A like feature may be observed by the roadside at Gorteen, on the south-western side of Croghan Hill, where " the limestones have been thrown into a highly inclined position, dipping towards the east at 60° or more, and their truncated ends abut against the sides of the neck."[1] At Glenmore holy wells, one-third of a mile north-north-east of the summit of the hill, black, shaly and cherty limestone are seen dipping south at a low angle into the body of the hill; a little north-west from this, on the hill, grey limestone is exposed, and several other outcrops of a similar limestone are seen round this point. This grey limestone runs south-west in a curved band, and is well seen on the road a short distance west of Gorteen. At this point a quarry is opened, and the rock is seen to be a hard, grey limestone, much jointed, and has all the appearance lithologically of the Lower limestone; but, owing to the lack of fossil evidence, this cannot be definitely ascertained.

On passing over this band of grey limestone, in a northerly direction, the black, shaly limestone again appears, and is now seen to dip northwards at about 20° under the ash, which covers the surface between this point and the bog to the north. The dark, shaly limestone is also seen a little east of this, but here it has a north-easterly dip. As mentioned above, this limestone has all the appearance of the Middle limestone or " Calp," and in all probability represents the basement beds of this series. This is overlain directly by the ash and underlain by the compact grey or Lower limestone, the latter being brought to the surface by an anticlinal fold, as the black limestone is seen dipping south under the main ash on Croghan Hill and dips north under the ash surrounding Boston; the grey limestone being exposed on the surface

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[1] Sir A. Geikie, " Ancient Volcanoes of Great Britain,' vol. ii, 1897, p. 38.

between the two outcrops. It seems to have been over this bed of black, shaly limestone that most of the ash was originally deposited, the Croghan Hill ash and that in the neighbourhood of Boston being at one time a continuous bed. The small anticlinal fold, just north of the main vent, was probably caused by the disturbances that took place at the close of the carboniferous period when the Hercynian folds were formed. From the summit of this anticline, the ash and the underlying bed of black, shaly limestone have been worn away, separating the ash into two parts, and exposing the upper beds of the Lower limestone.

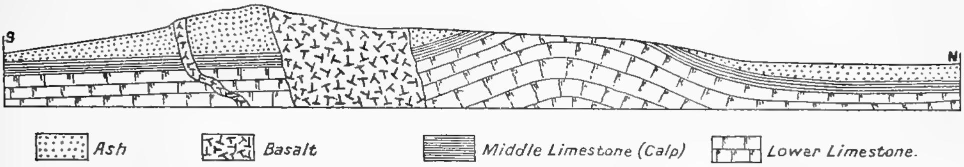

FIG. 1.—Diagrammatic Section across Croghan Hill.

No very conclusive evidence of the interstratification of the ash and limestone was observed, but a few instances occur which throw some light on the age of the volcanic eruptions. As noted by Sir A. Geikie,[1] one of these can be seen near Gorteen on the south-west side of the hill. Here there is a band of limestone only a few feet thick, with ash above and below it, and, although the junction between the two is well defined, no trace of any volcanic material can be seen in the limestone. Pieces of chert and limestone are, however, of common occurrence in the ash. Another instance occurs at the most easterly neck, just north of Coolmount House, where the limestone, much undulating, appears to dip below the ash. On the northern side of this neck the limestone is seen, again rapidly undulating, and it finally plunges southwards beneath the ash on the hill. The ash, which here overlies the limestone, shows a series of divisional planes suggestive of bedding, which dip south parallel with the limestone. About two hundred yards west of this point a well has been sunk to a depth of twelve feet. This passes through about six feet of dark limestone with bands of shale and chert. This is seen to be underlain by a bluish, grey clayey material which is highly calcareous, and when examined had all the appearance of weathered ash, as it consisted of small vesicular fragments of pale grey pumice lying in a clayey matrix. This material appears to be ash weathered in situ, which has been decomposed by the infiltering of water through the over-lying limestone. This limestone is evidently a continuation of the dark, shaly beds which occur a little further to the east, where they

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[1] *Op. cit.*, p. 39.

dip south beneath the ash on the hill, and it thus appears to be interstratified between the two beds of ash. Hence the volcanic eruptions which gave rise to the ash were intermittent during the deposition of the black, shaly limestone, and are probably of Middle Carboniferous Limestone age. Although, as Sir A. Geikie suggests, the band of stratified rock seen in the section near Gorteen, on the western side of the hill, may be a large included mass lying within the vent itself, this does not appear to be the case with the limestone near the most easterly neck, which seems to be a continuation of the beds underlying the bog to the north. The ash found below this limestone is probably a lenticular mass that thins out and finally disappears northwards. It would seem from this that a portion of the ash is contemporaneously interstratified in the lower beds of the Middle Carboniferous Limestone series.

Although volcanic eruptions are a conspicuous feature of Carboniferous times, both in England and the south of Scotland, this period was one of comparative quiescence in Ireland, as the only undoubted volcanic rocks of this date so far known occur in the neighbourhood of Limerick, and have recently been re-investigated by the Geological Survey.[1]

In the south-western headlands, about Bantry Bay, various igneous rocks occur which consist of "greenstone," ash, and breccia. It is possible that these are of Carboniferous slate age, but they may be of later date.

In the Limerick area the first volcanic phenomena manifested themselves in Upper Old Red Sandstone times, and, after a period of rest, they broke out again in a minor way during the deposition of the Lower limestone. But it was not until the incoming of the Middle limestone epoch that the eruptions reached their maximum. Then the volcanic action declined and eventually disappeared.

In the Croghan Hill area there is no evidence to show that any eruption took place as early as the Old Red Sandstone and Lower Carboniferous limestone epochs; but it appears that shortly after the beginning of the Middle limestone epoch volcanic activity commenced. That physical conditions underwent a change is shown by the difference in the two limestones which exist in the area. Volcanic activity took place shortly after the argillaceous conditions of deposition set in, as no great thickness of the black shaly limestone was observed in any section between the ash and the underlying grey limestone. This condition very much resembles that which occurs in the Limerick area, as will be seen by the following quotation from the memoir[2]:—"From what has been set forth above regarding the lithological

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[1] Geo. Surv. Ireland, "Geology of the Country round Limerick," 1907.

[2] *Ibid.*, p. 19.

difference noticeable in the rocks of this higher member of the limestone group [Middle Limestone], it seems obvious that corresponding differences of an interesting character prevailed in the conditions of contemporaneous deposition. There is little doubt that the sudden change, and diversity in character and contents, in the higher series, was accompanied, if not caused, by the commencement and continuance for a time of volcanic activity in the region."

The movements which occurred immediately preceding or during the volcanic eruptions may have caused the local undulations in the sea-floor, and, as suggested for the Limerick district, may have caused the abrupt alteration and diversity of conditions which gave rise to the deposition of the argillaceous type of limestone.

The ash of the Croghan Hill district bears a close resemblance to much of that which occurs in the Limerick area, and is similar to that of Carboniferous Age in Scotland and central England.

It is of a pale colour, very uniform in character, and contains much calcareous material.

Another rather striking feature, which tends to connect the Limerick and Croghan Hill volcanic areas, is that they lie on a line which is parallel to the Caledonian axes of folding, which played so conspicuous a part in the topography of the country. It is not a little remarkable that such a line marks the boundary of the rocks of Atlantic affinities, occurring in the Lower Carboniferous series in Great Britain and Ireland.[1] This line passes just south of the Scottish carboniferous volcanic areas, and the series of rocks both in Ireland and Scotland belong to a province of a distinctly Atlantic type. In the south of Scotland the Atlantic type is overlapped by a series of dykes and sills of late Carboniferous age, or even later, consisting of subalkaline rocks, which belong to a Pacific province; but no such type of rock has been found in the Carboniferous intrusions in Ireland.

DESCRIPTION OF THE VOLCANIC ROCKS.

The igneous rocks occurring in the district are roughly divisible into two main types, which can be classed as pyroclastic and intrusive. The pyroclastic rocks are breccias and tuffs. The fragmentary material composing these breccias and tuffs consists mainly of basic lapilli, which were blown out of the vent, being in a liquid form at the time of the explosion, since this glassy material contains oval, much elongated, and tubular bodies produced by the drawing out of steam-cavities, most of which have now become filled

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[1] A Harker, "Natural History of Igneous Rocks," 1909, p. 107.

with calcite or a green chloritic mineral. This ash falling in showers into the sea became mixed with epiclastic material, such as limestone and chert, the whole finally consolidating to the compact rock which now forms the breccia or ash of the district (fig. 2).

Fig. 2.—× 8.

The intrusive rocks occur for the most part as solid pipes, filling up the vents from which the ash was ejected. One of these intrusions forms the core of Croghan Hill itself, with the ash surrounding it; and the smaller cones, standing out, particularly on the eastern and northern sides, as low hills round the base of the main vent, were probably parasitic cones fed by channels from the chief pipe of the volcano. Towards the close of activity, when the explosions which gave rise to the ash had ceased, the lava rose quietly from below, and solidified in the vents. An examination of these intrusions produced no evidence to show that they took place at different intervals, nor any indication of the successive protrusion of progressively different types of lava. The petrographic types, having much in common, and not being possessed of great variety, seem to point to the conclusion that they were intruded simultaneously from a common magma, the small variation in composition being due to local physical causes in the magma at the time of intrusion. The rock varies from a blue-black fine-grained basalt to a more doleritic type, where the plagioclase is distinct, and in a few instances a more basic type, passing into a limburgite. All have a more or less prevalent amygdaloidal structure; the amygdales are generally composed of calcite, but often contain serpentine.

In one locality in Croghan demesne Professor Watts[1] calls attention to a noticeable feature in these volcanic rocks. This is the occurrence in them of lumps of a highly crystalline material quite distinct from the enclosing rock. The enclosures referred to vary in size up to a foot in diameter, and are doubtless blocks caught up by the lava in its ascent. These rocks are described by Professor Watts. One specimen "contains relics of garnets, surrounded by rings of kelyphite, embedded in a mosaic of felspar, with a mineral which may possibly be idocrase." He describes another specimen as containing "the relics of garnets preserved as kelyphite, set in a matrix of quartz-grains, much strained, and containing a profusion of crystals of greenish-yellow or red

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[1] Geol. Surv. Ireland, "A Guide to the Collection of Rocks and Fossils," p. 38.

sillimanite. This appears to be a metamorphic rock, and may be a fragment of some sediment enclosed in the igneous rocks." From an examination of one of these rock-sections it appears to be a fragment of a sedimentary rock which has been broken off and enclosed by the lava in its ascent. The quartz crystals contain numerous cracks which are filled with a brown glass. The liquid mass was evidently forced into the interstices of the rock and into the cracks in the crystals. In this feature the rock much resembles that in a dolerite dyke from Ross Harbour Point on the shore of Lower Lough Erne.[1] The interest of these rocks is obvious, as giving some indication of the character of the floor of the country below the Carboniferous and, perhaps, below the Silurian strata.

The various outcrops of the intrusive rocks will now be described in detail, beginning with the more northern outcrops. About three quarters of a mile north-north-east of the cairn on the summit of Croghan Hill, a circular-shaped knoll rises about two hundred feet above the level of the plain. It is surrounded on the north, west, and south sides by ash, which in turn is surrounded by limestone, the limestone abutting directly against the intrusive rock on the western side. This is a dark-blue compact, slightly amygdaloidal rock, the amygdales being composed of calcite (fig. 3). It is fine-grained and crystalline, and it shows good idiomorphic crystals of augite set in a matrix of smaller crystals. The pyroxene, which occurs in two generations, has generally the purplish tinge which is taken as an indication of the presence of titanium. The larger crystals sometimes show zonal structure, and a gradation in colour, being brown or purple on the outside, and fading away to a perfectly clear pyroxene at the centre. Much olivine was originally present in the rock, both as crystals and irregular blebs, but it now only exists as pseudomorphs in calcite and chlorite, and often presents a mosaic structure, the cracks of which in some cases still show traces of iron oxide. Some of these pseudomorphs have a perfect olivine outline, while others occur as irregular grains and patches scattered through the ground. No fresh olivine was seen in the rock. Much titaniferous magnetite was originally present, but it is now mostly altered into leucoxene. A few crystals of apatite were also observed. Amygdales occur filled with calcite, which show a radial structure round the edges,

FIG. 3.—× 8.

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[1] Geol. Surv. Ireland, Explan. Mem., Sheet 32, pp. 43 and 21.

the internal part being granular. A noticeable feature of the rock is the occurrence in it of irregular patches of crystalline material. These are of a whitish colour, and are in marked contrast to the darker ground of the rock. They are composed of olivine crystals completely altered, which are notched by and include crystals of a pale pyroxene, the latter showing some alteration into a green fibrous mineral. This appears to be an example of the glomero-porphyritic structure first described by Judd[1] in the ophitic dolerite of Fair Head, Co. Antrim, the associated olivine and pyroxene having separated out at an earlier period from the magma, out of which the enclosing rock was itself formed. A feature of these glomero-porphyritic aggregates is the absence of titaniferous magnetite; although it occurs abundantly scattered throughout the rest of the rock, these areas are almost all entirely free from it. The individual grains of these porphyritic aggregates are related to each other in the same manner as the grains in an ordinary holocrystalline basic rock, such as a gabbro. They are allotriomorphic with regard to each other; but in relation to the ground mass they are sometimes idiomorphic in outline.

The absence of titaniferous magnetite seems to point to an earlier crystallization of these patches at some depth below the surface, while the magma was still molten, the idiomorphic outline being due to a secondary crystallization which has probably taken place during a later stage in the process of consolidation. This is illustrated by some of the pyroxene crystals which lie on the borders of these porphyritic areas. The crystals have a distinct junction which divides them roughly into two equal portions, one half being colourless, the other with the characteristic purplish brown tint. The inner half, which is portion of the porphyritic area, is colourless, and has no definite crystalline boundaries, while the outer portion, which projects into the matrix of the rock, is idiomorphic, and is identical in colour with that which occurs in the ground. The pale part of the crystal is free from magnetite, while along the junction between the two parts, which are in optical continuity, a band of magnetite grains lie; these grains are also enclosed by the brownish portion of the crystal. Thus, the pale part of the crystal was an earlier crystallization which had taken place in the magma before intrusion, and before any of the titaniferous magnetite had begun to crystallize, the other portion being added after intrusion when the whole rock had begun to consolidate, and, as is usual with the pyroxene, after the titaniferous magnetite had crystallized. There can be very little doubt but that the porphyritic aggregates were formed under plutonic

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[1] Quart. Jour. Geol. Soc., Lond., vol. xlii, 1886, p. 71.

conditions, and that the external zone, which contains the crystal faces in contact with the matrix, was added during the general crystallization of the magma. These aggregates belong to the category of "enclaves homœogènes," described by Lacroix, or, as Harker[1] prefers to call them, "cognate xenoliths." They represent an intratelluric crystallization, which would have produced a more or less coarse-grained rock, had it been prolonged. Although these patches and the matrix have crystallized from the same magma, they differ slightly in mineralogical composition, "progressive crystallization being itself a process of differentiation."[2] The rock contains very little felspar, and this only in microlites, which are too small for determination of species. It has a specific gravity of 3·02, and is a basic type of altered olivine dolerite. At the northern extremity of this neck the rock is somewhat similar. It is more altered, less basic, and the ground consists of a brown, altered glass, in which lie porphyritic crystals of purple augite, with many smaller crystals. There is less olivine, which is recognized as pseudomorphs in calcite and chlorite. Dark brown biotite, which changes to a pale brown when the polarizer is rotated, occurs as scales generally adherent to the irregular crystals of titaniferous oxide, the latter being nearly all altered into leucoxene. The rock differs from the preceding chiefly in the quantity of felspar, which is fairly abundant. In one or two instances it occurs in lath-shaped crystals, exhibiting typical lamellar twinning, but extinguishes too indefinitely to permit of identification. It is generally present as irregular areas with no definite boundaries, enclosing idiomorphic crystals of augite and magnetite. The indefinite boundaries of these areas have a notched appearance due to the crystals of augite and magnetite protruding into the felspar. Apatite is common in long, hexagonal needles, which pierce the other constituents. Calcite, chlorite, leucoxene, and limonite are the principal secondary products.

About two hundred yards north of the cairn on Croghan Hill, a rudely oval-shaped area of intrusive rock occurs. One specimen[3] is a highly vesicular rock. The matrix, now much altered, was probably originally glass, with grains and skeletons of magnetite in an isotropic base. Olivine occurs as pseudomorphs, these presenting a mosaic structure, and sometimes including glass. The most striking feature of the rock is the numerous oval-

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[1] A. Harker, "Natural History of Igneous Rocks," 1909, p. 348.

[2] *Op. cit.*, p. 348.

[3] I am indebted to the Director of the Geological Survey of Ireland for giving me an opportunity of examining this rock-section, and also the volcanic rocks collected in the Limerick district.

shaped vesicles, which in the hand specimen give the rock somewhat the appearance of an oolitic limestone (fig. 4). In nearly all cases these vesicles are lined with calcite and filled in with radial serpentine. A crack occurs in the rock which is now filled in with calcite, and the vesicles adjacent to it are all filled with calcite to the exclusion of serpentine. The rock is an amygdaloidal diabase of a very basic type, and may originally have been a limburgite, as no felspar is observable. Another specimen examined from the centre of this outcrop very much resembled that previously described from the more northern outcrop. It has numerous areas of notched felspar, enclosing augite, apatite, and titaniferous magnetite. The latter, which has undergone alteration into yellowish-white leucoxene, is very abundant, and gives the rock a white speckled appearance. Much augite occurs with the characteristic purple colour, and a little apatite. This rock also shows the glomero-porphyritic structure referred to above, the porphyritic aggregates being composed of olivine, which is now mainly replaced by calcite, with pyroxene showing decomposition into a greenish mineral and a few irregular crystals of allanite. The matrix of the rock is much decomposed, but was in all probability glassy. It now consists chiefly of calcite and chlorite.

Fig. 4.— × 8.

About half a mile due east of the summit of the hill another outcrop of the intrusive rock was observed. It rises abruptly from the edge of the bog to a height of 100 feet on its eastern side, and abuts against the hill to the west. It is almost circular in cross-section, and from its general appearance is undoubtedly a small neck which has been choked with intrusive material. The rock is compact and of a bluish colour, with a few cavities containing calcite. In section it is fine-grained, and has much calcite dispersed throughout. It has an altered glassy base with numerous microlites of plagioclase felspar. Phenocrysts of hornblende occur as dark granular pseudomorphs enclosing hexagonal crystals of apatite, some crystals of which also occur scattered through the matrix. The felspar microlites, as a rule, show no trace of flow-structure except where they approach the phenocrysts, when they are seen to be arranged tangentially round them. Much altered titaniferous magnetite occurs, particularly in the areas now occupied by the hornblende pseudomorphs.

The most easterly outcrop occurs a little over a mile in a south-easterly direction from the summit of Croghan Hill. The ash here is continuous with that which surrounds the hill. A small oval-shaped neck rises just south of Barrysbrook House and close to the northern boundary of the ash, the latter extending to the east, beyond the neck, in a tongue-shaped area, the boundary of which is sharply marked off from the limestone plain by a low but steep escarpment. The ash here shows signs of bedding which dips parallel to the underlying limestone. The rock in this neck is a dark compact basalt in which lie numerous felspar laths in all positions in a matrix of altered glass. Phenocrysts of augite with many smaller crystals are scattered profusely through the rock (fig. 5). Much titaniferous magnetite occurs in small grains, and a few long needles of apatite are present. The glomeroporphyritic structure is again a noticeable feature in the rock of this neck. The olivine, as in the other specimens described, is completely altered, while a fibrous mineral occurs which seems to be an alteration of the pyroxene, as a small patch of the original mineral is seen in the centre.

FIG. 5.—× 8.

Near Gorteen, on the southern side of the hill, and about two hundred yards south of the cross-roads, another small outcrop of the intrusive rock is seen. It is only exposed in one place in an old quarry just north of a farmhouse near the road. It is a dark crystalline rock, very hard and tough, and difficult to fracture. It is slightly amygdaloidal, the cavities being lined with radial serpentine, and the interior filled with calcite. Crystals of pinkish augite are common, and pseudomorphs of olivine occur. Very little felspar is seen, and this only as microlites and skeletons, whose species could not be determined. Much titaniferous magnetite is present in small grains. It was originally a rather basic type of olivine dolerite, and, although much altered, has a specific gravity of 2·81.

In an old quarry in the Clonearl estate, about two miles south-west of Croghan Hill, the igneous rock is seen overlying the limestone, which has an easterly dip of 15°, the limestone occurring in thick-and-thin-bedded shaly bands. No ash was visible between the limestone and the basalt, nor was any seen to overlie the basalt. On the Geological Survey map ash is shown to the north-east as far as the bog; but it is pointed out in the memoir that "the ash marked on the map here is merely drawn on the supposition of the ash at Boston extending south beneath the bog, as neither the ash nor any other rocks are visible here." It is a dark fine-grained rock with a fair vertical columnar structure, and appears to occur as a sill which has been intruded into the limestone. The latter does not appear to have been altered to any extent by contact with the igneous material, except for about an inch from the junction, where its flinty character seems to be intensified.

This is the most basic rock observed in the district. It consists for the most part of a ground mass of small pink pyroxene crystals, with a little brown interstitial glass. Many larger crystals of a pale pyroxene occur, and pseudomorphs of olivine, in which no trace of the original mineral is seen; they can, however, be easily detected by their outline. The phenocrysts of augite and altered olivine are set in a complex of augite microlites. Much magnetite occurs in small grains (fig. 6). The rock is a limburgite or magma-basalt with a specific gravity of 2·84, and bears a close resemblance to some of the Scotch limburgites of Carboniferous Age, particularly the rock from Chester Quarry, Haddingtonshire, described by Dr. Hatch.[1] A section of this rock was examined from the collection in the Royal College of Science, Dublin. The Irish example differs from this only in containing less glass, its place being taken by augite microlites; there is, moreover, no fresh olivine, but otherwise the rocks appear to be identical.

Fig. 6.—× 20.

Fig. 7.—× 36.

Just outside Philipstown, and across the canal to the north-east, at Castle Barnagh, a small knoll rises which is visible for some distance. It is formed by an intrusion of igneous rock, which has been forced up through the limestone. No ash was found in its neighbourhood. It is a dark compact rock, and is so highly charged with carbonate of lime as to effervesce freely with acid. In section it is seen to be crystalline, with numerous notched felspathic areas which enclose crystals of augite and magnetite; also numerous very slender needle-like crystals which may possibly be apatite. The augite occurs as good idiomorphic crystals, and also with a second generation of smaller crystals in the matrix. Some olivine occurs as pseudomorphs in calcite and chlorite (fig. 7). A feature of the rock is the quantity of mica it contains

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[1] Dr. Hatch, "Lower Carboniferous Volcanic Rocks of East Lothian," Trans. Roy. Soc. Edinburgh, 1892, 37, p. 116.

as reddish brown pleochroic flakes, which, though it occurs in isolated patches, is usually seen as a mantle round the iron ore grains which are scattered abundantly in the rock. This intrusion appears to belong to the lamprophyre group, and might be described as a mica-augite-lamprophyre. It has a specific gravity of 2·88.

The ash over the whole area is of a very uniform character, having a greenish colour, and enclosing fragments of chert, limestone, and basalt. The fragmentary material for the most part is a highly vesicular pumice, the vesicles being generally filled with calcite. The pumiceous fragments are angular, sub-angular, and rounded, and are set in a calcareous cement, which is now generally represented by white calcite, but which undoubtedly consisted in large part originally of limestone. On weathering, the rock often gives rise to a curious mosaic structure due to projecting fragments of pumice. In some instances the calcareous cement is stained red with iron oxide. In the calcite material between the fragments, spherulitic areas occur, in which lie a number of microlites of felspar in an almost opaque white ground. In some of these areas the microlites lie haphazard, but in others crystallization seems to have taken place from the outer rim, the microlites radiating towards the centre (fig. 8). The spherules are probably concretions, similar to those described from a tuff from Torres Strait.[1]

FIG. 8.—× 8.

In the Irish examples the spherules are probably composed of complex lime silicates, from which the felspar has crystallized as a product of secondary change. On the south-west side of the hill, near Gorteen, a small outcrop of a tuff appears, which differs in character from the main mass. It is a brittle greyish rock, containing patches of a slightly altered brown glass. In section these brown patches have a flecked appearance, which is probably due to minute enclosures of felspathic material. The interstices between the glass is filled in with felspar in which secondary crystallization has taken place. The rock is a palagonite tuff. Just north of the summit of Croghan Hill, the ash is of a very compact nature, with a bluish-green colour. It contains many joint planes along which it splits very readily. These planes

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[1] Haddon, Sollas, and Cole, "Geology of Torres Strait." Trans. Royal Irish Academy, **30**, p. 419: cf. I. Friedlaender, "Über die Kleinformen der vulkanischen Produkte." Zeitschrift für Vulkanologie, Band I, Heft I, Jan. 1914, p. 37, fig. 13.

are horizontal, three or four occurring in the space of an inch, and they pass through the fragments of pumice. The closeness of the joints gives the rock a shaly appearance when shattered (fig. 9). The ash over the whole district is unstratified, except at the most easterly outcrop, where a suggestion of bedding is seen, and again in a small exposure north of the summit, where the weathered surface of a projecting crag shows alternate beds of coarser and finer material, the beds being about a foot in thickness.

FIG. 9.—× $\frac{1}{8}$.

The uniformity in character and pumiceous nature of this breccia distinguishes it as "one of the most remarkable breccias anywhere to be found in the volcanic records of the British Isles."[1]

SUMMARY.

Croghan Hill and the smaller hills surrounding it are a series of volcanic vents, from which the fragmentary pumice, now forming the green ash and breccia of the district, was ejected.

The volcanic eruptions took place in the Carboniferous sea during the deposition of the cherty and shaly zone at the junction of the Lower and "Calp" (Middle) Limestone.

They are consequently of the same age as the major outbursts of volcanic rocks during the Carboniferous Period in the neighbourhood of Limerick.

From the number of rounded fragments of chert and limestone found in the ash, these vents seem to have formed small volcanic islands in the Carboniferous sea, which, at that epoch, was shallow over a large part of Ireland. Towards the close of the volcanic activity, when the explosions which gave rise to the ash had ceased, the lava welled quietly up from below and solidified in the vents.

No sheets or sills occur in the district, with the exception of that seen in the quarry on the Clonearl estate. This mass, from its columnar structure and absence of ash, appears to be a sill which has been intruded into the Carboniferous Limestone.

The intrusive material filling the necks is of a basic nature. It varies from a dolerite in which the plagioclase is distinct, to a blue-black fine-grained basalt, some portions being more basic and passing into limburgite.

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[1] Sir A. Geikie, "Ancient Volcanoes of Great Britain," vol. ii, 1897, p. 39.

The basalt from many of the outcrops shows the glomero-porphyritic structure, and where an appreciable quantity of felspar is present, it occurs generally with irregular boundaries, notched by the intrusion of idiomorphic crystals of augite and magnetite. This is, perhaps, the most noticeable feature to be observed in this series of rocks. The intrusive sill in the Clonearl quarry is the most basic rock occurring in the district, and is a true limburgite.

At Castle Barnagh a small intrusive knoll occurs which is composed of a rock best described as a mica-augite-lamprophyre.

The ash is of a very uniform nature throughout the district. It is composed of angular, sub-angular, and rounded fragments of a pale, greenish grey basic pumice, the vesicles of which are filled with calcite. The ash encloses rounded fragments of chert and limestone, the whole being held together by a cement of calcite.

IV.

A NOTE ON SOME HUMAN BONES FROM AN ANCIENT BURIAL GROUND IN DUBLIN.

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(From the Anthropological Laboratory, Trinity College, Dublin.)

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Early in 1913 workmen, in the course of some excavations under the City Hall in Dublin, came across a number of bones which, with two exceptions, proved to be human remains. Thanks to the courtesy of the City Coroner, Dr. Louis Byrne, I had the privilege of examining these, and as opportunities for observing skeletons of the ancient Irish from authentic sites but rarely occur, it has been thought worth while to place on record notes regarding these specimens, with some remarks regarding special characteristics of the lower limb bones.

A brief note as to the history of the site from which these skeletons were obtained will not be uninteresting; it is taken from Gilbert's History of Dublin. On the south side of Cork Hill there was originally a church dedicated to the Virgin Mary and named, "owing to its proximity to a mill dam," St. Marie de la Dam. The precise date of its erection is not known, but it was most probably founded before the twelfth century, as in the archives of the Cathedral of the Holy Trinity is preserved a deed executed about 1179 by Archbishop Lorcan O'Tuahal, and among the signatories to it as witness is Godmund, priest of St. Mary's.

At the end of the sixteenth century the church and graveyard came into the possession of Richard Boyle, first Earl of Cork, and on its site he built Cork House, the graveyard becoming portion of the garden. This house afterwards changed hands and was used for many purposes, being finally demolished in 1768, a new building or exchange being commenced in the following year. In 1852 the latter was taken over by the Corporation for use as a City Hall, and it was deep under the basement of this that these bones were found. We thus see that this graveyard may have been in use for at least four hundred years, from some time in the twelfth century, or probably earlier, until well on into the sixteenth. It is likely, however, that it was not used for interment towards the latter end of this period, so that these bones have a fairly definite age. It is interesting to inquire what manner of people the inhabitants of Dublin were some few hundred years ago, and if they showed any marked anatomical differences from those of the present day.

In all other previous descriptions of ancient remains, the worn condition of the crowns of the teeth, especially the molars, has been noted; and these specimens from Cork Hill show a similar state. The bones of the lower limbs also show distinct points of difference from those of present-day subjects; the various other differences which will be duly noted are of minor importance.

It is quite possible and likely that, during previous operations on this site, human remains have been uncovered and reburied in a common grave, thus accounting for the undue preponderance of lower limb bones in this collection, and for some points of dissimilarity between individual specimens.

It is considered that seventeen skeletons are represented in the series of remains recovered.

CRANIUM.

No complete skull was obtained; in one specimen the cranium cerebrale was fairly complete, and in another the facial portion was partially represented; the remainder consisted of smaller portions of probably six male and three female crania.

So far as could be ascertained, the crania were of the mesati-cephalic type, and of average capacity. From the presumed age, it was not to be expected that they would show any outstanding difference from those of modern type; the variations were chiefly due to marked development of muscles, especially those used in mastication.

The measurements of the most complete specimen are given; and it will be seen that the cranium had a fairly average capacity for a female specimen, and that it was of a mesati-cephalic and metrio-cephalic type.

This skull apparently belonged to a subject of middle life, the coronal suture being obliterated, and the sagittal closed near the bregma.

For a female, the mastoid was strong and the muscular attachments well marked.

The pterygoid processes were broken, but the lateral plate had been markedly prolonged posteriorly on the left side, so that it overhung the spina angularis. Its anterior margin was continued upwards on the greater sphenoidal wing as a sharp curved ridge passing to the infra-temporal crest. This was seen in all the specimens, and indicated strong development of the external pterygoid muscle. The lower border of the processus zygomaticus was deeply grooved. The whole of the area for the attachment of the temporal muscle was strongly marked. The muscles of mastication had, apparently, been more powerful than is usual in modern Irish people. The specimen had been damaged in two places on the frontal bone; one hole exposed the right frontal sinus filled with loose greyish soil.

Of the other specimens three showed indications of the grooves produced by the divisions of the supra-orbital nerve. The male specimens all showed strong development of the arcus superciliaris, and, in one particularly, the projection of the glabella and the prominent ridges united to it was striking.

Two specimens showed portions of the face and some teeth. The larger of these consisted of an almost complete facial aspect of a young skull. The forehead was high and vertical; the arcus superciliaris feebly developed; the frontal eminences well shown. Grooves for the supra-orbital nerve were very distinct. The orbits were large, the apertures almost quadrilateral, the nasal orifice narrow with sharp margins and prominent nasal bones. The facial breadth was 115 mm. The palate was high, well arched, and measured just 40 mm. transversely between sockets for wisdom teeth. With the exception of the third permanent molars, which apparently had not erupted, the teeth were perfect, the crowns moderately worn, more on the right side than on the left—the specimen was from a young subject. The incisors showed distinct small posterior cusps. The other specimen was from an individual of more gaunt aspect, with prominent malar bones and deeply sunk canine fossae. All the molars on one side were in position, their crowns were well worn, and the third molar smaller than the first. The subject was comparatively young, the wisdom tooth apparently having been erupted only a short time. The palate had been high, and the external pterygoid plate was similar to that described previously.

Portions of two mandibles were recovered. The larger specimen comprised rather more than half of a powerfully developed jaw-bone, presumably from a male. The mental protuberance was markedly shown, the sigmoid notch deep, and muscular impressions strong. The bone was of a high type of development, massive and well marked. The last molar tooth was in position and showed a well-worn crown.

The other mandible was of a lighter build; the sigmoid notch was shallow and wide; and the muscular impressions were strongly marked. In the first specimen the angle was everted, in the second somewhat inverted. In both cases the angle between ramus and body suggested middle life.

From the above it will be noticed that there is as much variation among the parts of the skull under consideration as we would expect to find among a group of skulls taken at random from the existing inhabitants of Dublin.

Measurements of Cranium A ; *adult female.*

1.	Cubic capacity,	1293 c.c.
2.	Length, from glabella to maximum occipital point,	180 mm.
3.	Basio-bregmatic length or height,	125 mm.
4.	Basio-nasal length,	99 mm.
5.	Antero-posterior measurement, foramen magnum,	3·7 c.m.
6.	Bi-asteric breadth,	110 mm.
7.	Bi-stephanic breadth,	116 mm.
8.	Minimum frontal breadth,	90 mm.
9.	Breadth, greatest above parietosquamosal suture,	136 mm.
10.	Auriculo-bregmatic radius,	120 mm.
11.	Horizontal circumference,	500 mm.
12.	Cephalic index,	75·5
13.	Vertical index,	79·4

HUMERUS.

Eight specimens representing this bone were found. One was from a young subject, one from a tall, slender female, one from a short, stoutly built male; the rest were of average size and proportions. All were more or less damaged.

With the exception of the female specimen above referred to, all were stout and strong, with well-marked prominences for the attachment of the deltoid. The size and development of this eminence made the groove for the nervus radialis appear more distinct than usual, as it curved round the lateral border of the bone. In one case the groove in this position was limited below by a prominent rounded projection of bone.

One specimen showed a deficiency in the floor of the coronoid fossa, whilst another showed that the mode of formation of this foramen was due to absorption of the bone from in front, the anterior lamella being absent, the posterior remaining, and so demonstrating that the existence of the foramen was not due to the pressure of the olecranon process of the ulna.

RADIUS AND ULNA.

Three fragments of the former and four of the latter were recovered.

One of each was long and slender.

The remainder were chiefly remarkable for their strength and for the enormously powerful muscular impressions.

Os Coxae.

Eight specimens were found, of which two represented comparatively young subjects, the line of junction of the epiphysis for the ischial tuberosity being still obvious. Of the remainder, two were probably from males, the rest from females.

The bones were somewhat small, but well marked both for muscles and ligaments.

The crest of the ilium in these bones showed particularly well the various points in connexion with its curvature, including more especially the marked double bend of the crest in the female bone in which the posterior third is pushed outwards by the relatively short and broad sacrum and the distinct linear buttress in the region of the anterior limit of the facies auricularis corresponding to the point of deepest concavity of the curvature. The anterior part of the crest becomes convex laterally, and bends sharply medially near the anterior superior spine, so that the point of greatest width of the false pelvis lies at the posterior limit of the iliac tubercle. The tubercle itself is more outstanding and triangular in the female. In the male the curvature of the crest as looked at from above is not so marked posteriorly, and in its anterior portion it represents a segment of a much larger circle than in the female. Consequently the buttresses of bone, the tubercle and auricular ridge, placed at the points of greatest convexity of the curvatures, are not so well marked.

The anterior inferior iliac spines were not so prominent as in recent Irish specimens, and have the appearance of extending almost to the acetabular margin, the usual deep notch at this point being absent. This condition was probably associated with the great strength of the ilio-femoral ligament.

The ligamentous impressions around the facies auricularis were well defined.

The bones did not show the bridging over of the cotyloid notch nor the widening of the facies lunata of the acetabulum, described by Charles in the Punjabi squatters.

Femur.

The bones from the lower limb were the most interesting of those recovered, and the femora showed a number of remarkable features. In all, fragments of seventeen thigh-bones came to light, a majority probably representing female subjects. Of these only one showed the head, two the neck, and four the lower articular surface; the remainder consisted of portions of the shaft of varying length. Two were from young subjects.

The head.—The fovea was not of the usual type, the anterior part being only slightly depressed, and the posterior being raised and rough, semicircular in shape, with everted edge.

The margin of the articular surface extended on to the upper and anterior aspect of the neck, as described by Charles in the squatting Punjabi. He found this condition constantly present in these people, and ascribed it to pressure against the acetabular margin; it is, I believe, more probably produced by the cotyloid ligament. Frequently a somewhat similar condition is found in recent Irish specimens; but if these be carefully examined, it will be seen that the smooth extension is placed at a slightly lower level on the neck, and that its margin is rough and generally raised. I have seen the retinacular fibres running to this margin in fresh specimens, and believe the impression to be caused by contact with the ilio-femoral ligament such as would arise from prolonged standing.

Following Dwight's classification, we must regard this bone, from the diameter of the head, as belonging to a female subject.

Neck.—Each of the femora in which the neck was preserved showed, just internal to the femoral tubercle, a long, narrow, smooth-grooved area, apparently produced by close contact with a strongly developed iliacus.[1] There was no marked groove for the obturator externus. The neck was short, and not, as in the Punjabi, elongated. The tuberculum colli inferior was only marked in one of three cases.[2]

Shaft.—A trochanter tertius was found in six cases, whilst another specimen showed an indication of its presence, and the remaining bone possessed a more prominent gluteal ridge than usual. The latter two specimens do not show the same degree of platymeria as the others. The development of a third trochanter is frequently associated with flattening of the upper end of the bone. Although it was difficult to determine the sex, as the bones were so fragmentary, yet the trochanter was seen in specimens which various considerations would lead us to assign to both sexes.[3] The third trochanter undoubtedly appears to be more common in ancient than in modern femora, though Houzé[4] described it in the femora of inhabitants of Brussels in 1883, as well as in Neolithic Belgians, and Torok,[5] three years later, refers to it as present in modern specimens of both sexes, as well as in Hungarians of the Bronze Age. Dixon described the occurrence of a separate epiphysis for it in recent specimens, and sometimes a centre appears for the whole gluteal ridge, and is

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[1] Walmesly in a communication to the Anatomical Society of Great Britain, June, 1914, states that this groove is due to the presence of circular fibres in the capsule at this point.

[2] Charles, Journal of Anatomy and Physiology, 1894.

[3] Dwight, Journal of Anatomy and Physiology, vol. xxiv, 1890.

[4] Houzé, Brussels, 1883.

[5] Torok, Anatomischer Anzieger, 1886.

a marked example of a traction epiphysis. Frequently this trochanter is associated with a fossa hypotrochanterica, the whole arrangement being indicative of a strong development of the gluteus maximus, and of a greater attachment to bone than usual.

The superior platymeria of these bones is perhaps the most interesting feature in connexion with them. Both internal and external flanges were seen, though not always on the same specimens. The dissociation of these flanges would lead one to suppose either that they are due to different causes or to the action of the same cause in different degrees. Since Manouvrier[1] published his paper it has been thought that the flattening is due to excess development of the various constituent parts of the quadriceps, caused, he believed, by the frequency of their contraction in a reverse manner to their usual mode of action, the fixed point being distal. He pointed to the occurrence of the condition among certain mountaineering races in whom the movement of climbing would produce the above-described action of the extensor mass. Platymeria, however, is neither invariable in races living in mountainous districts, nor can it be limited to those races, as these bones showed the condition well, corresponding to Hepburn's classification of "distinct," the average index being 73 and the range 70–77. I have followed Hepburn's method of measurement, and, to emphasize the prominence of the feature, I would draw attention to the following figures, which are the averages given by various authors for modern bones:—

Modern British—Hepburn,[2] . . .	81·8.
Modern French—Manouvrier,[3] . .	88·2.
Modern European—Scott,[4] . . .	86·6.
Old Dublin, average of ten specimens, .	73.

The lateral extension appears to be always associated with a rough fossa external to the gluteal line, apparently for insertion of fibres of the gluteus maximus. The outer margin of the depression and the flange gives attachment to the vastus lateralis, and the front of the flange affords origin to the vastus intermedius. If this interpretation be correct, we must consider the formation of the flange to be, in part, associated with increased attachment of gluteus maximus pushing outwards the vastus lateralis, and in part due to development of the vasti themselves. As has been remarked, the lateral extension was more frequent than the medial, though it was, perhaps, best

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[1] Manouvrier, Congrès international d'Anthropologie et d'Archéologie préhistorique, 1889; Bulletin de la Société d'Anthropologie de Paris, 1893, 1895.

[2] Hepburn, Journal of Anatomy and Physiology, 1897.

[3] Manouvrier, Bulletin de la Société d'Anthropologie de Paris, 1892.

[4] Scott, Annals of New Zealand Institute, 1894.

marked when the latter was also present. Turner,[1] many years ago, considered that the gluteus maximus had some influence in causing the formation of the lateral flange which is present in platymeria, and particularly refers to it as likely to be caused by pull on this muscle in squatting races. Hepburn[2] states that platymeria is most likely to occur when there is a frequently flexed condition of hip and knee. It appears to be common among squatting races and in ancient bones. Young human femora frequently show some indication of this lateral flange, but the condition usually disappears with age. Whether in youth it is due to the action of the gluteus maximus in balancing the pelvis and raising the body, and to the vasti in climbing movements producing an effect on the young and pliable bone, or to a survival of a condition constant in earlier times, it is difficult to guess. If the lateral flange in young bones is a survival of the nature indicated, we may compare it with the condition of the foetal talus, which frequently shows an extension from the upper articular surface on to the neck, believed to be reminiscent of the squatting posture presumably adopted by ancestral forms.[3]

In the gorilla, where the gluteus maximus has an extensive attachment to the ischium, this ischio-femoralis mass is inserted into a depression on the back of the shaft, and there is at this point some platymeria indicated by a lateral flange. [Parsons,[4] whose work has been published since this paper was written, believes that the gluteus maximus takes no part in the formation of the lateral flange, and that platymeria is due to the vasti only.]

The medial flange is not sufficiently marked in any of these old Dublin bones to obscure the lesser trochanter when the bone is viewed from in front. I believe that, when present, it indicates an attachment of the vastus medialis to the medial surface of the shaft, and of the intermedius to the front, the flange itself giving attachment to both muscles. In other words, development of the vastus intermedius has pushed the medialis round to the medial side, and the development of a medial extension of the shaft in this position has allowed of more extensive attachment of both muscles. Where I have seen it in recent Irish bones it has been more pronounced when the shaft was but little curved, though Duckworth[5] seems to think that platymeria is usually well seen in curved and pilastered femora. Bryce[6] records the case of a negro whom he dissected, where the vastus medialis was confined to the medial

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[1] Turner, Challenger Reports and Journal of Anatomy and Physiology, vol. xxi, 1887.

[2] Hepburn, Journal of Anatomy and Physiology, vol. xxxi, 1897.

[3] Keith, "Human Embryology and Morphology."

[4] Parsons, Journal of Anatomy and Physiology, vol. xlviii, 1914.

[5] Duckworth, "Morphology and Embryology."

[6] Bryce, Journal of Anatomy and Physiology, vol. xxxii, 1898.

surface of the shaft, i.e., behind the flange, the vastus intermedius occupying the front of the bone and the anterior aspect of the ridge. The presence of the flange was afterwards verified in the skeleton. It seems likely, therefore, that in at least some cases this medial extension is associated with alteration in the proportionate attachments of the vastus medialis and intermedius, the formation of the flange providing a greater area for the attachment of both these muscles. In two specimens from this collection, in which this flange was only developed to a small extent, a condition is present bearing out this view. Usually the spiral line to which the vastus medialis is attached appears to be directly continuous with the anterior intertrochanteric ridge, as the muscle arises from both. If the muscle be pushed round to the medial surface, we would expect this continuity to be less manifest, and in the specimens here described this is found to be the case. The spiral line can be traced up to the medial flange, and there a somewhat rough area is present, indicating the upper attachment of the muscle.

The medial flange appears to be of the nature of a buttress for the upper end of the shaft, and I found, on making sections of recent specimens in which the flange is present, that the spiral lamellae are more concentrated in this region than in other bones.

High degrees of platymery are usually associated, according to Hepburn and Manouvrier, with a pilastered condition of the shaft, but, as the former remarks, high degrees of either may be present independently, and so probably result from different causes. The pilastric index in this series average 109; the inner fossae were flat, the outer in some cases concave. The latter condition indicates probably a marked development of the vastus intermedius. Pilastering is often seen in slender femora, particularly if the specimen be one of recent times, but is not confined to bones of this type. It is noteworthy that many pilastered bones show strong development of gluteus maximus, even if there be no distinct platymeria, and that this muscle would undoubtedly, under certain circumstances, tend to pull the upper end of the bone backwards, and so accentuate its curvature. It is necessary to remark that there may be strong prominence of the linea aspera without marked hollowing of the outer pilastric fossa. I think this is more common in modern pilastered bones. The index in this collection was determined by Hepburn's method. Only five specimens were suitable for the estimation; the lower index was 96·2, and the highest 112.

The series show that the most platymeric bones are not necessarily the most pilastered. The collection is not sufficiently large for any dogmatic statements, but it conveys the impression that bones with marked curvature of the shaft do not show a well-developed medial flange.

Distal End of Femur.

Four specimens showed this portion of the bone; one of these was much damaged. The latter was remarkable for an extremely narrow intercondyloid notch, such as I found in the Haddon collection of femora from the Torres Straits, which were also very long and slender. In the specimens here referred to, only the very distal end of the bone was preserved, and so a definite statement cannot be made; but the impression given, derived from its examination, leads me to believe that it is portion of a slender thigh-bone.

In the other three cases the intercondyloid notch is broad, indeed it is increased in size, and it seems that the greater breadth is due to more definite curvature of the medial condyle, whereas the narrow notches appear to be associated with marked bowing inwards of the lateral condyle, especially at its anterior part. Large notches are also accompanied by exceedingly strong impressions for the cruciate ligaments, and this is particularly so in respect to the posterior band.

The articular surface does not extend so far up the anterior aspect of the shaft as is usual in relation to the lateral side. For this reason, the medial and lateral segments of the femoral patellar area are more nearly on a level. The facies semilunaris, for the patella in extreme flexion, was well defined, and the indentations at the margins of the articular surface were sharply shown.

On the posterior and upper aspect of each medial condyle was a small facet such as was described by Charles[1] as caused by extreme flexion of the knee-joint.

The popliteal index (Hepburn[2]) in each of the three specimens conformed to that found in modern bones.

Tibiae.

Only three showed portion of the upper extremity, and unfortunately in each of these the articular surface is much damaged.

There is in these bones no backward curvature of the shaft, such as has been described by Collignon,[3] Fraipont,[4] and Thomson[5] as occurring in ancient tibiae and indicating in them a less erect gait, with the angle between femur and tibia intermediate between that found in man and the anthropoid apes. This condition is said to be interchangeable with an increase of the convexity

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[1] Charles, *loc. cit.*

[2] Journal of Anatomy and Physiology, vol. xxxi, 1897.

[3] Collignon, Revue d'Anthropologie de Paris, vol. ix, 1880.

[4] Fraipoint, Revue d'Anthropologie de Paris, vol. iii, 3rd series.

[5] Thomson, Journal Anatomy and Physiology, vol. xxiii, 1889.

of the curvature of the lateral condylic surface. Thomson attributes the latter to habitual use of the flexed position of the knee-joint. The articular surface is too damaged in each of the specimens to allow of measurement according to Thomson's method, but I consider that the convexity had been somewhat greater than usual. The association of this condition with the platycnemia described below is interesting, as is also the occurrence of the facet at the lower end of the bone. The three conditions are found together in anthropoids, and are apparently associated with habitual and forcible flexion at the knee- and ankle-joints.

The remaining part of the upper surface of the tibia calls for no comment save for the strong impressions produced by the cruciate ligaments and the horns of the semilunar cartilages.

The shafts are chiefly remarkable for the increase in antero-posterior diameter producing flattening, or platycnemia. This is caused by the strong prominence of the upper part of the ridge intervening between the areas for attachment of the tibialis posticus and flexor longus digitorum respectively.

In one thick bone the lower part of the soleal ridge is enormously developed and very prominent. The area of attachment of the tibialis posticus is increased. If we presume that these people were squatters, we can readily understand the increased development of the tibialis posticus, the flexors, and the soleus, as these muscles would, in the squatting position, serve to balance the leg on the foot, and in rising from that attitude they would be brought into play at the beginning of the act. The platycnemic index was estimated and found to average 69·2, ranging from 60·7 to 75·8. It is only right to add that the lower indices were obtained from damaged specimens, where absolute accuracy could not be obtained.

It is interesting to compare these figures with the indices given by Manouvrier and Duckworth :—

Modern French (males)—Manouvrier,	88·2
„ (females) „	80·6–108·3
Negroes „	85·3
Pre-Columbian Venezuelans—Duckworth,	76·1
Maori A, „	77·7
Maori B, „	66·6 right side. 60·0 left side.
Old Irish—average of six specimens,	69·2

In my own series I found the index lower on the right side than on the left.

In all the cases the upper part of the origin of the flexor longus digitorum is particularly well defined, and the prominence of the ridge separating it from the tibialis posticus is greatest about one inch below the nutrient foramen.

The index was estimated by Broca's method, taking the measurements at the level of the nutrient foramen.

The distal end of the tibia is only present in two specimens, and in each of these there is a definite extension forwards of the articular surface from the inferior aspect on to the anterior margin of the bone close to its lateral limit. This is rarely found in recent Irish specimens, but is common in squatting races, and is associated with forcible and constant flexion at the ankle-joint producing contact between the neck of the talus and the tibia. Unfortunately no tali were recovered.

FIBULA.

Portions of three were recovered, and one of these is complete but for the upper aspect of the head. It is chiefly remarkable for its antero-posterior compression, causing it to appear as though flattened, and for the bowing of the shaft as shown by the marked lateral curvature of the lower portion and malleolus. The increase in width was due to extension inwards in a flange-like manner of the postero-medial border, providing a very large surface for attachment of the tibialis posticus. The posterior surface was also considerably increased in width, especially about its centre, and thus afforded an extensive area for the flexor longus hallucis. These conditions indicate that, as we found in the tibia, the muscles in the posterior crural region had been subject to some extra functional strain causing their development to a greater extent than is usual in recent specimens.

SUMMARY OF LOWER LIMB BONES.

1. The only femur with a complete head showed an extension on the articular surface on to the front and upper aspect of the neck. This is probably produced by the cotyloid ligament, and differs from that seen in recent bones, which is placed lower down, and lies against the ilio-femoral ligament.

2. The presence on the lateral and anterior aspect of the femoral neck of the groove produced by the iliacus muscle is remarkable as indicating strong development of this muscle and close contact with the capsule, such as would be expected in a squatting race.

3. The frequency of development of a third trochanter is noteworthy, it being relatively uncommon in recent bones. Its association with (*a*) lateral

flanging, and (*b*) pilastering is noteworthy. One would expect a powerful gluteus maximus in a squatting people.

4. Platymeria is relatively uncommon among modern bones. In this collection it was well marked, and the lateral and medial flanges occurred separately.

The association of trochanter tertius and fossa hypotrochanterica with the lateral flange leads one to believe that the gluteus maximus has some influence in its production, though I do not believe that it alone will produce it.

The condition of the medial femoral flange in some of these bones suggests its production by alterations in the relative attachments of the vastus medialis and intermedius.

5. The association of the rough depression at the lateral side of the gluteal ridge with the size and extent of the lateral flange suggests that it may have some influence on the formation of the latter.

6. Probably the cause of the medial flange is not a single one; its presence is not due to development of muscles alone. The position of the flange, its occurrence occasionally among modern specimens, and the appearance of the bone on section would suggest that it may also act as a supporting factor or buttress. It seems less marked in bones with a distinct forward curvature of the shaft; sections of the flange show the cancellous arches passing more definitely and strongly to this region than in ordinary specimens, suggesting that the bone had been subjected to marked twisting movements. In habitual squatting there would be maintenance of the femur for long periods in a rotated position.

7. The amount of pilastering is moderate, and is only noteworthy in that it bears out former statements as to the likelihood of platymeria and pilastering being due to different causes.

8. The deep impressions for the posterior cruciate ligaments and the small facet at the back of the internal condyle both bear out the assumption of a frequently flexed condition of the knee-joint in these people.

9. The distinct platycnemia appears to be associated with strong development of the tibialis posticus and flexors, the strength of these muscles leaving its impress on both tibia and fibula. The occurrence of these conditions (increase in strength of muscles in posterior crural region) may be explained either by assuming the adoption of the squatting attitude or frequent running exercise in an active race. The various other points detailed indicate that the former is here most likely to be the correct explanation.

10. The facet on the outer part of the front of lower tibial extremity indicates full habitual flexion of the ankle-joint. Altogether we can best and most easily explain the occurrence in association to such a marked extent in a small series by assuming that these people adopted the more primitive mode of rest and maintained the joints of the lower limb in a condition of marked flexion for prolonged periods.

It would be most interesting to ascertain when the Irish relinquished this squatting attitude. Through the kindness of Professor John MacNeill, I am able to quote the following statement, which indicates how our knowledge of the habits of the older people of Ireland fits in with our assumption as to the cause of the remarkable features in these lower limb bones. In a letter dated August, 1913, he writes: "On the whole, then, I think we must suppose artificial seats to have been in use in Ireland, not only throughout the Celtic period, which I date from 400 B.C., but probably to a greater or less extent during the preceding thousand years of the Bronze Age, and must go back to the Stone Age to find a population among whom artificial seats are unknown." But he points out that we must differentiate between various classes of the people, and that even to-day, in the more remote districts, the peasants frequently use the squatting position, and that it could not have been until after iron was introduced (about 500 B.C.) that seats of an artificial nature became available for anything but ceremonial purposes. Probably it was many centuries before they came into common use, and that even then the people frequently returned to the older method of rest.

V.

STUDIES IN THE DIFLAVONE GROUP.

I.—Diflavone.

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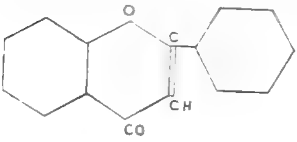
Read January 25. Published April 26, 1915.

The best known and the most widely distributed of the plant dyes are those which are derived from flavone, or from the closely related substance, flavonol.

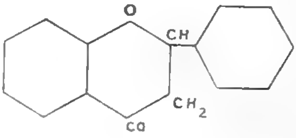
These dyes are, however, of a light yellow, or a yellow colour; and in no case is the colour of a flavone, or of a flavonol, of a deeper tint than yellow.

There are, however, several natural red dyes, the constitutions of which have not yet been determined; and in this connexion it seemed to us of interest and importance to prepare substances containing a condensed form of two flavone rings with a view to determining the effect of such a structure on the depth of the tint of the compound.

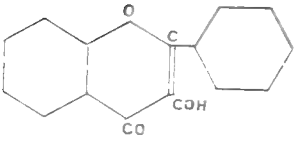
Thus from flavone, flavanone, flavonol, and their parent substance chromone



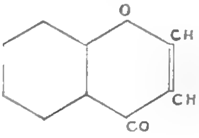
Flavone.



Flavanone.

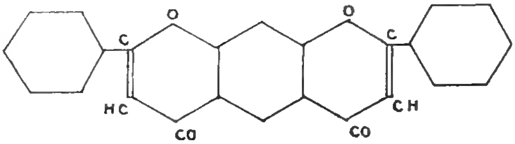


Flavonol.

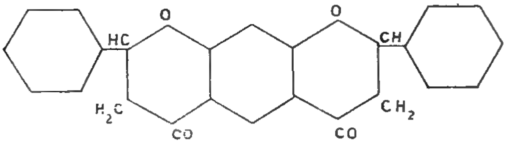


Chromone.

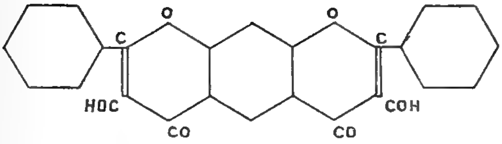
we may derive compounds represented by the formulæ :—



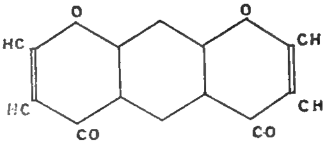
Diflavone.



Diflavanone.



Diflavonol.

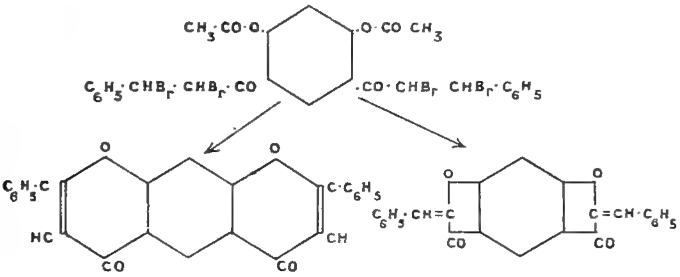


Dichromone.

and which may be termed, provisionally, diflavone, diflavanone, diflavonol, and dichromone respectively.

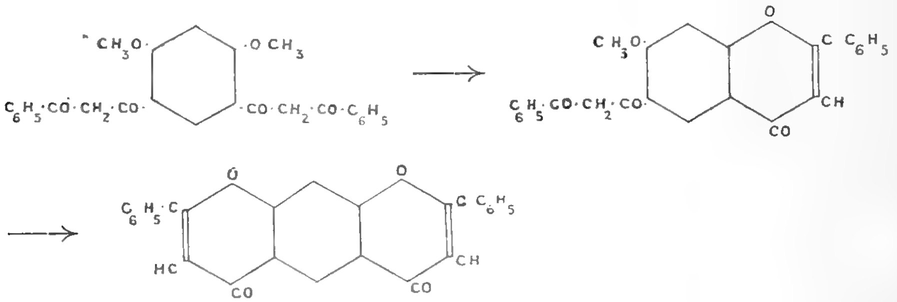
We have so far attempted the preparation of two of these compounds, and in the present communication we describe the syntheses of one of them.

As parent substance we employed diacetoresorcinol, a compound which Eijkman, Bergema, and Henrard (Chemisch Weekblad I, p. 453) obtained from resorcinol diacetate. We converted the diacetoresorcinol into its dimethylether, and from the latter by interaction with benzaldehyde we obtained the dimethylether of dihydroxy-dichalkone which reacted with aluminium chloride to give dihydroxy-dichalkone. By acetylation and bromination of the latter compound we prepared the diacetate of dihydroxy-dichalkone-tetrabromide, which reacted with alcoholic potash to give diflavone and some dibenzylidene-dicoumaranone :—



Diflavone. Dibenzylidene-dicoumaranone.

A purer preparation of diflavone was obtained from the diketone, dibenzoylaceto-resorcinol dimethylether, formed by the condensation of methyl benzoate with diacetoresorcinol-dimethylether. This diketone when boiled for an hour with concentrated hydriodic acid is converted into benzoylaceto-methoxy-flavone, and on more prolonged boiling forms diflavone:—



The reactions do not proceed so smoothly as in the monoflavone series, and it was only after many failures and many variations of the conditions of the different experiments, that we were successful in the preparation of the compounds.

Diflavone, which has a faint yellow colour, is only slightly more coloured than the colourless flavone. Also its sulphuric acid solution, which has a brilliant blue fluorescence, has a faint yellow colour, while that of monoflavone is colourless.

As the substance, however, like flavone contains no auxochrome groups, we must postpone the consideration of the effect of the structure on the depth of the colour until we shall have prepared derivatives of diflavone containing auxochrome groups.

Experimental Part.

Resorcinol diacetate was prepared by cooling a mixture of 44 grams of resorcinol and 56 c.c. of acetyl chloride in a round flask under a reflux condenser until the energetic reaction, which set in, had subsided, and then heating the flask in an oil bath to 120° C. until the evolution of hydrochloric acid ceased.

Diacetoresorcinol was obtained from the diacetate by dissolving 10 grams of anhydrous zinc chloride in the hot diacetate and heating the mixture to 130° C. for a quarter of an hour. The molten mass was cooled and extracted a few times with methylated spirit. The solid residue was dissolved in boiling chloroform, and from the chloroform solution the diacetoresorcinol was precipitated by addition of alcohol. About 24 grams of diacetoresorcinol were obtained. After solution in chloroform and reprecipitation by alcohol it crystallised in colourless prisms which melted at 183° C., and in alcoholic solution gave a red colour with ferric chloride.

It can be readily converted into its dimethylether by means of aqueous alkali and dimethyl sulphate.

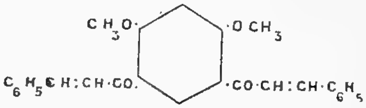
Diacetoresorcinol-dimethylether $C_6H_2(O\,CH_3)_2(CO\,CH_3)_2$.

Diacetoresorcinol (20 grams) was added to a solution of potash (23 grams) in water (50 c.c.), and the mixture was heated in a large flask on a sand bath. Dimethyl sulphate (38 c.c.) was added in about five instalments, and when the reaction was completed the contents of the flask were cooled, diluted with 200 c.c. of water, and made slightly alkaline by addition of potash. The solid, which separated, was filtered, washed with water and alcohol, and finally recrystallised from chloroform and alcohol.

About 14 grams of the dimethylether were obtained. It crystallised in colourless prisms, which melted at 171° C. It was insoluble in dilute alkali, and its solution in alcohol gave no coloration with ferric chloride. Eijkman, Bergema, and Henrard (*loc. cit.*) obtained it by the action of alkali and methyl iodide on diacetoresorcinol.

The dimethylether condenses readily with benzaldehyde to form the dimethylether of dihydroxy-dichalkone.

o.o. Dihydroxy-dichalkone-dimethylether
Dibenzylidene-diacetoresorcinol-dimethylether.



On addition of 1 c.c. of fifty per cent sodium hydrate to a warm solution of 2 grams of diacetoresorcinol-dimethylether and 2 c.c. of benzaldehyde in 25 c.c. of alcohol, and on warming the mixture for a short time on the water-bath, a yellow crystalline compound separated. The solid was filtered, washed with dilute alcohol, dried and recrystallised from boiling benzene. The yield was nearly quantitative. When dried at 105°C., the substance melted at 156–157°C., and gave on analysis the following results:—

0·1558 substance gave 0·4498 CO_2 and 0·0838 H_2O
corresponding to C 78·7, H 5·9
$C_{26}H_{22}O_4$ requires C 78·4, H 5·53.

Dihydroxy-dichalkone-dimethylether crystallises from benzene in light yellow prisms which are insoluble in water, dilute potash, petroleum ether or ligroïn, scarcely soluble in cold alcohol or ether, and readily soluble in chloroform.

The crystals turn red on contact with concentrated sulphuric acid, in which they dissolve to an orange-red solution. An alcoholic solution of the substance gave no coloration with ferric chloride.

The substance is readily demethylated by hydriodic acid.

When 0·1510 gram of the compound was heated for an hour with 15 c.c. hydriodic acid of constant boiling-point,

0·1774 gram of silver iodide (Zeisel's method) was got,
corresponding to O CH_3 15·52
$C_{24}H_{16}O_2(OCH_3)_2$ requires O CH_3 15·58.

Although dibenzylidene-diacetoresorcinol-dimethylether can be readily prepared, and completely demethylated by means of hydriodic acid, it is not a convenient parent substance for the preparation of diflavanone or diflavone. The dichalkone which was formed from it by the action of hydriodic acid was so resinified during the demethylation that no crystalline substance could be extracted from the product. Demethylation by means of anhydrous aluminium chloride gave a well crystallised dichalkone, but the yield was poor.

o.o. Dihydroxy-dichalkone $C_6H_2(OH)_2(CO.CH:CH.C_6H_5)_2$.

About 4 grams of dibenzylidene-diacetoresorcinol-dimethylether were dissolved in 25 c.c. of boiling xylene, and 3 grams of anhydrous aluminium chloride were added. The mixture was heated in an oil-bath to gentle boiling for an hour and a half. The orange-red solid, which separated, was washed with ether, decomposed by dilute hydrochloric acid, and extracted with warm chloroform. The yellow crystalline substance which was left on the evaporation of the chloroform was washed with alcohol and ether and then recrystallised from boiling benzene. It melted at 196–198° C., and gave on analysis the following results:—

0·1526 substance gave 0·4358 CO_2 and 0·0766 H_2O,
corresponding to C 77·88, H 5·5,
$C_{24}H_{18}O_4$ requires C 77·84, H 4·9.

Dihydroxy-dichalkone separates from benzene in small doubly refractive crystals, which very closely resemble cubes in appearance, and are light yellow when cold, and deep yellow when heated. It is insoluble in water, scarcely soluble in alcohol or ether, and soluble in benzene, chloroform, or dilute aqueous potash. Ferric chloride colours its alcoholic solution red.

The crystals turn orange-red in contact with concentrated sulphuric acid, in which they dissolve to an orange solution.

The dichalkone was also obtained in small quantity by shaking for five weeks a solution of diacetoresorcinol in very dilute sodium hydrate with benzaldehyde. On recrystallisation from benzene the substance melted at 196–198°, and was identical in every respect with that prepared by the action of aluminium chloride on dihydroxy-dichalkone-dimethylether.

As the amount of dihydroxy-dichalkone at our disposal was small, we prepared the tetrabromide of the dimethylether in the hope that the interaction of it with aluminium chloride might enable us to form the diflavone more conveniently.

Tetrabromide of Dihydroxy-dichalkone-dimethyl ether,

$C_6H_2(OCH_3)_2(CO . CHBr . CHBr . C_6H_5)_2$.

One gram of dihydroxy-dichalkone-dimethylether was dissolved in 10 c.c. of dry chloroform, and 0·85 gram of bromine was added to the solution. The colour of the bromine disappeared rapidly without evolution of hydrobromic acid. After standing a short time alcohol was added, and the crystalline solid which separated was filtered. It was recrystallised from toluene, filtered when cold, washed with alcohol, and dried at 100° C. for analysis.

A determination of bromine in it by Stepanow's method gave the following results:—

0·1800 substance on treatment with sodium and alcohol gave an amount of sodium bromide which required 10·1 c.c. $\frac{N}{10}AgNO_3$ for complete precipitation

corresponding to Br 44·8,
$C_{26}H_{22}Br_4O_4$ requires Br 44·6.

The tetrabromide crystallises from toluene in nearly colourless prisms, which melt with decomposition at 185–186° C., and are only sparingly soluble in alcohol, ether, ligroïn, or chloroform. When suspended in boiling alcohol it gives no coloration with ferric chloride.

On heating a solution of the substance in boiling xylene with anhydrous aluminium chloride a dark green oily substance was formed, and from it we were unable to isolate any crystalline compound.

Having failed to obtain diflavone from the tetrabromide of the dimethyl ether, we then prepared the tetrabromide of dihydroxy-dichalkone-diacetate, in the expectation that the latter compound would react with alcoholic potash to form diflavone.

Tetrabromide of Dihydroxy-dichalkone-diacetate,

$C_6H_2(OOCCH_3)_2(CO . CHBr . CHBr . C_6H_5)_2$.

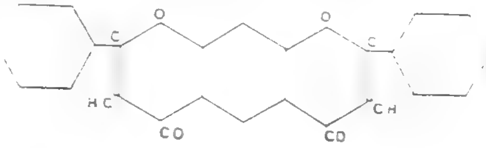
A mixture of 1 gram of dihydroxy-dichalkone, 1 gram of anhydrous sodium acetate, and 10 c.c. of acetic anhydride was heated to boiling on a sand-bath, cooled, and poured into water. After standing for some time the aqueous layer was decanted. The residual oil was dissolved in ether, the solution was washed with dilute sodium carbonate, and the ether was evaporated. The oily acetate was dissolved in dry chloroform, and to the solution 0·8 gram of bromine was added. The mixture was let stand in a stoppered flask until the colour of the bromine had disappeared, the chloroform was then evaporated, and the colourless crystalline residue was recrystallised from boiling toluene. When dried at 110° C. it melted at 176–178°, and gave on analysis the following results:—

0·1621 substance treated with sodium and alcohol required 8·3 c.c. $\frac{N}{10}$ $AgNO_3$ to completely precipitate the sodium bromide,

corresponding to Br 40·92,
$C_{28}H_{22}Br_4O_6$ requires Br 41·31.

It crystallises from boiling toluene in long colourless needles which are sparingly soluble in the ordinary organic solvents.

Diflavone.



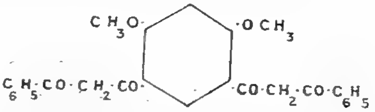
After addition of 0·5 gram of the tetrabromide of dihydroxy-dichalkone-diacetate to 7·8 c.c. of semi-normal alcoholic potash, the tetrabromide dissolved rapidly to a solution, the colour of which changed quickly from yellow to red. Potassium bromide was precipitated, and after warming for a short time on the water-bath a copious separation of felted needles ensued. The crystals were filtered, washed with water and alcohol, dried, and recrystallised from boiling toluene.

When dried at 105° C. it softened at 275° C. and melted to a brownish liquid at 277–278°C. It gave on analysis the following results:—

0·1587 substance gave 0·4558 CO_2 and 0·0537 H_2O.
corresponding to C 78·33 H 3·8
$C_{24}H_{14}O_4$ requires C 78·66 H 3·85.

It crystallises from toluene in faint yellow needles which are scarcely soluble in petroleum ether, alcohol, or ether, soluble in carbon disulphide, and readily soluble in chloroform. It is insoluble in water or dilute aqueous potash. In boiling alcohol it is sparingly soluble, and the solution gives no coloration with ferric choloride. The presence of dibenzylidene-dicoumaranone in the product was indicated by the fact that the crystals were turned orange by concentrated sulphuric acid, in which they dissolved to an orange-yellow solution which had a blue fluorescence. Pure diflavone which was got by acting on dibenzoylaceto-resorcinol-dimethylether with hydriodic acid is coloured only a faint yellow by concentrated sulphuric acid, and its faint yellow solution in the acid has a beautiful blue fluorescence.

Dibenzoylaceto-resorcinol-dimethylether.



A mixture of 10 grams of diacetoresorcinol-dimethylether and 100 c.c. of methyl benzoate was heated in a round flask under a reflux condenser until the solid had all dissolved. The solution was cooled and 4·2 grams of sodium wire were added gradually to it. When the energetic reaction had subsided the mixture was heated to 120° C. in an oil-bath for fifteen minutes, and then after addition of dry ether to the cold mixture it was let stand in a stoppered flask for several hours.

The sodium derivative of the diketone separated as a brownish solid. The latter was disolved in water, and separated from the ethereal solution of the excess of methyl benzoate.

On addition of hydrochloric acid to the aqueous solution a yellow solid was precipitated. The solid was filtered, washed with water and alcohol, dried and recrystallised from boiling benzene. About five grams of the diketone were obtained. When dried at 110° C. it melted at 200–201° C. and gave on analysis the following results:—

0·1971 substance gave 0·5254 CO_2 and 0·0920 H_2O
corresponding to C 72·7, H 5·2
$C_{26}H_{22}O_6$ requires C 72·6, H 5·1.

Dibenzoylaceto-resorcinol-dimethylether crystallises from benzene in light yellow plates which are sparingly soluble in alcohol, ether, or ligroïn, and readily soluble in chloroform. It dissolves slowly in aqueous potash. A hot alcoholic solution of the diketone develops a dark reddish-brown coloration on the addition of ferric chloride.

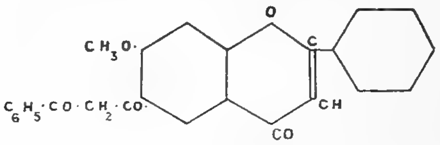
The crystals are turned red by concentrated sulphuric acid in which they dissolve to an orange solution.

In attempting to convert the diketone into diflavone we experienced many difficulties, due to the variable behaviour of hydriodic acid towards the substance; and it was only after numerous experiments under varying conditions that the difficulties were finally overcome.

While hydriodic acid (sp. g. 1·5) scarcely affects the diketone, the acid of specific gravity 1·7 converts the substance on short heating (1 hour) into

2. benzoylaceto–3. methoxy-flavone and on prolonged heating (5 hours) into diflavone.

2. *Benzoylaceto-3. methoxy-flavone.*



Two grams of dibenzoylaceto-resorcinol-dimethylether were heated with 20 c.c. of hydriodic acid (sp. g. 1·7) to 135° C. under a reflux condenser for an hour. The mixture was then well shaken with a solution of sodium bisulphite, filtered and washed with water and alcohol. The crystallised residue was dissolved in warm chloroform, filtered and mixed with two volumes of alcohol. The solid was filtered, dried, and recrystallised from boiling benzene. It melted at 238° C., and gave on analysis the following results:—

0·1539 substance gave 0·4259 CO_2 and 0·0629 H_2O,
corresponding to C 75·47, H 4·54.
$C_{25}H_{18}O_5$ requires C 75·4, H 4·52.

Benzoylaceto-methoxy-flavone crystallises in faint yellow prisms which are scarcely soluble in ether, alcohol, or petroleum ether, and readily soluble in chloroform. It is sparingly soluble in cold benzene or boiling alcohol, and the alcoholic solution gives a brownish-red coloration with ferric chloride.

The crystals are coloured a faint yellow by concentrated sulphuric acid in which they dissolve to a yellow solution which has a greenish fluorescence.

Conversion of Dibenzoylaceto-resorcinol-dimethylether into Diflavone.

Two grams of dibenzoylaceto-resorcinol-dimethyether were heated to 135° C. for 5 hours with 20 c.c. of hydriodic acid (sp. g. 1·7). The product was freed from iodine by shaking with a solution of sodium bisulphite, filtered, washed with water and alcohol. The solid was dissolved in warm chloroform. The solution, after shaking with dilute potash, was filtered and the chloroform was evaporated. The dry residue was recrystallised a couple of times from boiling toluene. It softens at 275° C. and melts at 281–282° C. to a brownish liquid. The pure diflavone obtained by this method differs from that got from the dihydroxy-dichalkone only in the slightly higher melting-point and in its behaviour towards sulphuric acid.

The pure diflavone dissolves in concentrated sulphuric acid to a faint yellow solution which has a magnificent blue fluorescence, while that got from the dichalkone containing some dibenzylidene-dicoumaranone gives an orange solution in sulphuric acid, with a somewhat less intense blue fluorescence.

VI.

ON THE CONDENSATION OF ALDEHYDES WITH β-DIKETONES.

BY HUGH RYAN, D.Sc., AND REV. J. M. DUNLEA, M.Sc.,
University College, Dublin.

Read JANUARY 25. Published APRIL 26, 1915.

ON a previous occasion we laid before the Academy the results of certain investigations [Proc. Royal Irish Acad., xxxii. B, p. I] we had made on the syntheses and properties of unsaturated β-diketones, with especial reference to dicinnamoyl-methane, which is supposed to be the parent-substance of the interesting plant-dye curcumin.

We mentioned that we had attempted the syntheses of such substances by two distinct methods, namely :—

(1) The condensation of esters with monoketones in the presence of sodium or sodamide.

(2) The condensation of aldehydes with saturated diketones in the presence of a dehydrating agent.

The first of these methods was dealt with in our previous communication; the second forms the subject-matter of the present one.

We have shown [*loc cit.*] that an unsaturated ester such as cinnamic ester condenses readily with saturated ketones such as acetone, acetophenone, methyl-ethyl-ketone, methyl-isopropyl-ketone, to form bodies of the type

$$C_6H_5 . CH : CH . CO . CH_2 . CO . R.$$

We also tried to condense cinnamic ester with benzylidene-acetone with a view to synthesising dicinnamoyl-methane,

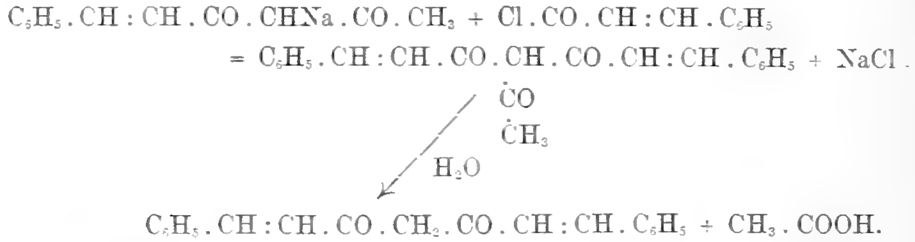
$$C_6H_5 . CH : CH . CO . CH_2 . CO . CH : CH . C_6H_5,$$

the parent-substance of curcumin, but without success. This compound has however, since been prepared by von Lampe and Milobedzka [Ber. 46 (1913) p. 2235], whose method may be briefly stated as follows :—

By hydrolysis of Fischer's cinnamoyl-acetoacetic ester they obtained cinnamoyl-acetone :—

$$C_6H_5 . CH : CH . CO . CH(COOC_2H_5) . CO . CH_3$$
$$\downarrow H_2O$$
$$C_6H_5 . CH : CH \quad CO \quad CH_2 . CO . CH_3 + CO_2 + C_2H_5OH.$$

With the mono sodium derivative of the latter they condensed cinnamic chloride, thus obtaining dicinnamoyl-acetyl-methane, which on hydrolysis yielded dicinnamoyl-methane:—



$$C_5H_5 . CH : CH . CO . CHNa . CO . CH_3 + Cl . CO . CH : CH . C_6H_5$$

$$= C_6H_5 . CH : CH . CO . \underset{\underset{CH_3}{CO}}{CH} . CO . CH : CH . C_6H_5 + NaCl .$$

$$\swarrow H_2O$$

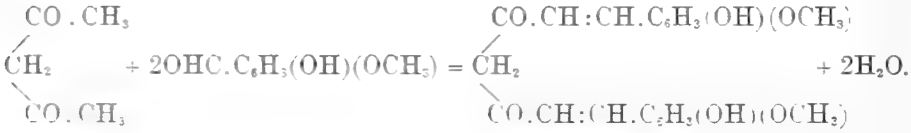
$$C_6H_5 . CH : CH . CO . CH_2 . CO . CH : CH . C_6H_5 + CH_3 . COOH.$$

The synthesis of a derivative of dicinnamoyl-methane was also tried by us by the second method mentioned above; and with the results of these experiments the present paper is concerned.

Although the study of the two methods was carried on simultaneously, unforeseen difficulties prevented the publication of the results of the second method. In the interval there has appeared another paper on similar lines by Heller [Ber. 47 (1914), p. 887], in which a claim is put forward for the synthesis of a stereo-isomeride of curcumin, which he calls iso-curcumin.

$$(CH_3O)(HO)C_5H_2 . CH : CH . CO . CH_2 . CO . CH : CH . C_6H_3(OH)(OCH_3).$$

This substance according to Heller is formed by the condensation of vanillin with acetylacetone in the presence of alcoholic hydrochloric acid thus:—

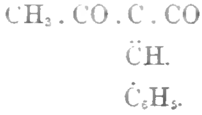


$$CH_2\begin{cases} CO . CH_3 \\ CO . CH_3 \end{cases} + 2OHC.C_6H_3(OH)(OCH_3) = CH_2\begin{cases} CO.CH:CH.C_6H_3(OH)(OCH_3) \\ CO.CH:CH.C_5H_3(OH)(OCH_2) \end{cases} + 2H_2O.$$

Making all allowances for the necessary imperfection of a preliminary report, Heller's paper is not convincing. We have found that the first product of the action of benzaldehyde on acetylacetone is not

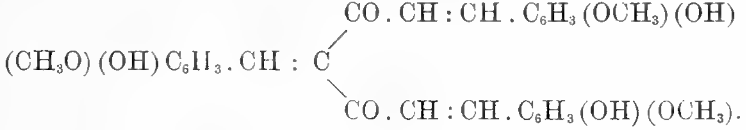
$$C_6H_5CH : CH . CO . CH_2 . CO . CH_3,$$

a crystalline compound obtained in another way by us [loc. cit., p. 4] and melting at 83–84° C., but rather a chlorinated substance, which, when heated *in vacuo* [Knoevenagel Ann. 281, p. 80], forms an oily compound



$$CH_3 . CO . \underset{\underset{C_6H_5.}{\overset{\|}{CH.}}}{C} . CO . CH_3$$

Consequently the result of complete interaction of vanillin with acetylacetone would probably be a tri-vanillin condensation product of the following formula:—



This is borne out by Heller's own analytical data. Thus for iso-curcumin he gives—

found . .	C 69·38	69·35	H 5·52	5·63
($C_{21}H_{20}O_6$) calculated .	68·48	—	5·43	—
difference .	0·9	0·87	0·09	0·2

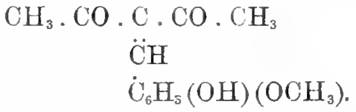
There is here a considerable discrepancy in the carbon column. On our tri-vanillin acetylacetone hypothesis the results would be as follows:—

found . .	C 69·38	H 5·52
($C_{29}H_{26}O_8$) calculated .	69·32	5·17
difference .	0·06	0·35

We might also mention that in the introduction to his paper Heller says that Knoevenagel [Ber. 37 (1904) 4480] obtained a vanillin-acetylacetone "of obviously the following formula":—

$$(CH_3O)(OH)C_6H_3 . CH : CH . CO . CH_2 . CO . CH_3.$$

Knoevenagel, however, gives no structural formula for this compound, but to anyone reading the communication it is apparent that the type of formula which Knoevenagel had in mind was



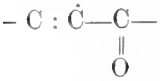
$$\begin{array}{c} CH_3 . CO . C . CO . CH_3 \\ \dot{C}H \\ \dot{C}_6H_3(OH)(OCH_3). \end{array}$$

From what we have just said, it is evident that to obtain a substance of the type attributed to curcumin it would be necessary to protect the methylene group of the diketone before attempting the condensation. This we did by converting the acetylacetone into its mono- or di-methyl derivative.

Using di-methyl-acetylacetone, the condensation with benzaldehyde in the presence of anhydrous hydrochloric acid yielded bright red crystals, which on exposure to the air gradually split off hydrochloric acid and became colourless. The colourless compound was found on analysis to have the formula $C_{25}H_{23}O_2Cl$. When heated with pyridine it was converted into another crystalline substance of the formula $C_{25}H_{22}O_2$. The latter body reacted with hydroxylamine to form a compound $C_{25}H_{23}O_2 . NHOH$, and with bromine to form a derivative $C_{25}H_{22}O_2Br_2$.

Since the compound $C_{25}H_{22}O_2$ is not decomposed on prolonged boiling with dilute, or concentrated potash, it cannot be a β-diketone derivative; and, as it adds on only two atoms of bromine, it probably contains only one non-aromatic double bond.

The formation of the *addition* compound with hydroxylamine instead of the expected oxime indicates the existence in the compound of the group $- C : \underset{\overset{\|}{O}}{\dot{C}}—C—$; and the fact that the hydrochloride forms an unstable red addition compound with hydrochloric acid points to the presence in the complex of a pyrone ring.



A compound having the empirical formula $C_{25} H_{23} O_2 Cl$ may be derived from dimethyl-acetylacetone according to either of the following equations :—

$$(1)\ 2C_6H_5 . CHO . + 2CH_3 . CO . C(CH_3)_2 . CO . CH_3 + 4\ HCl = C_{25}H_{23}O_2Cl + 3CH_3Cl + 4H_2O.$$

$$(2)\ 3C_6H_5CHO + CH_3 . CO . C(CH_3)_2 . CO . CH_3 + 2HCl = C_{25}\ H_{23}O_2Cl + CH_3Cl + CH_3COOH + 2H_2O.$$

As we have found experimentally that dimethylacetylacetone may be replaced by monomethyl-acetylacetone without altering the resulting product, it is evident that one or more methyl radicles must in fact get split off during the reaction.

Of the above equations we prefer the second for two reasons :—

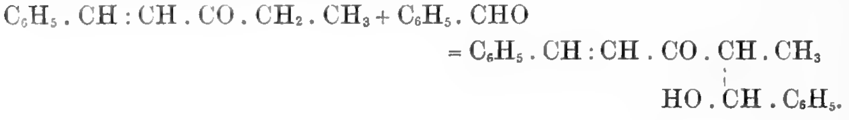
1. The yield of the compound, when three molecular quantities of benzaldehyde to one of the dimethyl-acetylacetone are taken, is much greater than when equimolecular quantities are employed.

2. Whilst it is easy to formulate according to the second equation a compound $C_{25}H_{22}O_2$ containing only one non-aromatic double bond, to do so according to the first equation would be very difficult, if not impossible.

Bearing these facts in mind, the reactions may be simply interpreted as follows :—

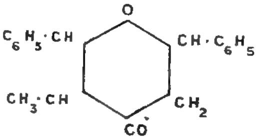
$$C_6H_5CHO + CH_3 . CO . C(CH_3)_2 . CO . CH_3 + HCl = C_6H_5 . CH = CH . CO . CH(CH_3) . CO . CH_3 + CH_3Cl + H_2O$$

$$C_6H_5 . CH : CH . CO . CH(CH_3) . CO . CH_3 + H_2O = C_6H_5 . CH : CH . CO . CH_2 . CH_3 + CH_3 . COOH.$$

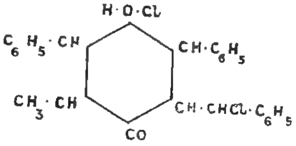


$$C_6H_5 . CH : CH . CO . CH_2 . CH_3 + C_6H_5 . CHO = C_6H_5 . CH : CH . CO . \underset{HO . CH . C_6H_5.}{\underset{|}{CH}} . CH_3$$

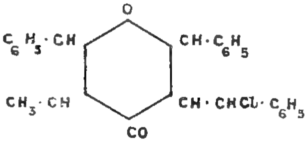
In the presence of hydrochloric acid the latter compound changes into the isomeride,



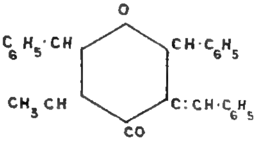
which reacts with benzaldehyde and hydrochloric acid to form the unstable red oxonium salt.



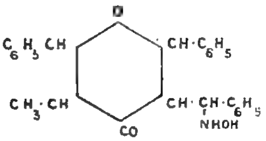
This by loss of hydrochloric acid forms, first the chlorinated compound



and then α . α′-diphenyl-β-methyl-β′-benzylidene-tetrahydro-γ-pyrone



The addition compound formed from this last with hydroxylamine must also be



which belongs to a type of substances obtained by Harries [Ber. 30 (1897), p. 230] from α-β-unsaturated ketones.

Experimental Part.

Condensation of Benzaldehyde with Dimethyl-acetylacetone.

Benzaldehyde (45 c.c.) was added to dimethyl-acetylacetone (10 c.c.) and the mixture was saturated at a low temperature with gaseous hydrochloric acid. The flask was tightly stoppered and allowed to stand at 0° C. for four days. A reddish crystalline mass formed which on exposure to the air became nearly colourless owing to loss of hydrochloric acid. It was washed with absolute alcohol, and on recrystallisation from a mixture of chloroform and alcohol about 20 grams of the condensation product were obtained. It contained chlorine, and crystallised in colourless prisms which turned slightly red at 148° C., and melted with decomposition at 170° C.

Analyses:—

0·2841	substance gave	0·7990 CO_2	and	0·1522 H_2O,
0·1858	„ „	0·5236 CO_2	„	0·1018 H_2O,
	corresponding to	C 76·7		H 5·9,
		C 76·9		H 6·1.
$C_{25}H_{23}O_2Cl$	requires	C 76·9		H 5·9.

The chlorinated product was boiled with pyridine for 3 hours under a reflux condenser, and the solvent was then distilled. The residue was dissolved in chloroform, washed with dilute hydrochloric acid, and the residue was filtered through a dry filter. On addition of alcohol to the filtrate, about 16 grams of colourless crystals were obtained. The product was free from chlorine, melted at 168–169·5° C., and gave on analysis the following results:—

0·3596	substance gave	1·1128 CO_2	and	0·2114 H_2O,
0·2398	„ „	0·7415 CO_2	„	0·1397 H_2O,
0·2368	„ „	0·7323 CO_2	„	0·1394 H_2O,
	corresponding to	C 84·4		H 6·6,
		C 84·3		H 6·5,
		C 84·3		H 6·6.
$C_{25}H_{22}O_2$	requires	C 84·7		H 6·3.

α-α′-Diphenyl-β-methyl-β′-benzylidene-tetrahydro-γ-pyrone crystallises in colourless prisms, which are sparingly soluble in alcohol or ligroïn, and easily soluble in chloroform or ether. It is insoluble in alkali, and undergoes no change on boiling for several hours with either dilute or concentrated potash. Its solution in alcohol gives no coloration with ferric chloride. In concentrated sulphuric acid the crystals are coloured orange, and dissolve to a yellow solution.

Condensation of benzaldehyde with monomethyl-acetylacetone.

A mixture of 10 grams of monomethyl-acetylacetone and 37 grams of benzaldehyde was saturated with gaseous hydrochloric acid under the same conditions as in the previous experiment. The reaction, however, required a longer time for its completion, and was, moreover, attended with the formation of a considerable amount of tarry matter. The latter was removed by repeated washing with cold alcohol until the residue was nearly colourless. When recrystallised from chloroform and alcohol the product was identical with the compound obtained, as described above, from dimethyl-acetylacetone. On boiling with pyridine, hydrochloric acid was split off and α-α'-diphenyl-β-methyl-β'-benzylidene-tetrahydro-γ-pyrone was obtained.

Action of Hydroxylamine on the Tetrahydro-pyrone Derivative.

About 3·5 grams of sodium carbonate were added to a solution of 3 grams of the tetrahydro-pyrone derivative, and 4·5 grams of hydroxylamine hydrochloride in alcohol, and the mixture was heated for three hours under a reflux condenser. Water was then added, and the voluminous mass of crystals was filtered. After drying, the hydroxylamine derivative was recrystallised a few times from a large volume of chloroform. It formed light felted needles, melting at 189–190° C. The yield was practically quantitative. For analysis the crystals were dried at 140°, and gave the following results:—

0·2386	substance gave	0·6731 CO_2	and	0·1454 H_2O,
0·2204	„ „	0·6246 CO_2	„	0·1312 H_2O,
0·2133	„ „	0·6054 CO_2	„	0·1302 H_2O,
0·3160	„ „	10·3 c.c. N. at 750 m.m.p. and 16° C.		

corresponding to	C 77·3	H 6·8,	
	C 77·3	H 6·7,	
	C 77·4	H 6·8	N 3·7,
$C_{25}H_{23}O_2$. NHOH requires	C 77·5	H 6·5	N 3·6.

The crystals of the hydroxylamine derivative are insoluble in potash and scarcely soluble in the ordinary organic solvents.

Action of Bromine on the Tetrahydro-pyrone Derivative.

When a solution of 0·48 gram of bromine in chloroform was added to a chloroformic solution of 1 gram of the tetrahydro-pyrone, the colour of the bromine disappeared without evolution of more than mere traces of hydrobromic acid. The addition compound was recrystallised a few times from chloroform and ligroïn. It forms colourless dense crystals which decompose with evolution of bromine at 160–182° C. They dissolve easily in chloroform or acetone, but are sparingly soluble in alcohol or ligroïn. On analysis the following results were obtained :—

0·2076 substance gave 0·4475 CO_2 and 0·0852 H_2O,
corresponding to C 58·8 H 4·6.
$C_{25}H_{22}O_2Br_2$ requires C 58·4 H 4·3.

VII.

CENSUS REPORT ON THE MOSSES OF IRELAND.

By HENRY WILLIAM LETT, M.A., M.R.I.A.

[Being the twelfth Report from the Fauna and Flora Committee.]

Read April 27, 1914. Published September 16, 1915.

INTRODUCTION.

The Divisions of Ireland adopted in R. Ll. Praeger's "Irish Topographical Botany" are used throughout this report, viz.:—

1. Kerry South
2. Kerry North
3. Cork West
4. Cork Mid.
5. Cork East
6. Waterford
7. Tipperary S.
8. Limerick
9. Clare
10. Tipperary N.
11. Kilkenny
12. Wexford
13. Carlow
14. Queen's Co.
15. Galway S.E.
16. Galway West
17. Galway N.E.
18. King's Co.
19. Kildare
20. Wicklow
21. Dublin
22. Meath
23. Westmeath
24. Longford
25. Roscommon
26. Mayo East
27. Mayo West
28. Sligo
29. Leitrim
30. Cavan
31. Louth
32. Monaghan
33. Fermanagh
34. Donegal E.
35. Donegal W.
36. Tyrone
37. Armagh
38. Down
39. Antrim
40. Londonderry

The nomenclature which I have used is that of Dr. Braithwaite's "British Moss Flora," and his "Sphagnaceæ of Europe and North America," except in the case of some few plants which were not known to that author, and have been described by more recent authors.

For each species there is given so far as has been possible the earliest and the latest known records, except in the case of eighty-six common mosses which occur almost everywhere.

There are certain records to which is joined the name of David Orr, the actual specimens of which exist in several herbaria, but on which doubt has been cast; and as they have not since been found, though carefully searched for, I have enclosed these records in square brackets with a note of interrogation attached to each. A few records of some other mosses will be found similarly marked, as it was not found possible to verify them.

There are some records which are taken from the "Census Catalogue of British Mosses" published by the Moss Exchange Club that I have failed to trace to their original sources, but which I do not feel disposed to reject altogether; such are designated in my "List of the Records" by the numeral "*7.*"

The numerals in italics at the ends of the entries of the records refer to the publication or herbarium from which such entries have been taken, the particulars of which will be found in the Bibliography; while those records which have no numbers appended are to be regarded as new records for the respective divisions. Dates of the nineteenth century are shown thus—'87. Those of the twentieth century are printed in full.

In the case of eighty-six of the commoner mosses which have been recorded from at least twenty-eight divisions, the separate records have been omitted for the sake of saving space.

To all those who have assisted me in compiling this report, I tender my grateful thanks for the collections sent to me, and in some instances for the lists of mosses found by them in the several Botanical Divisions, the respective numbers of which here follow their names:—

Bennis, E. H., 8, 10.
Bennis, Mrs. Helen N. P., 10.
Beresford, D. R. Pack, 13, 14.
Bingham, R. W., 32, 36.
Boyd, Miss M., 36.
Cooper, Miss E. V., 12.
Esmonde, Sir T. H. Grattan, 12.
Flemyng, Rev. W. W., 6.
Fogerty, Dr. George, 8, 9.
Glover, James, 35, 38.
Hemphill, Miss A., 10, 14, 18.
Hepenstall, Miss Dopping, 24.
Hibbert, Mrs., 9.
Hughes, Rev. J. B. A., 20, 21.
Johnson, Rev. W. F., 34.
Jones, D. A., 27.
Joyce, Mrs. F. (now Mrs. Prescott Decie), 15.
Kane, W. F. de V., 9, 16, 26, 32, 33.
Langham, Charles, 33.
M'Ardle, D., 21, 27–29.
Macnamara, G. V., 9.
O'Kelly, P. B., 9.
Peyton, Miss O., 4.
Phillips, R. A., 10–15.
Porter, Wm., 36, 38, 39.
Praeger, R. Ll., 12, 27, 35.
Russell, Miss, 18.
Russell, Canon C. D., 16, 18.
Tetley, W. N., 11–14, 17, 18, 25, 26, 28, 29, 33, 38.
Waddell, Rev. C. H., 2, 6, 8, 9, 31, 32, 35, 37–40.

To Mr. Tetley belongs the credit of having sent me the largest number of plants, amongst which are five species that had not previously been found in Ireland.

I would thank the librarian of the Royal Dublin Society for affording me facilities to consult certain volumes of the Society's Proceedings, and the Keeper and assistants in the Herbarium in the National Museum, for their attentions to me.

I must lastly acknowledge the kindly help given me on many occasions, during a long course of years, in examining critical specimens, by Mr. E. Charles Horrell, Dr. Braithwaite, Mr. H. N. Dixon, Mr. Nicholson of Lewes, and Mr. Wheldon of Liverpool.

And to my good friends Mr. Praeger and Mr. Waddell I am further indebted for their kindness in reading my MS. and proofs, and making many useful suggestions.

THE PROGRESS OF THE MUSCOLOGY OF IRELAND.

The earliest botanist who mentions any mosses found in Ireland is the Rev. **John Ray** (1627–1703) of Black Notley, in Essex. He was the father of systematic botany, and from him Withering and Jussieu gathered their ideas for the arrangement of their Floras, and worked them out. Ray, in his "Synopsis Methodica Stirpium Britannicarum" (London, 1690, 3rd edition, 1724), mentions and describes eight mosses found in Ireland, but only one of them has a locality specified for it. Most, if not all, of these were collected by **William Sherard**, of Oxford, during a visit he paid to Sir Arthur Rawdon at Moira in the county of Down, from whence he explored the shores of Lough Neagh and the Mourne Mountains. Such was the small beginning of the muscology of Ireland. Ray described each plant in a few sentences, and gave one or two references to previous writers who had mentioned it, but he did not give generic and specific names—they were not used at that date. A sample of his style will enable the reader to understand the great advantage that modern botanical works have over the production of the first of the systematists:—

"Hypnum erectum aut fluitans aquaticum, foliis oblongis perangustis acutis, C.G. 219. Muscus palustris valde ramosus, surculis erectioribus, foliolis in tenues et longos mucrones productis Syn. ii, 39, 14, fluitans, foliis et flagellis longis tenuibusque D. Sherard, Dood. Syn. ii, App. 338. In the pits of the shaking bogs in Ireland."

The chief authorities referred to by Ray are Sherard, Doody, and his own history of Oxford plants.

This system of writing a Flora was a new thing, and did not find favour in the eyes of Caleb Threlkeld, M.D., whose "Synopsis Stirpium Hibernicarum" (Dublin, 1727) was the first essay of its kind published in the Kingdom of Ireland. For in it he remarks about Ray's Synopsis: "The curious who consult it will find themselves glutted with numbers and names upon which the author has not begrudged his pains to class them and name them."

Caleb Threlkeld, M.A., M.D. (1676–1738, buried in Dublin), was a native of Cumberland, and came to Dublin as a Dissenting minister, but afterwards was reconciled to the Established Church. He practised as a physician on week days. His botanical excursions extended into the North of Ireland. He mentions eleven species, which was all that was known in his day of mosses found in Ireland. His descriptions are partly in Latin, and never extend beyond eight or nine words. Here is a specimen: "MUSCUS TRICHOIDES LANUGINOSUS ALPINUS, Bryum trichoides erectus Capitulis, Lanuginosum, *A Tough Thready Moss*, called in the *North*, '*Old Wives Tow.*'" The title of Threlkeld's work is—"Synopsis Stirpium Hibernicarum Alphabetice Dispositarum, Sive Commentatio de Plantis Indiginis praesertim Dublinensibus instituta . . ." He gives a locality for one moss, which he takes verbatim from Ray, viz., "On the Mountains in *Crevetenau, Ballina-hinch* in the County of *Down*." Threlkeld quotes an interesting remark made somewhere by a Mr. King, that "Ireland doth abound with mosses more than other Kingdoms," which is as true now as it was in those olden days.

The next writer is **Walter Harris**, whose "The Antient and Present State of the County of Down" (Dublin, 1744) gives "A Catalogue of the more rare Plants found spontaneously growing in the County of Down," in which two mosses are described at p. 184, "Muscus repens major foliis & flagellis longis et tenuibus, donatus *Sherardi. Hist. Oxon.*——Hypnum repens surculis magis erectis, foliis reflexis longioribus cinctis, operculo capituli magno. *Raii Syn.* ——On the Mountains near *Ballinchinch*." This is not much, and it reads as if it were borrowed from Ray; but the book is interesting, as it was the first attempt to produce a distinctive County Flora, and mosses have a share in it.

Then came **Walter Wade,** M.D., A.L.S., 1792. Died in Dublin, 1825. He was Professor to the Dublin Society (now the Royal Dublin Society), and he instigated the establishment of their Botanic Garden at Glasnevin. In "Plantae rariores in Hibernia inventae" (1804), Transactions Dublin Society, iv, i–xiv, 1–214, he gives the names of, and localities for, twenty-seven mosses, viz., *Phascum curvicollum, Fontinalis antipyretica, F. squamosa, Cryphaea arborea, Buxbaumia aphylla, Webera secunda, Tetraplodon bryoides, Polytrichum alpinum, P. urnigerum, P. aloides, Leucobryum glaucum, Bryum ventricosum, Blindia acuta, Bartramia norvegica, Campylopus flexuosus, Swartzia montana, Amblystegium stramineum, A. filicinum, Hylocomium loreum, Pterigynandrum filiforme, Acrocladium cuspidatum, Leucodon sciuroides, Plagiothecium sylvaticum, Thuidium abietinum, Hypnum velutinum* var.

intricatum, *Anomodon viticulosus*, *Stereodon polyanthos.* Of these *Buxbaumia aphylla* has not since been found in Ireland.

Robert Brown, 1773–1858, A.L.S. 1798, F.R.S. 1811, D.C.L. (Honorary), Oxford, 1833, collected mosses in Donegal, Sligo, and Londonderry. As Assistant Surgeon to the Fifeshire Regiment of Infantry, he was stationed in the North of Ireland during the close of the eighteenth century. There is a notice of his botanical work in Ireland in the "Journal of Botany" for 1888.

Dawson Turner, M.A., F.R.S., F.L.S. (1775–1858), of Yarmouth, published his "Muscologiæ Hibernicæ Spicilegium" in 1804, which was the first book entirely devoted to the mosses of Ireland. This author describes 231 species of Irish mosses, "all of which had been, either seen by himself growing in Ireland, or sent from thence to him." The botanists who sent mosses from Ireland to Turner were Whitley Stokes, Robert Scott, John Templeton, and Ellen Hutchins; and the assistance of the three men is duly acknowledged in the preface to the work, but the lady is not mentioned. Long afterwards, William Wilson discovered in the herbaria of Turner and of Hooker in the British Museum, many specimens of Irish mosses which had been collected by Miss Hutchins. Turner's work includes the following 13 mosses, which subsequently through an oversight Taylor omitted from Part 2 of Mackay's "Flora Hibernica":—*Buxbaumia aphylla, Polytrichum subrotundum, P. attenuatum, Fissidens exilis, Anisothecium rufescens, Dicranum fuscescens, Orthotrichum Schimperi, Bryum bicolor, Mnium marginatum, M. cuspidatum, Amblystegium revolvens, Hypnum Teesdalii, H. Swartzii.*

Robert Scott, M.D., who died previous to 1813, was Professor of Botany in Trinity College, Dublin. He helped Turner in his examination of the Irish mosses, and Turner dedicated his "Muscologia" to him, and says it was begun at his suggestion. Scott got a reward of five guineas, Irish currency, from the Dublin Society, "for producing native plants not hitherto described;" these were the two mosses, *Grimmia maritima* and *Dicranum Scottianum*, of which descriptions and illustrations were published in the Dublin Society's Transactions, vol. iii, p. 157 (1803).

Whitley Stokes (1763–1845), M.D., Fellow of Trinity College, Dublin, Lecturer in Natural History, was a muscologist. He searched many parts of Ireland, and contributed many rare mosses to Sir James Smith's "English Botany," and also to Dawson Turner for his "Spicilegium."

About the same time as the foregoing, according to Moore in the introduction to his "Synopsis of the Mosses of Ireland," there was an Irishman, Dr. **Francis Barker**, who paid considerable attention to Irish mosses, and communicated his observations to Mackay and Whitley Stokes.

Miss **Ellen Hutchins**, daughter of Thomas Hutchins, was born in 1785, at Ballylickey, between Bantry and Glengarriff, in the County of Cork, and died in 1815, and was buried in Bantry churchyard. She was educated in Dublin, and when her schooltime was ended, her health was found to be unsatisfactory. Dr. Whitley Stokes, a friend of her family, who was consulted about the case, recommended her being left in his care. It was so arranged, and she soon recovered. When finally leaving for home, Dr. Stokes advised her to live in the open air as much as possible, and to this end to take up the study of some branch of natural history, by preference that of botany, which was his own speciality, and he offered to lend her books into which she had been dipping whilst in his house, where also she had become acquainted with Mr. Mackay of Glasnevin Gardens, and Mr. Dawson Turner of Yarmouth. This would provide exercise and fresh air and quiet occupation while indoors. She became an ardent student of mosses, hepatics, lichens, and algae, which abound on the hills, in the glens, or in the sea, around Bantry and Glengarriff. She discovered many rare species of all these in the neighbourhood near her home, and made many drawings for Turner's "Fuci."

A trait in her character was her natural modesty, which was so great that for some time she objected to her name being published as the collector of the rare plants she had found.

Sir James Smith wrote of her that "she could find almost anything." Turner in the conclusion of his "Fuci" (1819) laments her untimely death at the early age of thirty years, and says that by it he had been deprived of a most able assistant, and botany had lost a votary as indefatigable as she was acute, and as successful as she was indefatigable. Sir William J. Hooker in "Muscologia Britannica" (1817) acknowledges assistance received from Miss Hutchins in the preparation of that work.

David Moore writes in the introduction to his "Synopsis of the Mosses of Ireland," Proceedings of Royal Irish Academy (1872), that William Wilson notices in his "Bryologia Britannica" some species of mosses which were not included by Dr. Taylor in Part 2 of Mackay's "Flora Hibernica," but which Wilson had found when examining the herbaria of Dawson Turner and Sir William J. Hooker, to whom these plants had been sent by the late Miss Hutchins of Bantry, "whose name is well known to all cryptogamic botanists, both here and abroad." "To form some idea of her great success amongst the Hepaticae we have only to consult the pages of Hooker's 'Jungermaniae,' where her name is more or less connected with nearly every rare species contained in that grand work."

In the "Journal of Botany," February, 1912, p. 63, under the title

Eighteenth Century Women Botanists," is reprinted from a little-known work, "Primitiae Florae Essequeboensis" of G. F. W. Meyer, published in 1818, p. 199, a tribute to the botanical work of Miss Hutchins. She is described as having lately died at "Bontajae" in Ireland, which no doubt is intended for "Bantry." Allusion is made to the Hepatic *Jungermania* (*Frullania*) *Hutchinsiae* as having been named after her; mention is made of her fervent love of the study of cryptogamic botany, notwithstanding all its difficulties, and of her having found many plants new to English botany. The remarkable collection of plants which she made, together with a large number of beautiful drawings and notes on the plants, passed into the possession of Dawson Turner, and are now in safe keeping at Kew. Taylor, in Mackay's "Flora Hibernica," gives Miss Hutchins as the collector of eleven rare mosses in Ireland. In Braithwaite's "British Moss Flora" are several records of mosses collected by Miss Hutchins at "Belfast," and in the "North of Ireland" in the year 1801.

James Drummond (1784–1863), A.L.S., Curator of the Botanic Garden at Cork, was a good muscologist, and discovered some species new to Ireland, which he communicated to Dr. Taylor, by whom they were incorporated in the "Flora Hibernica."

H. Thomas Alexander, M.D. (1833–1845) of Cork, surgeon in the Royal Navy, investigated the mosses in the County of Cork, and some of the results were published in Power's "Contributions to the Fauna and Flora of Cork."

Thomas Drummond, A.L.S., who died (1835) at Havana in Cuba, came from Forfar on the formation of the Belfast Botanic Gardens, and became its first curator. He did not remain long in Belfast, but he made good use of his time while there in collecting mosses, which were subsequently published in folio without any letterpress, under the title "Musci Scotici," though a large proportion of the specimens are Irish. There is a copy of this herbarium bound in three volumes in the Belfast Natural History and Philosophical Society's library.

Thomas Power (1845), M.D., Lecturer in Botany in Cork School of Medicine, was the author of "Contributions towards a Fauna and Flora of the County of Cork" (1845). The paper on which this was founded was read at the meeting of the British Association held in Cork in the year 1843. This work gives the names of 172 species of mosses found in the county, with locality and collector's name for each, amongst which Dr. Power's name occurs frequently. It is a model of what such a list should be. Four of these species—*Pottia Wilsoni*, *Oligotrichum incurvum*, *Physcomitrium pyriforme*, *Epipterygium Tozeri*, had not been noticed by Taylor, and were additions to the Irish flora. One collector, **Denis Murray**, who is mentioned as having helped, was an assistant in Cork Botanical Gardens; he flourished about 1845. The other collectors whose names are given are:—Miss Hutchins, Mr. Alexander, Dr. Scott, Mr. J. Drummond, **Mr. W. Wilson.**

Isaac Carroll (1829–1880) died at Aghada, Co. Cork. His herbarium is in the British Museum. In a communication entitled "New or Scarce Irish Mosses" in the "Phytologist," 2nd series, vol. i, p. 236 (1856), he records 57 species, of which the following were new to the Irish list:—*Sphagnum subsecundum* var. *contortum, Dicranum schisti, Pottia crinita, Ditrichum flexicaule. Barbula Hornschuchii, Tortula laevipila, Grimmia orbicularis, Bryum cernuum, B. inclinatum, B. intermedium, B. ventricosum, B. Donii, Funaria fascicularis, Stereodon subrufus, Hypnum rivulare, H. speciosum, H. circinatum, Amblystegium chrysophyllum.*

John Templeton, A.L.S. c. 1794, of Cranmore, Belfast (1766–1825), was engaged for several years on a "Hibernian Flora," to which Turner alludes in the preface to his Spicilegium. Some of the MSS. are still in existence in six volumes, and are now deposited in the Library of the Royal Irish Academy. Two of these are devoted to mosses and hepatics, and describe 258 mosses found in Ireland, and are accompanied by 115 accurate drawings, some portions being on an enlarged scale, many of which are beautifully coloured after nature. Turner, in his preface, mentions Templeton's intention of publishing this flora.

Dr. **Thomas Taylor**, F.L.S., M.R.I.A., of Dunkerrin, near Kenmare (d. 1848, who was associated with Sir W. J. Hooker in "Muscologia Britannica" (1st edition 1817). was the next student of Irish mosses. He contributed the musci to Part II of Mackay's "Flora Hibernica" (1836), and described 228 species. It appears that, through a mistake, Taylor omitted 14 mosses which are in Turner's list; so that 242 mosses were then known as having been found in Ireland. Taylor discovered two species which were new to Ireland: they are described in the Transactions of the Botanical Society of Edinburgh, vol. ii, p. 1 (1844); these were *Leptodontium recurvifolium* (Tayl.), and *Grimmia affinis* (Schleich).

Sir **William Jackson Hooker** (1785–1865), in "Muscologia Britannica" (1817), recorded 43 mosses from Ireland, for 24 of which the localities are given.

Samuel Pickworth Woodward, A.L.S. (1821–1865), born at Norwich, buried at Highgate Cemetery, visited Glengarriff in 1843, and collected mosses. The names of 11 species which he found on that occasion are given in a paper, "Notes of a Botanical Excursion including part of Ireland," read before the Botanical Society of London, and published in the "Phytologist," No. xxxiv, March, 1844.

William Wilson (1799-1871) belonged to Warrington, where he was born, died, and was buried. In his "Bryologia Britannica" (1855) he gives "Ireland" as the locality for 86 mosses, of which one is a Sphagnum, viz., the species *rubellum.* He paid a long visit in 1829, from July to December, to Cork and Kerry, for the purpose of investigating the mosses and hepatics of the south-western counties. His "Bryologia Britannica" added 27 species and varieties, including several of his own collecting, to the Irish moss flora. These were *Didymodon denudatus, Grimmia patens, G. campestris, Tortula ericaefolia, T. Vahlii* var. *subflaccida, T. lamellata, Mollia hibernica, Pleurochaete squarrosa, Leersia laciniata, Orthotrichum tenellum, Weissia coarctata, W. Drummondi, Philonotis Wilsoni, P. rigida, Bryum pallescens, Hedwigia imberbis, Isopterygium elegans, I. depressum, Amblystegium polygamum, A. palustre* var. *subsphaericarpon, A. ochraceum, Hypnum striatulum, H. pallidirostre, Fissidens incurvus* var. *tamarindifolius, F. osmundoides, Barbula lurida, Sphagnum rubellum.*

David Moore, PH. D., born at Dundee, 1807, died at Glasnevin, Dublin, 9th June, 1879, passed 51 years in the service of Irish botany, first as assistant to J. T. Mackay, the Director of Trinity College Botanic Garden, then on field work on the Ordnance Survey of Ireland, during which time he made good use of the opportunities he had for studying and collecting mosses in many of the counties of Ireland, and lastly as Director of the Royal Dublin Society's Botanic Gardens at Glasnevin. In 1858 a paper by Moore, entitled "Observations on the Mosses of Ireland," was published in the Royal Dublin Society's "Journal," which added 16 species to the Irish list. In 1872 his "Synopsis of the Mosses of Ireland" was published in the Proceedings of the Royal Irish Academy. This added 36 species, and left the total of Irish mosses at 377. Dr. Moore gives not only the localities, but also briefly describes the generic and specific characteristics of each plant. This was the first contribution to anything like a census of Irish mosses; it was much better in this way than Dawson Turner's work, but it was still very imperfect, and wanting in several respects. Moore also drew up a list of Dublin and Wicklow mosses for the meeting of the British Association in Dublin in 1878, which was published by the Royal Dublin Society; it records 273 species and 7 varieties; and he contributed from time to time several papers concerning the discovery of new mosses in Ireland to the Proceedings of the Dublin University Zoological and Botanical Association. A full list of Moore's writings on Irish mosses is given in the Bibliography, Nos. 49 to 58.

The additions made to the Irish moss flora by Moore were these 67 species and varieties:—*Sphagnum tenellum, S. fimbriatum, S. Girgensohnii, Andreaea crassinervis, Polytrichum gracile, Fissidens decipiens, F. viridulus, Anisothecium crispum, A. Grevillei, Didymodon denudatus* var. *alpinus, Campylopus introflexus,* *C. Schwarzii*, *C. brevipilus*, *Dicranum majus*, *Oncophorus crispatus*, *Ephemerum cohaerens*, *Pottia bryoides*, *Tortula aloides*, *T. mutica*, *T. papillosa*, *T. princeps*, *T. montana*, *Mollia tortilis*, *M. rutilans*, *M. calcarea*, *M. fragilis*, *Leptodontium flexifolium*, *Barbula sinuosa*, *B. reflexa*, *Grimmia aquatica*, *G. decipiens*, *G. ovata*, *G. Hartmanni*, *G. conferta*, *Anoectangium Mougeotii*, *Orthotrichum rupestre*, *O. stramineum*, *O. pallens*, *O. affine* var. *fastigiatum*, *Weissia phyllantha*, *W. ulophylla* var. *crispula*, *W. Bruchii*, *Funaria obtusa*, *Pohlia acuminata*, *P. polymorpha*, *P. annotina*, *P. albicans*, *Bryum bicolor*, *B. torquescens*, *B. erythrocarpum*, *B. Warneum*, *B. Duvalii*, *Philonotis calcarea*, *Mnium cuspidatum*, *Amblystegium lycopodioides*, *A. Kneiffii*, *A. eugyrium*, *A. irriguum*, *A. vernicosum*, *A. intermedium*, *A. megapolitanum*, *A. glareosum*, *Hypnum illecebrum*, *Stereodon rufescens*, *S. Lindbergii*, *S. hamulosus*, *Entodon orthocarpus*.

David Orr, who died 1892, was an assistant to Dr. Moore in Glasnevin Gardens. He collected and studied the mosses of Antrim, Dublin, and Wicklow. Many specimens of his collecting are in the British Museum, the National Museum, Dublin, and other herbaria. He was the author of a short paper entitled "Some Mosses collected in Ireland," that appeared in the "Journal of Botany," 1881, pp. 83, 84. Much doubt exists as to some of Orr's discoveries, which prevents reliance being placed upon his work unless it is corroborated by other botanists. [See under *Ptilium crista-castrensis*, *Neckera pennata*, and *Pterogonium ornithopodioides*.]

William McCalla (1814-1849), a native of Galway, who discovered *Erica Mackaii*, and did good work as an algologist, was also a muscologist, there being many specimens of Irish mosses of his collecting in the herbarium of Trinity College, Dublin.

Captain **Frederick Wollaston Hutton**, Deputy Quartermaster-General to the Forces in Ireland, died in New Zealand (1905). Whilst resident in Dublin he studied Irish mosses and collected in the four provinces. When he left the army he emigrated and settled in New Zealand, where he became Professor of Geology, in which science he was a zealous worker. He discovered two mosses new to Ireland, *Amblystegium molle* and *A. dilatatum*. He formed a herbarium of British and other European mosses in six volumes, which contain 1283 specimens, representing 637 species, illustrated by 977 coloured microscopic drawings, beautifully and accurately done by his own hand. David Orr contributed largely to this collection, which is now in the herbarium of the present writer.

The Rev. **M. J. Berkeley**, F.L.S., in his "Handbook of British Mosses" (1863), gives "Ireland" as the locality for 49 species.

Charles Codrington Pressick Hobkirk, F.L.S., was born at Huddersfield, Yorkshire, 1837, and died at Ilkley, 1902. In his "Synopsis of British Mosses" (1873), while he does not give many localities, he mentions "Ireland" as the locality of 35 species.

George Edward Hunt (1841–1873) buried at St. Saviour's, Manchester, visited the south-west of Ireland in the years 1861, 1864, and 1872, for the purpose of collecting mosses, and distributed a large number of these specimens to students. His herbarium is now at Kew.

Professor **S. O. Lindberg**, in a paper, "Hepaticae in Hibernia mense Julii 1873, lectae," published in "Acta Societatis Scientiarum Fennicae," 1875, describes a few mosses he collected on this visit to Ireland. He visited Killarney and Wicklow.

The **London Catalogue of British Mosses and Hepatics** (1877), published under the directions of the Botanical Record Club (Mr. **H. Boswell** being responsible for the census numbers), was the first attempt at a census of the distribution of mosses in the British Islands. In this the occurrence of each species in each district is shown by use of the numbers of the Watsonian Botanical Provinces for Great Britain, and by the letter "I" for Ireland—a very vague and scarcely useful practice as regards Ireland, which was also used in the second edition (1881). The total of species thus recorded for Ireland is 397, out of a total of 568 for the British Islands.

Alexander Knox, M.D., published in Dublin (1875) "A History of the County of Down," in which he states that 234 species of mosses are known to grow in the North of Ireland, and he gives the names of 8 of the rarer species. He seems to infer that mosses found in any part of the North of Ireland are to be found everywhere in it. But most certainly one of the species he names, viz., *Tayloria serrata*, has not yet been discovered in the County of Down.

Robert Clayton-Browne, who was born at Newmount, Carlow, 3rd May, 1838, and died at Greenville, Carlow, 15th December, 1906, studied and collected mosses in Carlow, Wexford, and Kilkenny. He made a large number of excellent drawings of magnified parts of the plants, all of which, with his herbarium, are in the National Museum, Kildare Street, Dublin.

Henry Chichester Hart (1847–1908), as part of his botanical work, collected mosses in many of the counties of Ireland, and submitted them for identification to D. Moore and G. A. Holt. A list of 28 of the rarer species which he found, and the localities, was published by him in the "Journal of Botany" for 1886.

Benjamin Carrington, M.D., F.R.S.E., born at Lincoln, 1827, died at Brighton, 1893. Chiefly known as an hepaticist, he was also a student of mosses. He spent several months in 1862 at Killarney and other places in Kerry and

Cork, and compiled a list of 163 species of mosses which he collected in these counties. There are 9 Sphagnums amongst the number. This list, which contains much valuable matter, is very interesting. It was published in the "Transactions" of the Botanical Society of Edinburgh, vii, in 1863, under the title "Gleanings among the Irish Cryptogams."

Samuel Alexander Stewart, of Belfast (1826-1910), began the study of mosses in 1862, and contributed several valuable papers on the subject to the "Proceedings" of the Belfast Naturalists' Field Club, and of the Royal Irish Academy, his first communication being to the former in the form of "A List of the Mosses of the North-East of Ireland" (1875), which gives a list of 238 species. A supplement to the foregoing appeared nine years afterwards (1884), in which he added 37 species, thus bringing up the total for the district to 275.

In the year 1888 the Belfast Naturalists' Field Club published "A Flora of the North-East of Ireland," by S. A. Stewart and T. H. Corry, of which 53 pages are devoted to the mosses of the counties Down, Antrim, and Derry. This gives a list of 293 species, with 28 varieties for the three counties. A supplement to this was issued in 1894 by Stewart and R. Ll. Praeger, in which the list of mosses for the district was brought up to 301. The large number of localities given for each species renders this a most valuable work.

Shortly after the appearance of the Flora and Supplement, Stewart drew up a Report on the Botany of South Clare and the Shannon, which appeared in the "Proceedings" of the Royal Irish Academy in 1889, in which is a list of 84 species and 3 varieties of mosses found in the district. In 1884 Stewart visited the island of Rathlin, north of the coast of Antrim, and drew up a report on the botany of the island, which was presented to and published in the "Proceedings" of the Royal Irish Academy for the same year; it gives a list of 83 mosses which he found in Rathlin.

Greenwood Pim, M.A., F.L.S., was born at Monkstown, Co. Dublin, 4th May, 1851, and died at the same place, 14th November, 1906. In addition to mycology, he studied mosses in Dublin, Wicklow, and Kerry. His copy of Berkeley's "Handbook," on the margins of which he kept records of what he collected and their localities, is now in my possession.

John Henry Davies was born, 1838, at Warrington, and died at Belfast, 1909. He lived during fifty years in Ireland, and worked diligently on the mosses. The results of his work appear in articles that from time to time he contributed to the pages of the "Phytologist" and "Irish Naturalist." Many of his records are given in Stewart and Corry's "Flora of the North-East of Ireland." In early life he corresponded with William Wilson, and kept up the intimacy till Wilson's death. In 1901 he was fortunate in discovering on the summit of Colin Mountain, near Belfast, the moss *Ditrichum vaginans,* which had not been found in any other station in the British Islands. Davies also collected the following, which were new to Ireland:—*Fissidens rufulus, Dicranum Bonjeani* v. *rugifolium, Tortula angustata, Barbula acuta* v. *viridis, B. brevifolia* v. *subglobosa, Mollia rostellata, M. viridula* v. *subglobosa, Amblystegium Kneiffii* v. *laxum, A. Juratzkae, A. serpens* v. *angustifolium* (Limpr.), *Hypnum imponens, Ctenidium molluscum* v. *condensatum, Fontinalis gracilis,* all of which he recorded in the "Irish Naturalist." Specimens of mosses collected by him shortly after he came to Ireland are contained in the herbarium of Trinity College, Dublin.

G. A. Holt, of Manchester, who was for many years a careful and diligent student of cryptogamic botany, collected many mosses in the Killarney district, which he visited in 1885, in the company of Samuel Alex. Stewart, of Belfast.

Mrs. Leebody, who was born near Portaferry, in the county of Down, and whose death in 1911 was announced in the "Irish Naturalist" for that year, paid considerable attention to the mosses of Derry and Donegal. She resided in the city of Londonderry, and is mentioned in the "Flora of the North-East of Ireland," as the collector of several rare species found in the above counties.

Dr. R. Braithwaite, F.L.S., in the "British Moss Flora," 3 vols. (1880–1905), gives localities in Irish counties for 204 species of mosses, which is a most useful record. In his "Sphagnaceae or Peat Mosses of Europe and North America" (1880), 14 species are described as found in Great Britain, while only four of these are localized as Irish. Braithwaite's Irish localities for mosses and Sphagnums are accordingly 208. He visited Ireland in 1900.

It is remarkable that the Sphagnums of Ireland have not yet received the attention that might have been expected from their profuse abundance almost everywhere throughout the island. The wide stretches of bogs covered with them, extending across the middle of Ireland, are an unknown land to almost all bryologists.

Thus it happened that Carrington in 1863 recorded only 9 Sphagnums found in Ireland. Moore in 1872 gives the localities for the same number, which he collected in Wicklow, Kerry, Galway, Dublin, Antrim, and Derry.

The "London Catalogue of Mosses" (1881) gives 16 species of Sphagnum as British, but only 7 of these, together with 4 varieties, are mentioned as having been found in Ireland.

Stewart in his "Flora" (1888), and supplement to same (1894), mentions 12 species of Sphagnum as found in Ireland.

In the "European Sphagnaceae" (1901), by E. Charles Horrell, F.L.S., which had originally appeared in the "Journal of Botany" for the previous year, only one species is assigned to an Irish locality.

"The Student's Handbook of British Mosses" (2nd edit., 1904), by **H. N. Dixon**, names 37 mosses as found in Ireland, and specifies the localities of 3 of these, while for the Sphagnums, Ireland is not mentioned.

The Moss Exchange Club published in 1907 "A Census Catalogue of British Mosses," the Irish portion of which was done by the Rev. C. H. Waddell, B.D., and the present writer. The number of Irish species in this is 449 with 134 varieties, the total being 583; the total for the whole of the British Islands is 893. There is evidence in the lists in this catalogue that the Sphagnums of Ireland have of late been receiving more attention that had been previously paid to them by botanists—36 species and varieties being listed as Irish out of the 49 known to occur in the British Islands.

I must mention several muscologists who have worked, and I am glad to say are still working, at the mosses of Ireland.

Rev. **C. H. Waddell**, B.D., M.R.I.A., Rector of Greyabbey, Co. Down, has furnished many records from Down, Antrim, Monaghan, Waterford, Limerick, Kerry, and Mayo.

David M'Ardle, of Glasnevin Gardens, during the last eighteen years, has furnished reports of his work amongst the mosses and hepatics of Cork, Louth, Galway, Dublin, Wicklow, Sligo, Cavan, Fermanagh, Mayo, and Roscommon, to the "Proceedings" of the Royal Irish Academy.

Miss **Eleonora Armitage** investigated a portion of County Limerick.

J. Hunter has devoted himself with much success to the mosses of Donegal.

From **W. N. Tetley** of Portora Royal School, Enniskillen, I have received a great amount of assistance, by his collecting mosses in those divisions where scarcely anything had been done, particularly in Fermanagh, Cavan, Leitrim, Sligo, Mayo East, Roscommon, Galway North-east, Galway South-east, Carlow, Wexford, and Kilkenny. He has established many records from all these divisions, some of which are of species very rare in Ireland, and the following are new to the Irish flora: *Oncophorus crenulatus*, *Dicranella varia* var. *tenella*, *Dicranum fuscescens* var. *falcifolium*, *D. asperulum*, *Grimmia conferta*, *G. subsquarrosa*, *Mnium affine* var. *elatum*, *Hypnum viride* v. *majus*.

James Glover of Kircubbin, and **William Porter** of Balmoral near Belfast, have also given me much help by sending collections of mosses from Down, Antrim, and Tyrone.

From Great Britain have come the Rev. **C. H. Binstead** in 1894 and again in 1900 to Cork and Kerry, and Messrs. **D. A. Jones**, **J. C. Wilson**,

J. B. Duncan, and **J. Owen**, who have rediscovered many of the rarer plants in Mayo, Kerry, and Cork.

The last recruit to take to "moss-tramping" in Ireland is **James Dick Houston**, who has made a good beginning by discovering *Amblystegium Kochii* in Co. Londonderry, a species not before recorded as Irish.

In the forty-three years that have gone by since David Moore's "Synopsis of the Mosses of Ireland" was published, many species new to Ireland have been discovered by various botanists, the records of which are scattered through a number of publications, some of which are not easily accessible. I subjoin a list of these one hundred and eighteen mosses, which may be found useful:—

- Sphagnum
  - Austini *v.* imbricatum.
  - cymbifolium *v.* squarrosulum.
    - *v.* purpurascens.
  - subsecundum *v.* obesum.
  - molle.
  - medium.
  - squarrosum *v.* imbricatum.
  - acutifolium *v.* deflexum.
    - *v.* purpureum.
    - *v.* elegans.
    - *v.* fuscum.
    - *v.* subnitens.
  - Russowii.
  - intermedium.
    - *v.* pulchrum.
  - cuspidatum *v.* submersum.
    - *v.* falcatum.
    - *v.* plumosum.

- Andreaea
  - petrophila *v.* gracilis.
    - *v.* acuminata.
  - crassinervis *v.* Huntii.
  - Rothii *v.* hamata.
    - *v.* falcata.

- Catharinea
  - angustata *v.* rhystophylla.

- Polytrichum
  - alpinum *v.* septentrionale.
  - subrotundum *v.* longisetum.
  - gracile.
  - commune *v.* minus.

- Fissidens
  - incurvus
  - bryoides *v.* intermedius.
  - Curnowii.
  - fontanus.
  - rufulus.
  - pusillus.
  - [exsul].

- Ditrichum
  - zonatum.
  - vaginans.
  - flexicaule *v.* densum.

- Dicranella
  - curvata.
  - heteromalla *v.* stricta.
    - *v.* sericea

- Seligeria
  - Donii.

Campylopus
- Schimperi.
- subulatus *v.* elongatus.
- Shawii *v.* hamatus.
- flexuosus *v.* paludosus.
- atrovirens *v.* gracilis.
  - *v.* falcatus.
- brevipilus *v.* auriculatus.

Dicranum
- scoparium *v.* spadiceum.
- Bonjeani *v.* rugifolium.
- uncinatum.
- montanum.
- asperulum.

Dichodontium
- pellucidum *v.* fagimontanum.
  - *v.* compactum.

Oncophorus
- crenulatus.

Ephemerum
- minutissimum.

Pottia
- viridifolia.

Tortula
- marginata.

Mollia
- rostellata.
- viridula *v.* amblyodon.
- rutilans.
- calcarea.
- aeruginosa *v.* ramosissima.
- crispula *v.* elata.
- lutescens.
- tenuirostris *v.* Holtii.
- inclinata.
- tortuosa *v.* augustifolia.
- crispata.

Barbula
- rubella *v.* ruberrima.
  - *v.* dentata.
- unguiculata *v.* fastigiata.
- brevifolia *v.* acutifolia.
- fallax *v.* brevifolia.

Grimmia
- Donii.
- subsquarrosum.

Orthotrichum
- affine *v.* rivale.
- Sprucei.

Tayloria
- tenuis.

Discelium
- nudum.

Pohlia
- nutans *v.* longiseta.
- proligera.

Bryum
- affine.
- argenteum *v.* lanatum.
- rubens.

Philonotis
- fontana *v.* compacta.

Catoscopium
- nigritum.

Thuidium
- recognitum.
- delicatulum.

Amblystegium
- serpens *v.* depauperatum.
- Juratzkae.
- radicale *v.* serotinum.
- confervoides.

Amblystegium—*continued.*
  Kochii.
  chrysophyllum *v.* erectum.
  protensum.
  Sendtneri *v.* Wilsoni.
  dilatatum *v.* hamatum.
  fluitans *v.* submersum.
  exannulatum *v.* Rotae.
  Kneiffii *v.* polycarpon.

Hypnum
  curvisetum.
  rusciforme *v.* prolixum.
  velutinum *v.* praelongum.
  pseudoplumosum *v.* homomallum.

Isothecium
  myosuroides *v.* rivulare.
    v. tenuirostre.
    v. brachythecioides.

Heterocladium
  heteropterum *v.* flaccidum.

Hylocomium
  umbratum.
  proliferum *v.* Lambayensis.
  rugosum.

Ctenidium
  molluscum *v.* condensatum.

Stereodon
  imponens.
  cupressiforme *v.* ericetorum.
  callichrous.
  circinalis.

Plagiothecium
  denticulatum *v.* Donii.

[Hypopterygium
  immigrans.]

Fontinalis
  gracilis.

The following forty-two mosses are in the present report recorded for the first time from Ireland:—

Sphagnum
  cymbifolium *v.* squarrosulum.
  rigidum *v.* squarrosum.
    v. compactum.
  squarrosum *v.* subsquarrosum.
  acutifolium *v.* luridum.
    v. tenue.
  intermedium *v.* parvifolium.

Swartzia
  montana *v.* compacta.

Dicranella varia *v.* tenella.

Anisothecium
  rubrum *v.* tenellum.

Campylopus
  brevipilus *v.* auriculatus.
  Shawii *v.* hamatus.
  atrovirens *v.* gracilis.

Dicranum
  scoparium *v.* turfosum.
  fuscescens *v.* falcifolium.
  montanum.
  asperulum.

Oncophorus crenulatus.

Mollia
  viridula *v.* amblyodon.
  crispula *v.* nigro-viridis.

Grimmia conferta
  subsquarrosa.

Zygodon
  viridissimus *v.* rupestris.

Funaria
  microstoma.
  hygrometrica *v.* calvescens.

Pohlia
    nutans *v.* alpina.

Philonotis
    seriata.
    adpressa.

Mnium
    Seligeri.

Amblystegium
    Kneiffii *v.* polycarpum.
    fluitans *v.* submersum.
    riparium *v.* longifolium.

Hypnum
    viride *v.* major.

Hypnum—*continued.*
    pseudoplumosum *v.* homomallum.
    curvisetum.
    rutabulum *v.* robustum.
    velutinum *v.* praelongum.
    rivulare *v.* tenue.

Isothecium myosuroides *v.* brachythecioides.

Porotrichum
    angustifolium.

Stereodon
    cupressiforme *v.* longirostris.

Neckera
    fontinaloides *v.* Philipii.

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4 Gleanings among the Irish Cryptogams. Trans. Bot. Soc. Edinb., vii. (1863).

CARROLL, ISAAC:

5 New or scarce Irish Mosses. Phytologist, 2 Ser., i, 236 (1856).

6 Herbarium in Queen's College, Cork.

CENSUS CATALOGUE of British Mosses. York (1907).

7 (The portion relating to Ireland, compiled by Revs. C. H. Waddell and H. W. Lett.)

DAVIES, JOHN HENRY:

8 Muscologia Hibernica. Phytologist, 2 Ser., ii, p. 229 (1857).

9 Notes on the Muscology of Colin Glen. Phytologist, 2 Ser., i, ii, 185 (1859). In Report of Thirsk Natural History Society.

10 Some Mosses from north-east Ireland. Irish Nat., ix, 171 (1900).

11 *Ditrichum vaginans*, a new British Moss in Ireland. Irish Nat., x, 161 (1901).

12 Notes on some Mosses in northern Ireland. Irish Nat., xi, 10, 44 (1902).

13 On *Weisia rostellata* in Ireland. Irish Nat., xi, 289 (1902).

14 Moss-notes from North Ireland. Irish Nat., xiii, 15 (1904).

15 Some Mosses from Co. Down. Irish Nat., xiv, 1 (1905).

16 Bryological Notes from Co. Down. Irish Nat., xvi, 215 (1907). (See also Nos. 115, 118.)

DIXON, H. N., M.A., F.L.S.:

17 The Mosses of Co. Donegal. Journ. Bot., xxix, 359 (1891). (See also Nos. 109, 110, 111.)

DRUMMOND, THOMAS, A.L.S.:

18 Musci Scotici, i, ii, iii, Belfast (about 1829 or 1840). (Contains species of mosses from Ireland. A copy is now in the Belfast Museum.)

HARRIS, WALTER:

19 The Antient and Present State of the County of Down. 8vo. Dublin (1744), chap. xi. Catalogue of rare plants . . . (includes two mosses).

HART, HENRY CHICHESTER, B.A., F.L.S.:

20 Localities for Irish Hepatics and Mosses. Journ. Bot., xxiv, 360 (1886).

21 HERBARIUM in Science and Art Museum, Dublin.

HOOKER, Sir WILLIAM JACKSON, D.C.L., LL.D., F.R.S., F.L.S.:

22 In English Flora of Sir J. E. Smith, v, pt. 1, Mosses. London (1833).

HOOKER, Sir WILLIAM JACKSON, and THOMAS TAYLOR:

23 Muscologia Britannica. London, 1817.

HUNT, G. E.:

24 Notices of several recently discovered and undescribed British Mosses. Manchester Literary and Philosophical Society's Transactions, ix, 19 (1871).

HUNTER, J.:

25 North Donegal Mosses. Journ. Bot., xl. 191 (1902).

26 *Dicranodontium longirostre* at Holywood. Irish Nat., xiv, 222 (1905).

KNOX, ALEXANDER, M.D.:

27 A History of the County of Down. 8vo. Dublin (1875), Chap. xlii, pp. 691–710, on Botany.

LETT, Rev. Canon HENRY WILLIAM, M.A., M.R.I.A.:

28 Report on the Mosses, Hepatics, and Lichens of the Mourne Mountain District. Proc. R.I.A., 3 Ser., i, No. 3, 265–325 (1890). This added 20 Mosses to the Irish Flora.

29 Mosses and Hepatics of Mourne Mountains. Science Gossip, New Ser., iii, 29, 67 (1897).

30 A Moss (*Hypnum confervoides* Brid), new to Ireland. Irish Nat., iii, 66 (1894).

31 Mosses new to Ireland. Journ. Bot., xxxix, 343 (1901).

32 Some Mosses and Hepatics of South Donegal. Journ. Bot., xli, 356 (1903).

33 *Leptodontium recurvifolium* in Ireland. Journ. Bot., xxxix, 187 (1901).

34 Mosses new to Ireland [*Dicranella curvata* and *Dicranum uncinatum*]. Irish Nat., xi, 149 (1902).

35 Herbarium.

(See also below at Nos. 89, 90, 92, 93, 96, 102, 104, 105, 106, 107, 108, 113, 119.)

Lindberg, S. O.:

36 Hepaticae in Hibernia mense Julii, 1873, lectae. Acta Soc. Scient. Fennicae, x (1875). Has records of a few mosses.

London Catalogue of British Mosses and Hepatics. 8vo.

37. 2nd Ed. London (1881). (The locality for species from Ireland is given as "Ireland," no names of counties being mentioned.)

M'Ardle, David :

38 A visit to Castletown-Berehaven. (Mosses.) Irish Nat., iii, 189 (1894).

39 Hepatics and Mosses from the Dundalk district. Irish Nat., iii, 65 (1894).

40 Irish Field Club Union. Report of the Conference and Excursion held at Galway, July 11 to 17, 1895. Mosses and Liverworts. Irish Nat., iv, 243 (1895).

41 Irish Field Club Union. Report of the fourth triennial Conference and Excursion held at Sligo, July 12 to 18, 1904. Musci. Irish Nat., xiii, 209 (1904).

42 Notes on the Fauna and Flora of Clonbrock, Co. Galway. Mosses and Hepatics. Irish Nat., v, 235 (1896).

43 Report on the Musci and Hepaticae of the County Cavan. Proc. R.I.A., 3rd Ser., vol. xiv, No. 5, 605 (1898).

44 Contributions to the Natural History of Lambay. Mosses. Irish Nat., xvi, 99 (1907).

45 Musci and Hepaticae from Co. Fermanagh. Irish Nat., xvi, 232 (1907).

46 Musci and Hepaticae from Co. Mayo. Irish Nat., xvi, 332 (1907). [Mr. M'Ardle corrected this to W. Galway, all the localities mentioned being in that division. See Irish Nat., xvii, 161 (1908).]

Mitten, William, a.l.s. :

47 A few notes on some British Mosses allied to *Tortula fallax* Hedw. Journ. Bot., v, 324 (1867).

48 New or rare British Mosses. Journ. Bot., vi, 97 (1868).

Moore, David, ph.d., f.l.s., m.r.i.a. :

49 Observations on the Mosses of Ireland. R. Dubl. Soc. Journ., i, p. 100 (1858). (Duplicate in Phytologist, 1857, 2 Ser., ii, 37, 1857, as "Irish Mosses").

50 On the occurrence of a metamorphosed state of *Bryum sanguineum* (*erythrocarpon*); and on the discovery of some additional species in the Irish Flora. Nat. Hist. Review (Proc.), v, 129 (1858).

51 Observations, &c. Also Notices of some new species to the Irish Flora, &c. Nat. Hist. Review (Proc.), vi, 155 (1859).

52 Contributions to the British and Irish Floras of Musci and Hepaticae, &c. Dubl. Univ. Zool. and Bot. Assoc. Proc., ii, 80 (1863).

53 On some Mosses new to the British Flora, &c. Proc. Dubl. Nat. Hist. Soc., iv., 290 (1865).

54 Addenda to the Musci and Hepaticae of Flora Hibernica, &c. Dubl. Nat. Hist. Soc. Proc., v, 89 (1866).

55 Note on some species of Mosses new to the Irish Flora. Dubl. Nat. Hist. Soc. Proc., v, 158 (1867).

56 Addenda to British and Irish Muscology. Dubl. Nat. Hist. Soc. Proc., v, 190 (1868).

57 A Synopsis of the Mosses of Ireland. Proc. R.I.A., 2 Ser. Sci. i, 329–474 (1872).

58 List of the Mosses of the Counties of Dublin and Wicklow. Sci. Proc. R. Dubl. Soc., N.S. i, 238 (1878).

MOSS EXCHANGE CLUB:

59 Reports (1896–1913). Occasional references to Irish plants.

ORR, DAVID:

60 Some Mosses collected in Ireland. Journ. Bot, x, 83 (1881).

POWER, THOMAS, M.D.:

61 Contributions towards a Fauna and Flora of the county of Cork, by J. R. Harvey, J. D. Humphreys, and T. Power. Part II, 8vo. London and Cork (1845).

RAY, Rev. JOHN, M.A., F.R.S.:

62 Synopsis Methodica Stirpium Britannicarum. 8vo. 2nd Edit. London (1696). 3rd Edit. London (1724).

SMITH, Sir JAMES EDWARD:

63 Descriptions of Musci, in Sowerby's English Botany (1790–1814).

STEWART, SAMUEL ALEXANDER, F.B.S.E., A.L.S.:

64 A list of the Mosses of the north-east of Ireland. Proceedings Belfast Nat. F. C. (1875).

65 Supplement to a list of the Mosses of north-east of Ireland. Belfast Nat. F. C. Proc. (1884).

66 Report on the Botany of South Clare and the Shannon. Proc. R.I.A. (3) i, 343 (1890).

67 Report on the Botany of Lough Allen and the Slieveanierin Mountains. Proc. R.I.A. (2) Sci., iv, 426 (1885).

68 The Moss Flora of Arran. Irish Nat., iv, 317 (1895).

69 Stewart and Corry's Flora of the north-east of Ireland. Musci, 195–307. Belfast Naturalists' Field Club (1888).

70 Supplement to Stewart and Corry's Flora of the north-east of Ireland. Belfast N. F. C. Proc., 220–236 (1894).

(See also 116, 117.)

TAYLOR, THOMAS, M.D., M.R.I.A., F.L.S.:

71 Flora Hibernica, by J. T. Mackay. Part 2. Musci, by Thos. Taylor. Dublin (1836).

TAYLOR, THOMAS, with Sir W. J. HOOKER:

72 Muscologia Britannica. 2nd Edit. (1827). (See No. 23.)

TURNER, DAWSON, M.A., F.L.S.:

73 Muscologiae Hibernicae Spicilegium. London (1804).

TEMPLETON, JOHN:

74 Ms. volume in R.I.A. Library, Dublin.

75 Ms. Hibernian Flora in R.I.A. Library, Dublin, 6 vols. (of which 1 and 6 contain descriptions and drawings of mosses. His Journal, from 1795 to 1825, contains many references to mosses.)

WADDELL, REV. COSSLETT HERBERT, B.D., M.R.I.A.:

76 Notes on Mosses and Hepaticae of Ulster. Irish Nat., vii, 157 (1898).

77 Guide to Belfast and the counties of Down and Antrim. Musci. British Assoc. Meeting. B.N.F.C., Belfast (1902).

78 Some Mosses and Hepaticae of the Benbulben District. Irish Nat., i, 194 (1892).

79. Herbarium.

(See also at Nos. 89, 112, 114.)

WADE, M.D., A.L.S.:

80 Plantae rariores in Hibernia inventae, or Habitats of some plants rather scarce and valuable found in Ireland. Trans. Dublin Soc., iv, i–xiv, 1–214 (1804). This gives the names of, and localities for, 29 mosses.

WILSON, WILLIAM:

81 Bryologia Britannica. 3rd Edition (1855).

WITHERING, WILLIAM, M.D., F.R.S., F.L.S.:

82 Systematic arrangement of British plants. Musci, vol. iii (1776). London.

WOOD, JOHN BLAND, M.D.:

83 Notes . . . on the *Orthotrichum anomalum* of British and foreign authors. Phytologist, 2 Ser., v, 26 (1861).

ADDENDA.

84 BRITISH MUSEUM HERBARIUM.

85 TRINITY COLLEGE, DUBLIN, HERBARIUM.

THRELKELD, CALEB, M.D, :

86 Synopsis Stirpium Hibernicarum, Dublin (1727). (Mentions 13 species of mosses found in Ireland, for only one of which is a locality given. This author describes his book as "The first essay of this kind in the kingdom of Ireland.")

HUNTER, J.:

87 *Pottia recta* in Co. Donegal. Irish Nat., xix, 192 (1910).

FOGERTY, GEORGE:

88 Herbarium.

LETT, H. W., and Rev. C. H. WADDELL:

89 Two Mosses new to Ireland (*Hypnum rugosum* Ehrh. and *Catoscopium* nigritum Hedw.). Journ. Bot., xxxviii, 359 (1900).

LETT, H. W.:

90 A New Irish Moss. (*Catharinea angustata* var. *rhystophylla*). Irish Nat., xviii, 120 (1909).

BRAITHWAITE, R., M.D., F.L.S.:

91 The Sphagnaceae or Peat Mosses of Europe and North America (1880).

LETT, H. W.:

92 [Discovery of *Sphagnum Austini* in Ireland.] Belfast Naturalists' Field Club Proceedings (1889–90), 214–215.

92A *Sphagnum austini* (Sull.) in Ireland. Irish Nat., ii, 22 (1893).

93 In Report of Field Club Conference at Rosapenna. Irish Nat., xix (1910), 192–194. List of 51 species of mosses.

SANDERSON, A. R., and CHEETHAM, C. A.:

94 Notes from the West Coast of Ireland. (Records of 13 Mosses from West Donegal and 13 from West Galway.) Irish Nat., xxi (1912), 54–55.

M'ARDLE, D.:

95 In Handbook to the city of Dublin and the surrounding district, prepared for the meeting (1908) of the British Association, 86–91, on mosses.

LETT, H. W.:

96 Musci and Hepaticae. Clare Island Survey, Parts 11, 12. Proceedings of the Royal Irish Academy, xxxi (1912).

HOUSTON, J. D.:

97 Rare Mosses in Counties Antrim and Derry. Irish Naturalist, xxii, 44 (1913).

Amblystegium Kochii in Ireland. Irish Nat., xxiii, 72 (1914).

JOHNSON, T., D.SC., F.L.S.:

98 The Irish peat question. Economic Proceedings of the Royal Dublin Society, i, Part I, No. 1 (1899). (Contains a list of 11 species and 5 varieties of Sphagnum found in Ireland.)

SCOTT, ROBERT, M.D., Professor of Botany, Dublin:

99 [Letter, enclosing *Dicranum Scottii* and *Schistidium maritimum* from Ireland.] Trans. Dublin Soc., iii, 157 (1802). (With figs.) This does not appear to have been known to Moore.

PRAEGER, R. LL., B.A., B.E., M.R.I.A.:

100 Official Guide to Co. Down and the Mourne Mountains. Published by the Belfast and County Down Railway Company (1898). (Gives list of 10 rare mosses found in this county.)

WOODWARD, S. P:

101 Notes of a botanical excursion in Warwickshire, Wales, and Ireland. (Read to the Botanical Society of London. This mentions 11 mosses collected on the occasion, about Glengarriff in Co. Cork.) Phytologist, iii, 875 (1844).

LETT, H. W.:

102 Notes on the Flora of the Saltees, ii. Mosses and Hepatics. Irish Nat., xxii, 192–194 (1913). (See also No. 108.)

JONES, D. A., F.L.S.:

103 Mosses and Hepatics of Killarney. Journ. Bot., li, 177–182 (1913.)

LETT, H. W.:

104 *Sphagnum medium* in Ireland. Irish Nat., ix, 80 (1900).

105 Mosses new to Ireland (*Campylopus Shawii, C. Schimperi,* and *Dicranum uncinatum*). Irish Nat., x, 196 (1901).

106 Mosses in Ireland, a correction. Irish Nat., xvi, 348 (1907).

107 Mosses of Co. Dublin. Irish Nat., xvii, 77 (1907).

107A *Ditrichum tortile* in Ireland. Irish Nat., xvii, 204 (1907).

108 Plants of the Saltees—Correction. Irish Nat., xxiii, 20 (1914).

DIXON, H. N., M.A., F.L.S.:

109 *Catharinea rhystophylla* C.M. Journ. Bot., xlvii, 212 (1909).

110 On some Irish forms of *Fissidens.* Journ. Bot., xlviii, 145–149 (1910).

111 Student's Handbook of British Mosses. 2nd ed. (1904).

Waddell, C. H.:

112 *Thuidium delicatulum* in Co. Down. Irish Nat., xii, p. 219.

Lett, H. W.:

113 Notes on *Hypopterygium.* Journ. Bot., xlii (1904), 249–252, tab. 463.

Waddell, C. H.:

114 *Orthotrichum diaphanum* var. *aquaticum* Davies. Journ. Bot., xlvi, 1908, 172.

Davies, J. H.:

115 *Barbula Hornschuchiana* in Counties Down and Armagh. Irish Nat., xviii, 23 (1909).

Stewart, S. A.:

116 Guide to Belfast and the adjacent counties, by the Belfast Naturalists' Field Club. British Association meeting, Belfast (1874). (Two pages (86, 87) give the names and localities for 57 of the rarer mosses. Though not mentioned, Stewart was the author of the chapter on botany.)

117 Report on the Botany of the Island of Rathlin, Co. Antrim. Proc. R.I.A., 1884.

Davies, J. H.:

118 On *Weissia rostellata* in Ireland. Irish Nat., xi, 289 (1902).

118a Bryological Notes from Counties Down and Louth. Irish Nat., xviii, 12 (1909).

Lett, H. W.:

119 A new Irish Moss [*Catharinea rhystophylla*]. Journ. Bot. xlvii, 109 (1909).

National Museum, Dublin:

120 Herbarium.

Boswell, Henry, m.a.:

121 New or rare British and Irish Mosses. Journ. Bot. xxv, 111 (1887). (*Sphagnum acutifolium* v. *luridum* and *Grimmia elatior*, collected in Mourne Mountains by H. W. Lett.)

LIST OF THE RECORDS.

Sphagnum Austini *Sull.* var. **imbricatum** *Ldbg.*

17 Clonbrock '93 (M'Ardle)—*120.*
18 Geashill '92 (HWL)—*70.*
39 Evish near Glenarriff '89—HWL *92.*

Sphagnum papillosum *Ldbg.*

In all Divisions, except 2, 4, 5, 6, 15, 19, 20, 22, 34, 40.

var. **confertum** *Ldbg.*

1 Connor Hill Pass (Lindberg)—*91.*
17 Clonbrock—M'Ardle *42.*
20 L. Bray (Lindberg)—*91.*
39 (Moore)—*91.*

Sphagnum cymbifolium (*Ehrh.*) *Hedw.*

In all Divisions, except 5, 22, 23, 36, 40.

var. **congestum** *Schpr.*

16 Kylemore—Moore *57.*
38 Slievenamaddy—HWL *28.*

var. **squarrosulum** *N. Hsch., St.*

20 Glenealy '96 (M'Ardle)—*120.*

Sphagnum medium *Limpr.*

3 *7.*
8 (Stewart)—*79.*
9 (Stewart)—*79.*
10 Roscrea 1912—HWL.
18 Geashill 1903—HWL.
30 Derrywinny Bog 1911—Waddell.
33 Topped Mt. 1905—HWL.
34 Buncrana—Hunter *25.*
35 1902—HWL.
37 Montiaghs '84—HWL. Derrycrow 1901—HWL.
38 Ballygowan Bog '98—HWL.

var. **roseum** *Warnst.*

37 Montiaghs 1901—HWL.

Sphagnum tenellum *Ehrh.*

1 Brandon—Moore *'57.* Connor Hill Pass '97—HWL.
2 *7.*
6 L. Coomshigaun 1902—HWL.
14 Slieve Bloom 1912—Tetley.
16 Loughnafooey—M'Ardle *46.*
18 Geashill 1903—HWL.
20 Glenmalure—Moore *57.*
21 *7.*
26 Slieve Gamph 1910—Tetley.
27 Mweelrea '74 (Moore)—*120.*
28 Truskmore 1910—Tetley.
30 Slieve Glagh 1908—HWL.
32 1910—Bingham.
33 Topped Mt. 1905—HWL.
34 Grianan Hill—Hunter.
35 Doochary Bridge '90 (Dixon)—*120.* S. League—HWL *32.*
36 Tamnaquin (Stewart)—*79.*
37 Derrycrow '85—HWL. Carriffkeeny 1900—HWL.
38 Hen Mt.—*69.* Ballyvarley '99—HWL.
39 Glendun (Brenan)—*70.*

Sphagnum laricinum *Spruce.*

3 Shrone Hill 1907—Miss Martin.
6 L. Coomshigaun 1902—HWL.
8 Miss Armitage *1.*
12 Blackstairs 1907—Miss Cooper.
16 Leenane 1901—HWL.
20 '56 (Davies)—*120.*
21 Three Rock Mt. '56 (Orr)—*120.*
27 Bengorm 1901—HWL. Achill Island 1901—HWL.
28 Tents Mt. 1910—Tetley.
29 Truskmore 1909—Tetley.
31 Carlingford Mt. 1908—HWL.
34 Buncrana—Hunter *25.*
35 Portaw Glen—Hunter *25.*
38 Ballygowan Bog 1903—HWL.
39 Murlough 1913—HWL.

Sphagnum subsecundum *Nees.*

1 *7.*
3 Glengarriff 1912—HWL.
4 Kinsale—Carroll *5.* Moore *57.*
6 Carroll *5.*
11 Mt. Brandon 1911—Tetley.
16 Connemara—Moore *57.*
17 Cloonlusk Bog 1910—Tetley.
20 L. Bray (Orr)—*57.*
21 Howth (Orr)—*57.*
25 Curlew Hills 1910—Tetley.
26 Slieve Gamph 1910—Tetley.
27 Mweelrea '74 (Moore)—*120.*
28 Truskmore 1910—Tetley.
30 Cuilcagh Mt. 1909—Tetley.
31 Anglesey Mt. (Waddell)—*28.*
33 Barr of Whealt 1909—Tetley.
35 *7.*
37 Carriffkeeny—HWL *28.*
38 Newcastle—Stewart *69.* Slieve Donard —HWL *28.*
39 Moore *57.* Glendun—Brenan. Parkmore—HWL *28.*
40 Coleraine—Stewart *69.*

var. **contortum** *Schpr.* (= **rufescens** *Warnst.*)

1 Coomanard Loughs '98—HWL.
2 *7.*
4 *7.*
6 L. Coomshigaun 1902—HWL.
8 Miss Armitage *1.*
11 Mt. Brandon 1911—Tetley.
12 Blackstairs Mt. 1907—Miss Cooper.
13 Mt. Leinster 1911—Tetley.
16 Leenane—HWL.
20 L. Bray—Moore *57.*
21 Dublin Mts. '54 (Orr)—*35.*
25 Kilronan Mts. 1910—Tetley.
27 Achill Island 1904—HWL.
29 Dartry Hills 1909—Tetley.
30 Cuilcagh 1910—Tetley.
31 *7.*
33 Monea Bogs 1905—HWL. Florencecourt 1909—Tetley.
35 Hunter *25.* Slieve League, 1910—HWL.
36 Baronscourt '91—HWL.
37 Slieve Gullion 1905—HWL.
38 Slieve Donard—Stewart *69.* Gruggandoo '85—HWL.
39 Glendun '90—Brenan.

var. **auriculatum** (*Schpr.*).

1 Killarney (Carrington)—*57.*
6 L. Coomshigaun 1902—HWL.
8 Miss Armitage *1.*
26 Slieve Gamph 1910—Tetley.
27 Pontoon 1901—HWL. Achill Island 1905—HWL.
28 Slishwood 1903—Tetley.
35 Slieve League—HWL *32.*
38 Slievenabrock '85—HWL.

Sphagnum obesum *Warnst.*

14 Slieve Bloom 1912—Tetley.
17 Tuam 1910—Tetley.
21 Howth '65 (Hutton)—*35.*
26 L. Glendaduff 1910—Tetley.
27 Achill—HWL.
30 Cuilcagh 1910—Tetley.
33 Barr of Whealt 1909—Tetley.
35 Tory Island 1910—Glover.
37 Derrycrow '84—HWL.
38 Slievenamaddy '83—HWL.
40 *7.*

Sphagnum molle *Sull.*

34 Grianan Hill—Hunter *25.*
37 Carriffkeeny 1900—HWL.
38 Mourne Mts. '85—HWL.
39 Slemish '97—HWL. Glendun (Brenan)—*35.*

Sphagnum rigidum (*Nees*) *Schpr.*

1 Killarney (Moore)—*120.*
14 Slieve Bloom 1912—Tetley.
16 Kylemore—Moore *56.*
17 1910—Tetley.
20 L. Bray '57 (Orr)—*120.*
21 Howth (Orr)—*120.*
27 Devil's Mother Mt. 1901—HWL.
30 Slieve Glagh 1908—HWL.
31 Carlingford Mt.—HWL.
32 1910—Bingham.

33 Topped Mt. 1905—HWL.
34 Buncrana—Hunter *25.* Grianan Hill 1908—HWL.
38 Kinnahalla (HWL)—*69.* Slieve Donard—HWL *28.*
39 Rasharkin Bog (HWL)—*70.*

var. **compactum** (*De Cand.*) *Schpr.*

1 Eagle Mt. nr. Ventry '98—HWL.
2 *7.*
16 Recess—C. D. Russell.
20 *7.*
21 *7.*
27 Pontoon 1901—HWL.
28 *7.*
31 Carlingford Mt. '83—HWL.
32 *7.*
33 *7.*
34 *7.*
35 *7.*
36 Strabane Glen '83—HWL.
38 Chimney Rock Mt. '83—HWL.
39 Parkmore '89—HWL.

var. **squarrosum** *Russ.*

27 Pontoon 1901—HWL.
31 Carlingford Mt. 1900—HWL.
33 Topped Mt. 1905—HWL.
35 Slieve League 1902—HWL.
37 Carriffkeeny '98—HWL.

Sphagnum squarrosum *Pers.*

2 *7.*
4 Blarney (Alexander)—*61.*
5 *7.*
7 Galtee Mts. 1902—HWL.
8 Miss Armitage *1.*
13 Fenagh '67 (R. C. Browne)—*120.*
16 Connemara '66 (Moore)—*120.*
20 Glendalough (Orr)—*120.*
21 Dublin Mts. '64 (Orr)—*120.*
22 '50 (Moore)—*120.*
27 Croaghpatrick—Waddell.
31 *7.*
32 Creaghan 1907—Kane.
33 Lough Carrick 1905—HWL.
34 Birdstown—Hunter *25.*
36 Arboe '90 — Brenan. Dungannon 1909—Porter.
37 Ardmore Bay moss '82—HWL.
38 Rathfriland '87 (HWL)—*120.* Saintfield 1912—HWL and Waddell.
39 Lambeg '04—Templeton *75.* Glenleslie '60—HWL.

This is a lowland plant, and is not abundant nor common.

var. **imbricatum** *Schpr.*

8 Miss Armitage *1.*
38 Loughbrickland 1904—HWL.

var. **teres** *Schpr.*

20 L. Bray '75 (Moore)—*120.*
34 Trillick Banks, Buncrana — Hunter *25.*
38 Hen Mt.—HWL *28.*

var. **subsquarrosum** *Russ.*

37 Derrycrow moss '88—HWL.
38 Loughbrickland 1904—HWL. Carrickmannon Lake 1903 (Waddell)—*59.*
39 Aghagallon 1905—HWL.

Sphagnum Girgensohnii *Russ.*

20 Glenmalure—Moore *57.*
34 Buncrana—Hunter *25.*
38 Saintfield 1912—HWL and Waddell.
39 Glendun '90 (S. A. Brenan)—*35.*

Sphagnum fimbriatum *Wils.*

20 L. Bray '75 (Moore)—*120.*
30 Tents Mt. 1910—Tetley.
33 Near Correll Glen 1910—Tetley.
34 *7.*
35 Scalp Hill—Hunter *25.*
38 Hen Mt. '87—HWL.
39 *7.*

Sphagnum acutifolium *Ehrh.*

In all Divisions, except 3, 6, 22, 23, 24, 36, 40.

var. **deflexum** *Schpr.*

18 Geashill—HWL.
38 Spinkwee River glen—HWL *28.*
39 Glendun (Brenan)—*35.*

var. **purpureum** *Schpr.*

6 L. Bolagh 1902—HWL.
10 Near Roscrea 1911—HWL.
18 Geashill '94—HWL.
21 Dublin Mts. '75 (Moore)—*120.*
23 Ballymorris bog 1908—HWL.
27 Achill Island 1903—HWL.
35 Slieve League 1902—HWL.
36 Bessy Bell Mt. '97—HWL. Dungannon 1900—Porter.
37 Camlough Mt.—HWL *28.* Ardmore Bog '85—HWL.
38 Slieve Donard—HWL *28.*
39 Glendun (Brenan)—*35.* Glenleslie '83—HWL.

var. **rubellum** (*Wils.*)

In all Divisions, except 5, 11, 12, 15, 19, 22, 24, 25, 29, 32.

var. **elegans** *Braithw.*

29. L. Allen '83 (Stewart)—*67.*

var. **fuscum** *Schpr.*

18 Geashill '94—HWL.
32 Scottstown 1900 (Waddell)—*35.*
33 Florencecourt 1909—Tetley.
34 Grianan Hill—Hunter *25.*
39 *7.*

var. **arctum** *Braithw.*

16 Connemara (Moore)—*91.*
31 Carlingford Mt.—HWL *28.*
38 Slieve Donard—HWL *28.*

var. **luridum** *Hübn.*

38 Bloody Burn, S. Donard—HWL *28.*

var. **quinquefarium** *Ldbg.*

1 L. Eagle '98—HWL.
2 *7.*
3 Shrone Hill 1907—Miss Martin.
6 L. Bolagh 1902—HWL.
7 Galtee Mts. 1902—HWL.
14 Slieve Bloom 1912—Tetley.
16 Connemara (Moore)—*120.*
27 Achill Island 1901—HWL.
29 Truskmore 1909—Tetley.
33 L. Carrick 1905—HWL. Castle Archdall 1907—Kane.
34 Buncrana—Hunter *25.*
35 Slieve League 1902—HWL *32.* L. Salt 1910—HWL.
36 Baronscourt '91—HWL.
38 Mourne Mts.—HWL.
39 Glendun 1890—Brenan.

var. **tenue** *Braith.*

29 Bundoran 1913—Porter.
37 Derrycrow bog '84—HWL.

var. **subnitens** (*Dixon*). (**S. subnitens** *Russ.* and *Warnst.*)

1 Connor Hill Pass '97—HWL.
3 Shrone Hill 1907—Miss Martin.
6 L. Bolagh 1902—HWL.
7 L. Muskry 1902—HWL.
8 Miss Armitage *1.*
9 Scariff 1909—Mrs. Hibbert.
11 Mt. Brandon 1911—Tetley.
12 *7.*
13 Mt. Leinster '67 (R. C. Browne)—*120.*
15 1907—Mrs. F. Joyce.
16 Leenane 1901—HWL.
18 Geashill 1903—HWL.
25 Kilronan Mt. 1910—Tetley.
26 Slieve Gamph 1910—Tetley.
27 Achill Island 1901—HWL.
28 Truskmore 1911—Tetley.
30 Slieve Glagh 1908—HWL. Cuilcagh Mt. 1909—Tetley.
31 Anglesey Mt. '89—HWL. Carlingford Mt. 1908—HWL.
32 1910—Bingham.
33 Topped Mt. 1905—HWL. Castle Archdall 1907—Kane.
34 Hunter *25.* Grianan Hill, 1908—HWL.
35 Slieve League—HWL *32.*

36 Bessy Bell Mt. '97—HWL. Dungannon 1906—Miss Boyd.
37 Carriffkeeny '87—HWL. Montiaghs 1901—HWL.
38 Slieve Martin '84—HWL. Ballygowan Bog 1903—HWL.
39 Parkmore '89—HWL. Selshan 1904—HWL.

Sphagnum Russowii *Warnst.*

34 Buncrana—Hunter *25.*
39 Glendun '90 (Brenan)—*35.*

Sphagnum intermedium Hoffm.

1 Connor Hill Pass '97—HWL.
6 L. Coomshigaun 1902—HWL.
7 L. Muskry 1902—HWL.
11 Mt. Brandon 1911—Tetley.
12 Blackstairs Mt. 1911—Tetley.
13 Mt. Leinster '67 (R. C. Browne)—*120.*
14 Slieve Bloom 1912—Tetley.
16 Leenane 1901—HWL.
20 L. Bray '75 (Moore)—*120.*
25 Kilronan Mt. 1910—Tetley.
26 Glendaduff L. 1910—Tetley.
27 Pontoon 1901—HWL.
28 Truskmore 1910—Tetley.
29 Glenfarne '75 (Moore)—*120.* Truskmore 1909—Tetley.
31 Clermont Mt.—HWL *28.*
30 Cuilcagh Mt. 1909—Tetley.
35 Hunter *25.* Slieve League—HWL *32.*
36 L. Fee—*79.*
37 Carriffkeeny '87—HWL.
38 Deer's Meadow (HWL)—*69.*
39 Parkmore '89—HWL.

var. **parvifolium** *Warnst.*

39 Sallagh Braes '84—HWL.

Sphagnum cuspidatum *Ehrh.*

1 Brandon—Moore *57.* Loughadoon '95—HWL.
2 *?.*
8 Foynes—Stewart *66.*
9 *?.*
10 Roscrea 1911—HWL.
11 Mt. Brandon 1911—Tetley.
12 Blackstairs Mtn. 1911—Tetley.
14 Slieve Bloom 1912—Tetley.
16 Kylemore—Moore *57.*
18 Geashill '95—C. D. Russell.
21 Dublin Mtns. '58 (Orr)—*120.* Howth '65 (Hutton)—*35.*
25 Kilronan Mtn. 1910—Tetley.
26 Slieve Gamph 1910—Tetley.
27 Mweelrea '74 (Moore)—*120.* Pontoon 1901—HWL.
28 Truskmore 1910—Tetley.
29 Largydonnell 1909—Tetley.
30 Slieve Glagh 1908—HWL. Leslie's Hill 1909—Tetley.
31 Anglesey Mtn.—HWL *28.*
32 1910—Bingham.
33 Topped Mtn. 1905—HWL. Derrygonnelly 1907—Tetley.
34 *?.*
35 Hunter *25.* Lough Salt 1910—HWL.
36 Pomeroy '75 (Stewart)—*79.*
37 Ardmore Bogs '82—HWL.
38 Grey Abbey—Templeton *75.* Lacken Bog 1901—HWL.
39 Carnmoney '09—Templeton *75.* Rathlin I.—Stewart *69.*

var. **submersum** *Schpr.*

1 Emalough—HWL.
8 Miss Armitage *1.*
18 Geashill 1903—HWL.
25 Kilronan Mtn. 1910—Tetley.
27 Doolough Pass 1901—HWL.
33 Castle Archdall 1907—Kane.
35 Slieve League—HWL *32.*
37 Ardmore Bay moss '81—HWL.
38 Speltha '85—HWL. Lacken Bog 1901—HWL.
39 Glendun '90 (Brenan)—*35.* Parkmore—HWL.

var. **falcatum** *Russ.*

7 Galtee Mtns. 1902—HWL.
8 Miss Armitage *1.*
11 Mt. Brandon 1911—Tetley.
13 Mt. Leinster 1911—Tetley.

17 Cloonlusk Bog 1910—Tetley.
18 Geashill 1903—HWL. Shinrone 1907—Miss Hemphill.
20 Lough Bray '75 (Moore)—*31.*
27 Nephin 1901—HWL.
29 Glencar 1909—Tetley.
30 Slieve Glagh '93—M'Ardle *43.*
32 Drumreaske 1907—Kane.
33 Topped Mtn. 1905—HWL.
35 Slieve League—HWL *32.*
36 Bessy Bell Mtn. '97—HWL. Dungannon 1909 (Porter)—*35.*
37 Camlough Mtn.—HWL *28.* Derrycrow '84—HWL.
38 Hilltown—HWL *28.*
39 Carnmoney '87 (Waddell)—*31.* Glendun '91 (Brenan)—*35.*

var. **plumosum** *Nees. Hsch.*

14 Slieve Bloom 1912—Tetley.
20 Lough Bray—*95.*
26 Slieve Gamph 1910—Tetley.
28 Truskmore 1910—Tetley.
33 *7.*
37 *7.*
38 *7.*
39 *7.*

Andreæa petrophila *Ehrh.*

1 *7.*
2 Horse's Glen 1906—Jones.
6 Lough Coomshigaun '92—HWL.
11 Mt. Coppanagh 1911—Tetley.
12 Blackrock Mtn. 1911—Tetley.
16 Connemara—Moore *57.*
20 Lugnaquilla—Moore *57.*
29 Truskmore 1909—Tetley.
31 Carlingford Mtn.—HWL *29.*
35 Dixon *17.* Slieve League—HWL *32.*
37 Camlough Mtn. 1900—HWL.
38 Slieve Donard—Stewart *69.* Slieve-na-brock—HWL.
39 Slemish '60—Moore. Sailagh Braes '84—HWL.
40 Clontygeera Mts. (Moore)—*69.* Mullaghmore Mtn. '84 (Stewart)—*79.*

var. **acuminata** *Shpr.*

31 Carlingford Mtn.—HWL.
38 Mourne Mtns. Slieve-na-brock (HWL)—*69.*
39 *7.*

var. **gracilis** *Shpr.*

38 Mourne Mtns. near Slieve Dermot (HWL)—*69.*
39 *7.*

Andreæa alpina (*Dill.*) *Sm.*

1 Brandon—Moore *57.* Coomanard L. '89—HWL.
2 Horse's Glen 1906—Jones.
7 Lough Dineen 1902—HWL.
13 Connemara—Moore *57.*
20 Upper L. Bray—Moore *57.*
21 Killakee Glen—Moore *58.*
28 Collooney '04—M'Ardle *41.*
31 Carlingford Mtn. '03—HWL.
35 Errigal—Dixon *17.*
36 Slieve Gallion—Templeton *75.*
37 Camlough Mtn. 1900—HWL.
38 S. Donard—Stewart *69.* Slievenamaddy—HWL.
39 Black Mtn.—Templeton *75.* Slemish '93—HWL.
40 Clontygera Mtns. (Moore)—*69.*

Ardreæa crassinervis *Bruch.*

2 '69 (Moore)—*120.* Cromaglaun '85 (Stewart & Holt)—*2.*
16 '53 (Moore) — *120.* Curranamona 1906—M'Ardle *46.*
20 Upper L. Bray—Moore *57.*
21 Killiney (Orr)—*120.*
27 Delphi 1832 (Shuttleworth)—*120.*
38 Slievemartin (HWL)—*69.* Eagle Mt. (Waddell)—*69.*

var. **Huntii** *Limpr.*

38 Slieve Dermot—HWL *28.* Shanslieve Mourne Mts. '83—Waddell.

Ardreæa Rothii *W. M.*

1 Coomanard Ls. '98—HWL.
2 Cromaglaun (Lindberg)—*2.*

4 Coachford—*84.*
5 Kildorrery '51 (Carroll)—*120.*
6 L. Bolagh 1902—HWL.
11 Mt. Brandon 1911—Tetley.
12 Blackstairs Mt. 1911—Tetley.
13 Mt. Leinster '67—R. C. Browne.
20 Glenmalure '56—Davies *8.* Upper L. Bray '98—HWL.
21 Dublin Mts.—Moore *58.* Kelly's Glen '51 (Orr)—*35.*
25 Curlew Hills 1910—Tetley.
26 Slieve Gamph 1910—Tetley.
27 Pontoon '91—HWL.
28 Collooney Hill 1910—Tetley.
29 Cloonaquin Mt. 1909—Tetley.
30 Cuilcagh 1910—Tetley.
31 Carlingford Mt.—Tetley.
33 Cuilcagh 1912—Tetley.
34 Buncrana—Hunter *25.*
35 Poisoned Glen—Dixon *17.*
36 Mullaghcarbadagh Mt. '88 (Stewart)—*79.*
38 Slieve Donard—Stewart *69.* Slievenamaddy '84—HWL.
39 (Moore)—*69.*
40 Slieve Gallion (Moore)—*69.*

var. **hamata** *Ldbg.*

1 Macgillycuddy's Reeks '85 (Stewart & Holt)—*2.*
12 Blackstairs 1911—Tetley.
20 Luggielaw (Lindberg)—*2.*
30 Cuilcagh 1909—Tetley.
37 Camlough Mt. '87—HWL.
38 Slieve Commedagh—HWL *28.*

var. **falcata** *Schpr.*

2 Horse's Glen 1906—Jones.
6 Commeragh Mts. 1902—HWL.
25 Arigna '85 (Stewart)—*79.*
27 Achill I. 1904—HWL.
29 *7*
30 Cuilcagh 1909—Tetley.
35 Poisoned Glen—Dixon *17.*
38 Mourne Mts. Pierce's Castle (HWL)—*69.*
39 Fair Head (HWL)—*69.*

Buxbaumia aphylla *Hall. L.*

1 Killarney, Purple Mt.—Wade *80.*

Georgia pellucida (*L.*) *Rabenh.*

1 O'Sullivan's Cascade '85 (Stewart)—*79.*
2 Cromagloun—Moore *57.*
6 Commeragh Mts. 1902—HWL.
13 South of Borris 1911—Tetley.
18 Derrygolan Wood '90—HWL.
20 Powerscourt—Templeton *74, 75.* Lr. L. Bray '98—HWL.
21 Near Dublin—*84.*
27 Pontoon 1902—HWL. Achill I. 1909—HWL.
28 Benbulben—Moore *57.*
29 Kinlough Wood 1907—Tetley.
32 Creaghan 1907—Kane.
33 Correl Glen 1905—M'Ardle *45.*
34 Carradoan Wood—Hunter *25.*
35 L. Salt '65 (Hutton)—*35.*
38 Tollymore Park—Waddell.
39 Glenarriff—Moore *57.* Near Belfast (Orr)—*35.*
40 Ness Glen—Templeton *74, 75.*

Georgia Brownii (*Dicks*) *C.M.*

20 Lough Bray (Stokes)—*74, 75.* '54 (Orr)—*35.*
21 (Taylor)—*74, 75.*
35 Ballycastle—Moore *57.*

Catharinea undulata (*L.*) *Web. Mohr.*

In all Divisions except 5, 7, 17, 22, 24, 25. Very common, and often abundant.

Catharinea angustata *Brid.* var. **rhystophylla** *Dixon.*

38 Saintfield 1908 (HWL)—*109.*

This plant was found in a large patch fifteen inches across, on top of a mud-capped wall south of Saintfield Demesne. It is well worth searching for in other localities.

Oligotrichum incurvum (*Huds.*) *Ldbg.*

1 *7.*
2 Horse's Glen 1906—Jones. Devil's Punch Bowl '85 (Stewart)—*79.*
4 Monkstown—*61.*
5 Great Island (Scott)—*61.*
13 Mt. Leinster 1911—Tetley.
20 Lugnaquilla—Moore *57.* Near Wooden Bridge '68—Moore *56.*
27 '57 (Dickie)—*57.*
29 Bronagh Mt. 1909—Tetley.
31 Carlingford Mt. (Waddell)—*28.*
34 Grianan Hill—Hunter *25.*
38 Mourne Mts.—Templeton *74, 75.* Slieve Donard—HWL *28.*
39 Kilwaughter—Templeton *74, 75.*

Polytrichum subrotundum *Huds.*

1 *7.*
2 Cromaglaun '73 (Moore)—*120.*
3 *84.*
4 Ballinhassig—Power *61.*
5 Templemichael '51—I. Carroll *6.*
10 Near Roscrea 1911—HWL.
12 Strokestown 1907—Phillips.
13 Mt. Leinster—R. C. Browne.
20 Lough Bray—Moore *57*, Kilcock Mt. 1908—Hughes.
21 Howth—Moore *57.* '53 (Orr)—*35.*
27 Nephin—Moore *57.*
28 Knocknarea Glen '04—M'Ardle *41.*
32 Eskmore 1910—Bingham.
33 Topped Mt. 1905—HWL.
34 Hunter—*25.*
35 Lough Salt 1910—HWL.
37 Carrifkeeny 1913—HWL.
38 Manyburn Glen—Templeton *74, 75.* Slieve Donard—HWL *28.*
39 Cranmore (Templeton)—*69.* Torr Head—Moore *57.*
40 R. Brown—*74, 75.*

var. **longisetum** (*Hampe*).

38 *7.* Ballymaghan—Stewart *69.*
39 Slievetrue—Stewart *69.*
40 *7.*

Polytrichum aloides *Hedw.*

In all Divisions except 7, 10, 15–17, 19, 22, 23, 25, 28, 29.

var. **Dicksoni** (*Turn.*).

5 Glanmire Wood—Power *61.*
38 Holywood—Templeton *74, 75.*
39 Cranmore—Templeton *74, 75.*
40 (R. Brown)—Taylor *71.*

Polytrichum urnigerum *L.*

In all Divisions except 6, 8, 9, 11, 13, 17, 19, 22, 23, 24, 27.

Polytrichum alpinum *L.*

1 Brandon—Moore *57.*
2 Mangerton—Wade *80.* Horse's Glen 1906—Jones.
7 Lough Muskry 1902—HWL.
13 Mt. Leinster 1911—Tetley.
16 Maam Turk—Wade *80.*
20 Templeton *74, 75.* Lugnaquilla—Moore *57.*
21 Kelly's Glen '57 (Orr)—*120.*
23 Mullingar 1909—HWL.
27 Nephin & Achill I. 1909—HWL.
28 *7.*
29 Slievanierin Mt. '83—Stewart *67.* Truskmore 1910—Tetley.
30 Slieve Glagh 1908—HWL. Cuilcagh 1908—Tetley.
31 Wade *80.* '82—HWL *28.*
34 Bulbin Mt. (R. Brown)—*74, 75.*
36 Mullaghcarbetagh Mt. '88 (Stewart)—*79.*
38 Templeton *74, 75.* Deer's Meadow (HWL)—*69.*
39 Mountains—Templeton *74, 75.* Glenarriff—Stewart *69.*
40 Templeton *74, 75.* Toome—Stewart *69.*

var. **septentrionale** *Ldbg.*

1 *7.*
26 *7.*
35 Slieve League—Dixon *111.*

Polytrichum gracile *Dicks.*

1 *7.* Eagle Mt. 1911—Jones.
2 Bog below Torc—Jones.
3 Glengarriff '43—Woodward *101.*
7 L. Muskry 1902—HWL.
8 Thornfield's bog—Armitage *1.*
11 Near Bagnalstown 1911—Tetley.
12 Blackrock Mt. 1911—Tetley.
13 Mt. Leinster 1911—Tetley.
14 Slieve Bloom 1912—Tetley.
17 Cloonlusk Bog 1910—Tetley.
18 Geashill 1907—HWL.
20 Turf bogs—Moore *58.* L. Dan—Hart *20.*
21 Moore *58.*
25 Kilronan Mt. 1910—Tetley.
26 Glendaduff L. 1910—Tetley.
29 Truskmore 1909—Tetley.
30 Slieve Glagh 1908—HWL. Cuilcagh 1909—Tetley.
33 Marble Arch Glen 1905—HWL.
36 Near Dungannon 1906—Miss Boyd.
37 Derryinver '82—HWL. Tartaraghan bog '70 (Stewart)—*79.*
38 Wood near Mourne Mts.—Drummond *18.* L. Shannagh '83—HWL *28.*
39 Divis Mt.—Templeton *74, 75.* Parkmore '61—HWL.
40 Near Dungiven '76 (Stewart)—*79.*

Polytrichum attenuatum *Menz.*

In all Divisions, except 3–6, 8, 15, 19, 21, 22, 34, 37.

Polytrichum piliferum *Schreb.*

In all Divisions, except 5, 8, 17, 19, 22-24, 28, 29. Common, and often abundant.

Polytrichum juniperinum *Willd.*

In all Divisions except 7, 8, 10, 15, 22, 23. Of frequent occurrence.

Polytrichum strictum *Banks.*

1 Eagle Mt. 1906—HWL.
3 *7.*
20 Moore *58.*
21 Moore *58.* Ballinascorney Glen '56 (Orr)—*35.*
28 Truskmore 1910—Tetley.
29 Dartry Hills 1909—Tetley.
38 Slieve Donard '85—HWL *28.*
39 Divis Mt. '02—Templeton *74, 75.*

Polytrichum commune *L.*

In all Divisions, except 2, 4, 10, 15, 19, 22–25. Frequent.

var. **minus** *Weiss.*

38 Near Gilford '04—Davies *15.*

Fissidens exilis *Hedw.*

1 *7.*
19 Curragh '61 (Hutton)—*35.*
20 *95.*
21 Glasnevin '53 (Orr)—*120.*
38 Loughbrickland '86—HWL *35.*
39 Near Belfast—Drummond *18.* White Mt.—Davies *10.*

Fissidens viridulus (*Swartz*) *Wahl.*

7 *7.*
12 Great Saltee I. 1913—HWL *102.*
14 Slieve Bloom 1912—Tetley.
16 Ashford near Cong 1907—Kane.
18 Geashill Rectory '92—C. D. Russell.
20 Altadore Glen '73 (Moore)—*120.*
21 Howth (Orr)—*57.*
22 New Grange 1912—HWL.
31 (Stewart)—*79.*
33 Ballycassidy 1910—Tetley.
37 Lurgan Demesne '82 (Waddell)—*12.*
38 Lisnatrunk—Davies *10.* Loughbrickland 1912—HWL.
39 Near Belfast '01—Templeton *74, 75.*

Fissidens incurvus *Starke.*

21 Clontarf '65 (Hutton)—*35.*
31 Clermont Mt. '85—HWL *28.*
33 Florencecourt 1910—Tetley.
37 Derryadd '85 (HWL)—*10.*
38 Lenaderg—Davies *15.*
39 White Mt. and Kilroot '00—Davies *10.*

var. **tamarindifolius** (*Don*).

3 Bantry (Miss Hutchins)—*81*.
21 Killakee '65 (Hutton)—*35*.
35 Glenalla '86—Hart *20*.
38 *7*.

Fissidens bryoides (*L.*) *Hedw.*

1 Dingle—*84*.
2 Torc Mt. 1906—Jones.
3 Glengarriff 1912—HWL.
4 Vernonsmount—Power *61*.
7 L. Dineen 1902—HWL.
8 *7*.
9 *7*.
10 Near Roscrea 1911—HWL.
12 Great Saltee I. 1913—HWL *102*.
13 Browne's Hill '67 (R. C. Browne)—*120*.
16 L. Corrib near Ballard '07 –M'Ardle *46*.
20 Moore *58*. Ovoca '64 (Hutton)—*35*.
21 Glasnevin '50 (Orr)—*120*. Santry 1908—M'Ardle.
27 Doolough Pass—HWL.
30 Killykeen 1908—HWL.
31 Ravensdale '98—HWL.
33 Correll Glen 1905—M'Ardle *45*.
34 Hunter *25*.
35 Cratlagh Wood 1910—HWL. Killybegs 1911—Cheetham *94*.
36 Ranfurly Park 1909—Porter.
37 Ardmore Glebe '85—HWL.
38 Donard Demesne—HWL *28*. Clonallon '85 (Waddell)—*120*.
39 (Moore)—*120*.
40 *7*.

var. **intermedius** *Ruthe.*

21 Dublin—Dixon *111*.
33 Correll Glen 1905—M'Ardle *45*.

Fissidens Curnowii *Mitt.*

2 Near Torc—Jones.
34 Bridge End '99—Hunter *25*.

Fissidens fontanus *Schpr.*

38 Lenaderg '08—Davies.
[Braithwaite (i, 71) gives Turner as the authority for the occurrence of this moss in "Ireland, 1809," but without mention of any locality.]

Fissidens rufulus *Br. Sch.*

38 Knocknagor—Davies *15*.

Fissidens osmundoides (*Swartz*) *Hedw.*

1 *7*.
2 Cromagloun (Moore)—*57*.
3 Glengarriff (Hunt)—*2*. Ballylickey 1912—HWL.
6 L. Coomshigaun 1902—HWL.
7 L. Muskry 1902—HWL.
10 Near Roscrea 1911—HWL.
12 Ballynastragh 1906—Esmonde.
14 Slieve Bloom 1912—Tetley.
16 Leenane 1901—HWL. Twelve Bens—Hart *20*.
18 Dovegrove 1907—Miss Hemphill.
19 Poulaphuca '56—Davies *8*.
21 Kelly's Glen (Nuttall)—*85*.
23 L. Deravaragh 1909—HWL.
24 Derrycasson 1907—Miss Hepenstall.
25 Curlew Hills 1910—Tetley.
28 Benbulben—Moore *57*.
30 Slieve Glagh 1908—HWL.
31 Carlingford Mt.—HWL *28*. Anglesey Mt. '83 (Waddell)—*120*.
32 Drumreaske 1907—Kane. Eskmore 1910—Bingham.
33 Rossinuremore 1905—HWL.
34 Buncrana—Hunter *25*.
35 Slieve League—HWL *32*.
36 Ranfurly Park 1909—Porter.
37 *7*.
38 '03 (Templeton)—*69*. Slievenabrock 1912—HWL.
39 Colin Glen—Davies.

* **Fissidens tequendamensis** *Mitt.*

Fissidens Orrii (Ldbg.) Braithwaite, Moss Flora, I, 73, 1880.

21 On stones in the Tolka river, and at an old quarry on its north bank near Finglas bridge, Glasnevin Botanic Garden, Dublin '54 — Orr.]

Fissidens decipiens *De Not.*

1 *7.*
2 Muckross (Moore and Wilson)—*57.*
3 Gouganebarra '64 (G. E. Hunt)—*120.*
6 L. Coomshigawn 1902—HWL.
11 Mt. Brandon 1911—Tetley.
12 Newtownbarry '64 (Hutton) — *35.* Wheelagower 1911—Tetley.
14 Mountmellick 1912—Tetley.
16 Wood west of Cong 1907—M'Ardle *46.*
17 Castle Hackett 1910—Tetley.
25 Near Boyle 1910—Tetley.
26 Slieve Gamph 1910—Tetley.
28 Mullaghmore 1910—Tetley.
29 Truskmore 1909—Tetley.
30 Lenliss 1909—Tetley.
33 Correll Glen 1907—Tetley.
35 Cratlagh Wood 1910—HWL. Killybegs 1911—Cheetham *94.*
38 Knocknagor—Davies *15.*

Fissidens taxifolius (*L.*) *Hedw.*

In all Divisions, except 5, 7, 16, 22. Frequent.

Fissidens cristatus *Wils.*, var. **brevifolius** *Ldbg.*

2 Killarney, near O'Sullivan's Hotel (Lindberg)—*2.*

Fissidens adiantoides (*L.*) *Hedw.*

In all Divisions, except 11, 12, 15, 19, 22, 24.

Fissidens polyphyllus *Wils.*

1 L. Aniscaul '98—HWL.
2 Killarney—*84.*
3 Glengarriff '29—Wilson *81.* Near Roche's Hotel 1911—Jones.
4 Blarney—*84.*
28 Ben Bulben '56 (Moore)—*35.*

Fissidens pusillus *Wils.*

1 Dingle—*84.*
39 Black Mt.—Stewart *69.*

*[**Fissidens exsul** *Dixon.*

21 Dublin "On the surface soil (loam) in pots and tubs where palms are grown in the Botanic Gardens, Glasnevin, Dublin, Nov., 1909" (D. M'Ardle) "—*110.*]

Fissidens minutulus *Sull.*

1 On sandstone blocks on E. of Brandon Hill, near L. Nalacken, 1900—HWL.
39 On fallen sandstone on E. face of the Black Mt., and chalk rocks in Red Hall Glen '69—Stewart.

Leucobryum glaucum (*L.*) *Schpr.*

In all Divisions, except 6, 8, 9, 10, 11, 12, 19, 22, 23, 24, 32, 36.

Generally abundant on the brown bogs, but in some districts scarce.

Archidium alternifolium (*Dicks*) *Sch.*

1 Dunkerron—Taylor *72.*
21 Glasnevin '52 (Orr)—*35.*
38 Loughbrickland 1907—HWL.
39 Near Belfast (Drummond)—*2.*

Pleuridium axillare (*Dicks.*) *Ldbg.*

1 *7.*
2 Horse's Glen 1906—Jones.
4 Rathpeacon—*61.* Near Ballincollig Castle—Carroll *5.*
38 Lenaderg 1903—Davies *14.*
39 Near Belfast '36 (Taylor)—*72.* (Moore)—*120.*

Pleuridium subulatum (*L.*) *Rabenh.*

1 Near Sneem '78—Carroll.
4 Near Rathpeacon—Power *61.*
14 Slieve Bloom 1912—Tetley.

20 (Moore)—*120.*
21 '56 (Orr)—*120.*
31 *7.*
34 Hunter *25.* Buncrana—Mrs. Leebody.
37 Ardmore Glebe '83—HWL *35.*
38 Ballymaghan — Stewart *69.* Near Scarva—HWL *28.*
39 White Mtn.—Stewart *69.* Woodburn Reservoir '85—HWL *35.*
40 (Moore)—*120.* Moneymore—Stewart *69.*

Pleuridium alternifolium (*Kaulf.*) *Rabenh.*

1 Near Inch '99—HWL *35.*
2 Horse's Glen—Jones.
3 *7.*
21 Near Dublin—*84.*
31 Clermont Mtn.—HWL *28.*
38 Warrenpoint (Waddell)—*69.* Aghaderg Glebe '89—HWL.
39 '47 (Orr)—*120.* Near Lisburn 1901—Davies *12.*

Ditrichum tenuifolium (*Schrad.*) *Ldbg.*

39 Near Botanic Gardens, Belfast, '30—Drummond *18.*

Ditrichum tortile (*Schrad.*) *Hampe.*

12 Great Saltee I. 1913—HWL *102.*
32 Rossmore Park 1912—HWL.
35 Rosnowlagh 1908—Rev. W. F. Johnson.
38 Scrabo Quarry 1908—HWL.

var. **pusillum** (*Hedw.*).

5 Dodge's Glen (Carroll)—*2.*
39 Near Botanic Gardens, Belfast—Drummond *18.*

Ditrichum homomallum (*Hedw.*) *Hampe.*

1 *7.*
2 Killarney '73 (Moore)—*120.*
3 Glengarriff—*84.*
4 Carrigaline (D. Murray)—*61.*
5 Glanmire '51—Carroll *6.*
6 Comeragh Mts. 1902—HWL.
12 Blackrock Mt. 1911—Tetley.
20 Luggielaw '02 — Templeton *74, 75.* Powerscourt '54 (Hutton)—*35.*
21 Dublin Mtns. '50 (Orr)—*35.*
27 '53 (Moore)—*120.* Pontoon 1903—HWL.
29 Drumshambo (Stewart)—*79.* Near Bundoran 1913—Porter.
31 Carlingford Mtn.—HWL *28.*
32 Eskmore 1910—Bingham.
33 *7.*
34 Near Burt—Hunter *25.*
35 Poisoned Glen—Dixon *17.*
36 Oughtnagar '88 (Stewart)—*79.*
38 Deer's Meadow—HWL *28.* Tollymore Park—Waddell.
39 Near Belfast—Stewart *69.*
40 Templeton *74, 75.* Slieve Gallion '76 (Stewart)—*79.*

Ditrichum zonatum *Limpr.*

39 Ballycastle—Dixon *17.*

Ditrichum flexicaule (*Schleich*) *Hampe.*

In all Divisions, except 4, 5, 7, 9, 11, 15, 16, 22, 24, 36, 37.

var. **densum** (*Br. Sch.*).

34 About Lough Swilly—Hunter *25.*
35 *7.*

Swartzia montana (*Lamk.*) *Ldbg.*

1 Connor Hill Pass—*79.* Sneem '78—Carroll.
3 *7.*
9 Blackhead '76 (Stewart)—*79.* Ballyvaughan '95—McArdle.
16 *7.*
20 L. Bray—Moore *57.*
27 '54 (Moore)—*120.*
28 Benbulbin—Taylor *71.* '56 (Moore)—*35.*
29 L. Allen shore '83 (Stewart) — *79.* Dartry Hills 1910—Tetley.

33 L. Erne shore 1912—Tetley.
34 Dunree East Head (R. Brown)—*74, 75.* Wade *80.*
40 Magilligan 1904—HWL *35.*

var. **compacta** (*Hubn.*).

33 Knockmore 1912—Tetley.

Swartzia inclinata *Ehrh.*

16 Connemara—*81.*
27 Killala—Moore *57.* Ballycastle—*2.*
28 Benbulbin (Mackay)—*23.* Inniscrone 1903—HWL.
33 Knockmore 1912—Tetley.
34 Ballyliffen Strand—Hunter *25.*
35 Dunfanaghy '90 (Dixon)—*2.* Rosapenna 1910—HWL.
40 Magilligan 1913—Hunter and Waddell.

Dicranella crispa (*Ehrh.*) *Sch.*

2 Killarney (Wilson)—*72.*
5 Dunbulloge Glen (Murray)—*61.*
16 Near Maam—Moore *57.*
34 Grianan Hill—Hunter *25.*
38 Moneyburn Course '01—Templeton *74, 75.* Ravarnet—Davies *10.*
39 Derriaghy — Templeton *74, 75.* near Belfast '47 (Orr)—*35.*
40 Near Derry (R. Brown)—*74, 75.*

Dicranella secunda (*Swartz*) *Ldbg.*

1 Connor Hill Pass—Moore *57.*
3 Bear Island '93—M‘Ardle.
5 Great Island (Scott)—*61.*
13 Browne's Hill '67 (R. C. Browne)—*120.*
21 Howth (Orr)—*120.*
38 Moneyburn (Templeton)—*72.*
39 Near Belfast (Miss Hutchins)—*2.* Rathlin I.—Stewart *69.*

Dicranella curvata (*Hedw.*) *Sch.*

12 Balloughton 1913—HWL.
27 Nephin 1901—HWL *34.*

Dicranella heteromalla (*Dill.*) *Sch.*

In all Divisions, except, 9, 11, 15, 17, 22, 24, 26, 28, 37.

var. **stricta** *Sch.*

2 *7.*
31 Anglesey Mtn. '83 (Waddell)—*120.*

Dicranella heteromalla v. **sericea** *Sch.*

38 Slievenamaddy—HWL *28.*

Dicranella cerviculata (*Hedw.*) *Sch.*

1 Dunkerron '19 (Taylor)—*120.*
2 Tralee '79—Carroll. Torc Glen 1906—Jones.
3 Bantry '78—Carroll.
4 Kilnap—*61.*
5 Rathcooney (Murray)—*61.*
6 Comeragh Mts. 1902—HWL.
14 Mountmellick 1912—Tetley.
16 Connemara '53 (Moore)—*120.*
20 Moore *58.*
21 Moore *58.*
24 Ballymorris Bog 1908—HWL.
25 Boyle 1910—Tetley.
29 Near Cloonty Lough 1910—Tetley.
33 Near Enniskillen 1907—Tetley.
34 Slieve Snaght (R. Brown)—*74, 75.* Bonnemain Bog—Hunter *25.*
35 Tory Island 1910—HWL.
37 Anaghmore '70 (Stewart)—*79.* Brackagh Bog 1909—Davies.
38 Deer's Meadow '86—*120.* Slieve Croob—Stewart *69.*
39 Lambeg—Templeton *74, 75.* King's Moss—Stewart *69.*

Anisothecium rubrum (*Huds.*) *Ldbg.*

1 Dunkerron '19 (Taylor)—*120.*
2 Killarney—*84.*
3 Ballylickey 1912—HWL.
4 Douglas—Power *61.*
6 Comeragh Mtns. 1902—HWL.
7 Near Clonmel '58 (Moore)—*120.*
10 Roscrea 1911—HWL.
12 Great Saltee I. 1913—HWL *102.*
14 Slieve Bloom 1912—Tetley.
17 Clonbrock—M‘Ardle *42.*
18 Slieve Bloom 1912—Tetley.
20 Moore *58.* Dargle '64 (Hutton)—*35.*
21 Near Dublin (Stokes)—*74, 75.* Howth '52 (Orr)—*35.*

29 Glencar 1909—Tetley.
30 Killykeen '93—M'Ardle *43*.
31 Anglesey Mtn.—Waddell.
32 Eskmore 1910—Bingham.
33 Correll Glen 1905—M'Ardle *45*.
34 Hunter *25*.
35 Melmore 1910—HWL.
36 Killymoon '87—HWL.
37 Ardmore Glebe '83—HWL.
38 Hillsborough Demesne '86—HWL. Scrabo 1908—HWL.
39 Near Belfast '01 (Templeton)—*69*. Drumnasole '90—Brenan.
40 Curleyburn (Moore)—*69*.

var. **tenuifolium** (*Bruch.*).

5 Great Island (Scott)—*61*.
38 Near Stormount—Stewart *69*.
39 Cave Hill '46 (Orr)—*35*. South of Larne—Stewart *69*.

var. **tenellum** *Schpr.*

12 Great Saltee Island 1913—HWL *102*.
25 Boyle 1910—Tetley.
32 Eskmore 1910—Bingham.

var. **callistomum** (*Dicks.*).

39 Colin Glen '02 (Scott)—*2*.
40 Turner *73*. Near Derry '02 (Scott)—*2*.

Anisothecium rufescens (*Dicks.*) *Ldbg.*

1 Near Killarney—Moore *57*.
2 Horse's Glen—Jones.
6 Bolagh Lough 1902—HWL.
14 Slieve Bloom 1912—Tetley.
20 Lough Bray—Moore *57*.
21 Kelly's Glen—Moore *57*.
31 Anglesey Mtn. (Waddell)—*120*. Clermont Cairn 1912—HWL.
32 Eskmore 1910—Bingham.
38 Loughbrickland (HWL)—*70*. Crown Mt. Newry (Waddell)—*69*.
39 Cranmore Belfast—Templeton *74*, *75*. Derryaghy 1901—Davies *12*.
40 Near Derry (R. Brown)—*74*, *75*.

Anisothecium Grevillei (*Br. Sch.*) *Ldbg.*

20 Lugnaquilla '64—Moore *57*.

Anisothecium crispum (*Schreb.*) *Ldbg.*

1 Mangerton (Miss Hutchins)—*2*.
2 *7*.
21 Dunsink '68 (Orr)—*120*.
34 Hunter.
38 Lenaderg—Davies *14*.
39 Near Belfast '47 (Orr)—*35*. Cushendall—Dixon *17*.

var. **elatum** *Sch.*

1 Mangerton (Miss Hutchins)—*2*.
21 Dunsink—Moore *58*.
38 Near Lisburn 1901—Davies *12*.
39 Magheralin—Waddell.

Anisothecium squarrosum (*Starke*) *Ldbg.*

1 Near Sneem '77 (Carroll)—*79*. Mount Eagle 1906—HWL.
2 Near Tralee '60 (Moore)—*120*. Horse's Glen 1906—Jones.
3 Bantry —*84*.
5 Near Fermoy '51—Carroll *6*.
6 Comeragh Mts. 1902—HWL.
7 Galtee Mts. 1902—HWL.
14 Slieve Bloom 1912—Tetley.
18 Slieve Bloom 1912—Tetley.
20 Near Arklow '68 (Moore)—*120*.
21 Templeton *74*, *75*. Kelly's Glen—Moore *58*.
27 Bengorm 1901 — HWL. Achill I. 1909—HWL.
28 Hazelwood 1904—M'Ardle *41*.
29 Slieveanieran Mts. '83 (Stewart)—*79*. Bronagh Mt. 1909—Tetley.
30 Tent's Mt. 1910—Tetley.
31 Anglesey Mt. '83 (Waddell)—*120*.
32 Eskmore 1910—Bingham.
33 Topped Mt. 1912—Tetley.
34 Templeton *74*, *75*.
35 Slieve League—HWL *32*.
37 Mullaghcarbetagh Mt. '88 (Stewart)—*79*.

38 Slieve Donard — Templeton *74, 75.* White River Glen—HWL *28.*
39 (Moore)—*120.* Slieve-na-nee (HWL) —*70.*
40 Meenard Mt.—Stewart *69.* Magilligan 1904—HWL.

Seligeria Donii *(Sm.) C. M.*

39 Colin Glen '76 (Stewart)—*120.*

Seligeria pusilla *(Ehrh.) Br. Sch.*

18 Slieve Bloom 1912—Tetley.
39 Near Belfast (Templeton)—*22.* Sallagh Braes '84—HWL.

Seligeria calcarea *(Dicks.) Br. Sch.*

39 (Templeton)—*69.* Black Mt.—Stewart *69.*

Seligeria setacea *(Wulf.) Ldbg.*

1 Brandon—Taylor *71.*
34 Innishowen (Taylor)—*74, 75.*

Brachydontium trichodes *(Web. Mohr.) Fuern.*

20 Lough Bray (Taylor)—*74, 75.*
21 Near Dublin—*23.* Kelly's Glen '63 (Moore)—*2.*

Blindia acuta *(Huds.) Br. Sch.*

1 Mangerton '55 (Orr)—*120.*
2 Mt. Torc—*84.*
3 Bantry (Miss Hutchins)—*71.* Caha Mts. '93—M'Ardle
6 Comeragh Mts. 1902—HWL.
7 Galtee Mts. (Moore)—*120.* L. Muskry 1902—HWL.
13 Mt. Leinster 1911—Tetley.
16 '64 (Moore)—*120.*
20 Powerscourt (Stokes)—*74, 75.*
21 Kelly's Glen—Taylor *71.*
26 Slieve Gamph 1910—Tetley.
27 Devil's Mother Mt. 1901—HWL. Mulranny 1909—HWL.
28 Ben Bulben—Templeton *74, 75.*
31 Carlingford Mt. (Waddell)—*28.* 1908—HWL.
33 Near Topped Mt. 1909—Tetley.
34 Innishowen—Templeton *74, 75.* Near L. Swilly—Hunter *25.*
35 Slieve League—HWL *32.*
37 Camlough Mt.—HWL *28.*
38 Slieve Donard '05—Templeton *74, 75.* Mourne Mts. (HWL)—*69.*
39 Agnew's Hill—Templeton *74, 75.*

Didymodon denudatus *Brid. Ldbg.*

1 Gap of Dunloe '85 (Stewart)—*79.*
2 Cromagloun '41 (Taylor)—*81.* 1911—Jones.
6 Comeragh Mts.—HWL and Waddell.
20 Glenmalure—Moore *57.*
21 Dublin Mts.—*84.*
27 Curraun-Achill—HWL and Waddell.
28 Ben Bulbin—Moore *57.*
33 Poulaphuca 1905—M'Ardle *45.* Cuilcach 1909—Tetley.
35 Melmore 1910—HWL.
36 Dungannon 1909—Porter.
38 Near Holywood—Hunter *26.*
39 Cushendall (Moore)—*69.*

var. **alpinus** *Schpr.*

1 Sneem '78 (Carroll)—*79.*
16 Kylemore (Moore)—*2.*
20 Powerscourt (Moore)—*2.*
21 Kelly's Glen (Moore)—*2.*
39 Cushendall (Moore)—*2.*

Campylopus pyriformis *(Schultz) Brid.*

1 Coomanard L. '98—HWL.
2 Muckross 1906—HWL.
3 *7.*
4 Dunscombe's Wood '51—Carroll *6.*
5 Great Island (Scott)—*61.*
6 L. Bolagh 1902—HWL.
7 L. Dineen 1902—HWL.
8 Thornfield's Bog—Miss Armitage *1.*
11 Great Saltee I. 1913—HWL *102.*
14 Slieve Bloom 1912—Tetley.
17 S. of Tuam 1910—Tetley.
18 Geashill 1902—HWL.
20 Moore *58.*

21 Moore *58.* Howth '57 (Orr)—*35.*
23 L. Deravaragh shore 1909—HWL.
27 Achill I. 1903—HWL.
29 Near Bundoran 1913—Porter.
30 Slieve Glagh 1908—HWL. Lenliss 1909—Tetley.
33 Near Topped Mt. 1905—HWL.
34 Hunter *25.*
35 Slieve League—HWL *32.*
36 Baronscourt '97. Mullaghcarbetagh Mt. '98 (Stewart)—*79.*
37 Slieve Gullion—HWL *28.*
38 Slieve Donard—Stewart *69.* Mourne Mts.—HWL.
39 Divis Mt.—Stewart *69.*
40 Benbradagh—Stewart *69.*

Campylophus fragilis (*Dicks.*) *Br. Sch.*

In all Divisions, except 5, 8, 9, 15, 19, 22, 23.

Campylopus Schimperi *Milde.*

2 Derrymore Glen near Cahir Conree '99—HWL *31.*
20 L. Bray '59 (Orr)—*120.*
39 Giant's Causeway '91—Dixon *17.*

Campylopus subulatus *Sch.*

2 Between Cromagloun and Hunting Tower '65 (Schimper and Wilson) —*2.*
3 Glengarriff 1900 — Braithwaite and Binstead.
16 L. Corrib shore near Ballard 1907—M'Ardle *46.*
27 Achill I. 1902—HWL.
29 Truskmore 1912—Tetley.
34 *7.*

Campylopus Schwarzii *Sch.*

1 Connor Hill Pass '57—Moore *53.* Carntual—Moore *53.*
2 Corcaguiny '99 (HWL)—*59.* Horse's Glen 1906—Jones.
3 *7.*
7 L. Muskry 1902—HWL.
16 Connemara '77—Stewart.
27 Nephin '57 (Moore)—*120.* Achill I. 1904—HWL.
28 Mullaghmore 1910—Tetley.
34 *7.*
35 Muckish '66 — Moore *57.* Slieve League—HWL *32.*
36 Mullaghcarbetagh Mt. (Stewart)—*79.*

Campylopus symplectus *Stirt.*

34 Trillick banks Buncrana 1902—Hunter.

Campylopus Shawii *Wils.*

3 Adrigole '96 (Binstead)—*120.* Glengarriff 1912—HWL.

var. hamatus *Schr.*

3 Adrigole '96 (Binstead)—*120.*

Campylopus flexuosus (*L.*) *Brid.*

In all Divisions, except 10, 15, 17, 22, 23, 24.

var. paludosus *Sch.*

38 Deer's Meadow—HWL *28.* Bog by Rocky River, Mourne Mts. (Waddell)—*69.*
39 Colin Mt.—Davies *15.*

Campylopus paradoxus (*Wils.*).

2 Cromaglaun 1906—HWL.
3 Glengarriff (Hunt)—Herb. Kew.
12 Blackrock Mt. 1911—Tetley. Great Saltee Island 1913—HWL *102.*
14 Slieve Bloom 1912—Tetley.
16 Leenane 1901—HWL.
21 Howth—Orr *60.*
27 Sraheens 1909—HWL.
32 1910—Bingham.
33 Near Topped Mt. 1905—HWL. Decriss Mt. 1912—Tetley.
35 Slieve League—HWL *32.*
38 Slieve Donard 1908—HWL.

Campylopus setifolius *Wils.*

1 Dunkerron (Taylor)—*81.*
2 Cromagloun—Moore *57.* '65 (Hutton) —*35.*

3 *7*.
6 L. Coomshighaun 1902—HWL.
7 L. Muskry 1902—HWL.
9 Carn Sefin—M'Ardle *40*.
16 Kylemore '70 — Moore *57*. Connemara (Holt)—*2*.
17 *7*.
20 Powerscourt '64—Moore *57*.
21 Dublin Mts.—*84*.
30 Cuilcagh 1909—Tetley.
32 Scotstown 1910—Bingham.
34 Slieve Snaght (Moore)—*2*.
35 Errigal—Dixon *17*.
38 Slieve Donard 1908 (HWL)—*69*.

Campylopus atrovirens *De Not.*

1 Brandon—Waddell.
2 Killarney—Moore *57*. Connor Hill Pass '97—HWL.
3 Adrigole 1906—Jones. Dursey I. '93—M'Ardle.
4 Coachford '51—Carroll *6*.
6 Comeragh Mts. 1902—HWL.
7 Galtee Mts. 1902—HWL.
14 Slieve Bloom 1912—Tetley.
16 Leenane 1901 — HWL. Loughnafooey 1907—M'Ardle *46*.
20 Seven Churches—Moore *57*. Glenmalure '56—Davies *8*.
21 Near Dublin (Stokes)—*74*, *75*. Glassamucky Brakes '68 (Hutton)—*35*.
26 Near Foxford 1910—Tetley.
27 Moore)—*21*. Achill I. 1904—HWL.
28 Collooney 1904—M'Ardle *41*. 1910—Tetley.
29 Cloonaquin Mt. 1909—Tetley.
30 Cuilcagh 1909—Tetley.
31 Anglesey Mt. (Waddell)—*28*. Carlingford Mt. 1908—HWL.
32 Eskmore 1910—Bingham.
33 Correll Glen 1909—Tetley.
34 Hunter *25*.
35 Gweedore—Dixon *17*. Melmore 1910—HWL.
38 Slieve Donard—Stewart *69*. Mourne Mts. 1908—HWL.
39 Rathlin I.—Stewart *69*. Knock Dhu '84—HWL.
40 *7*.

var. **falcatus** *Braith.*

3 Adrigole 1906—Jones.
16 Connemara '68 (Barker)—*2*.
35 *7*.

var. **gracilis** *Dixon.*

3 Glengarriff 1912—HWL.

Campylopus introflexus (*Hedw.*) *Brid.*

1 Gap of Dunloe (Stewart and Holt)—*2*.
2 Cromagloun—Moore *52*. '99—HWL.
3 Glengarriff '64 (Hunt)—*1*. 1912—HWL.

Campylopus brevipilus *Br. Sch.*

1 Pedlar's L. 1906—HWL.
2 Cromagloun '65 (Hutton)—*120*.
3 Adrigole 1905—Jones.
6 *7*.
7 Near Clonmel '90 (Carrington)—*2*.
8 Foynes—Stewart *66*.
16 Kylemore—Moore *57*.
20 L. Bray '53 (Moore)—*120*.
21 Howth (Orr)—*57*.
26 Slieve Gamph 1910—Tetley.
27 Achill I. 1904—HWL.
28 Slishwood—Tetley.
29 Cloonaquin 1909—Tetley.
31 Anglesey Mt. '99—HWL.
33 Derrin Mt. 1912—Tetley.
34 Buncrana—Hunter *25*.
35 Poisoned Glen—Dixon *17*. Melmore 1910—HWL.
38 Slieve Donard (HWL)—*69*. Slievenabrock 1912—HWL.
39 Colin Glen—Davies *15*. Carnlough 1910—HWL.

var. **auriculatus** *Ferg.*

3 Adrigole 1906—Jones *103*.

Dicranoweissia cirrata (*L.*) *Ldbg.*

3 Glengarriff '78 (Carroll)—*79*.
4 Kilnap '51—Carroll *6*.

5 Great Island (Scott)—*61.* Glenbower '51—Carroll *6.*
6 L. Coomshigaun 1902—HWL.
19 *120.*
20 Powerscourt '03 (Stokes)—*74, 75.*
21 Howth—Moore *58.* '54 (Orr)—*35.*
31 Anglesey Mt.—HWL *28.*
34 Portaw Glen—Hunter *25.*
35 Slieve League—HWL *32.*
36 Cullion Bog 1909—Porter.
37 Ardmore—HWL.
38 Tollymore Park—Templeton *74, 75.* Slieve Donard '85—HWL.
39 Cave Hill—Templeton *74, 75.* Near Lisburn—Davies *10.*
40 Slieve Gallion (Moore)—*69.*

[**Dicranoweissia crispula** *(Hedw.) Ldbg.*

20 Powerscourt (Stokes)—*73?*
21 Howth '04—Templeton *74, 75.* '57 (Orr)—*35.* See Moore's Synopsis, p. 369].

Dicranum fulvellum *(Dicks.) Sm.*

1 MacGillicuddy's Reeks—Taylor *71.*

Dicranum Starkei *Weber Mohr.*

7 Galtee More '71—Carroll *6.*
20 Powerscourt Waterfall—Orr *60.*

Dicranum majus *Smith.*

1 *7.*
2 Cromagloun—Moore *57.*
3 Bantry (Stokes)—*73.* Shrone Hill 1907—Miss Martin.
5 Glenbower Wood '51—Carroll *6.*
6 Comeragh Mts. 1902—HWL.
7 L. Muskry 1902—HWL.
10 Killeen 1907—Miss Hemphill. Roscrea 1911—HWL.
11 Graiguenamanagh 1907—Phillips.
12 Poulmounty 1907—Phillips.
13 Borris 1911—Tetley.
20 L. Bray—Moore *57.*
21 Near Dublin—*84.*
26 Largannmore Cliff 1910—Tetley.
27 Mulranny 1909—HWL.
28 Hazelwood 1904—M‘Ardle *41.*
29 Glencar 1904—M‘Ardle *41.* 1909—Tetley.
30 Ballyhaise '93—M‘Ardle *43.*
31 Anglesey Mt. '99—HWL.
33 Rossinuremore 1905—HWL.
34 Portaw Glen—Hunter *25.*
35 Slieve League—HWL *32.* Rathmullen '65 (Hutton)—*35.*
36 Dungannon 1908—Bingham.
38 Tollymore Park '05—Templeton *74, 75.* Ballyhomra '84—HWL.
39 Colin Glen — Drummond *18.* L. Mourne '81—HWL.
40 Carndaisy Glen—Stewart *69.*

Dicranum scoparium *(L.) Hedw.*

In all Divisions, except 22, 23.

Occurs frequently in some of its numerous forms.

var. **alpestre** *Hueben.*

2 Torc Glen 1906—HWL.
6 Comeragh Mts. 1902—HWL.
7 Galtee More '51 — Carroll *6.* L. Muskry 1902—HWL.
12 Great Saltee I. 1913—HWL *102.*
27 Achill I. 1904—HWL.
31 Carlingford Mtn. 1908—HWL.
32 Eskmore 1910—Bingham.
33 Rossinuremore 1905—HWL.
35 Slieve League 1902—HWL.
38 Slieve Donard—HWL *28.* Scrabo 1908—HWL.
39 Colin Mt. 1908—HWL.
40 Benevenagh 1900—HWL.

var. **turfosum** *Milde.*

10 Near Roscrea 1911—HWL.
24 Derrycasson 1907—Miss Hepenstal.
30 Slieve Glagh 1908—HWL.
31 Anglesey Mt. '99—HWL.
37 Carriffkeeny 1904—HWL.
38 Slievenabrock '84—HWL. Scrabo 1908—HWL.
39 Carnlough Mt. 1910—HWL.
40 Magilligan 1904—HWL.

var. **orthophyllum** *Brid.*

6 L. Bolagh 1902—HWL.
7 L. Dineen 1902—HWL.
20 Lower L. Bray '98—HWL. Luggilaw '51—Orr *35.*
23 Mullingar 1909—HWL.
27 Nephin 1901—HWL.
30 Cuilcagh 1909—Tetley.
31 Clermont Mt.—HWL *28.*
33 Rossinuremore 1905—HWL.
37 Camlough Mt. '98—HWL.
38 Slieve Donard—HWL *28.*
39 Moore.

Dicranum Bonjeani *De Not.*

In all Divisions, except 5, 10, 11, 14, 20, 22, 28, 32, 40.

var. **rugifolium** *Bosw.*

27 Clare Island 1909—HWL.
29 White Mt.—Davies *14.*

Dicranum fuscescens *Turner.*

2 Killarney—*84.*
6 Comeragh Mts. 1902—HWL.
7 L. Muskry 1902—HWL.
16 L. Corrib shore near Ballard 1907—M'Ardle *46.*
20 L. Bray (Stokes)—*73.* '56 (Orr)—*35.*
21 Howth (Orr)—*120.*
26 Near Foxford 1910—Tetley.
27 Achill I.—HWL.
29 Cloonaquin Mtn. 1909—Tetley.
30 Swanlinbar (Scott)—*74, 75.* Tents Mt. 1910—Tetley.
34 Grianan Hill—Hunter *25.*
35 Slieve League—HWL *32.* L. Salt '65 (Hutton)—*35.*
38 Slieve Bingian (HWL)—*69.*
40 Templeton *74, 75.*

var. **falcifolium** *Braithw.*

30 Tents Mtn. 1910—Tetley.

Dicranum montanum *Hedw.*

26 Slieve Gamph 1910—Tetley.

Dicranum flagellare *Hedw.*

2 Glen Flesk—Taylor *71.*
3 Glengarriff (Wilson)—*22.*
[The Glen Flesk Wood has recently been in great part felled, and the habitat for this moss may have been removed with the timber. It has not been found of late years.]

Dicranum Scottii *Turn.*

1 Killarney '29—Wilson *81.* Cahirconree Mt. '79 (Carroll)—*79.*
2 Torc Glen (Holt and Stewart)—*2.* L. Guitane '93—M'Ardle.
3 Glengarriff—Wilson *81.*
5 Glenbower '51—Carroll *6.*
6 L. Coomshigaun 1902—HWL.
7 L. Muskry 1902—HWL.
16 Kylemore—Moore *57.*
20 L. Bray '98 (HWL)—*59.*
25 Kilronan Mt. 1910—Tetley.
26 Slieve Gamph 1910—Tetley.
27 Pontoon 1901—HWL. Achill I. 1901—HWL.
29 Slieveanierin Mt. '83 (Stewart)—*79* Cloonaquin 1909—Tetley.
30 Swanlinbar (Scott)—*73.* Cuilcagh 1909—Tetley.
33 Rossinuremore 1905—HWL. Correll Glen 1907—Tetley.
35 Rathmullen '65 (Hutton)—*35.* Slieve League 1903—HWL *32.*
38 Mourne Mts.—Drummond *18.* Slieve Commedagh '90—HWL *28.*

Dicranum asperulum *Mitt.*

30 Cuilcagh Mt. 1909—Tetley.

Dicranum uncinatum (*Harv.*) *C. Muell.*

20 [Powerscourt—Orr *60* ?]
27 Nephin 1901—HWL *34.* Slievemore Achill I. 1909—HWL.
Very fine, and in some quantity in both localities.

Dichodontium pellucidum (*L.*) *Schpr.*

In all Divisions, except 4, 6, 10, 11, 15, 17, 18, 19, 22, 23, 24, 25.

Of frequent occurrence, but never abundant.

var. **fagimontanum** (*Brid.*).

27 Nephin 1901—HWL.
30 Killykeen 1911—HWL.
37 Kinnego '84—HWL.
38 *7.*
39 Sallagh Braes (HWL)—*69.* Cave Hill '86—Waddell.
40 Magilligan—Waddell.

var. **compactum** *Schpr. Ms.*

34 Ballymacstocker Bay 1907 (Hunter) —*79.*

Dichodontium flavescens (*Dicks.*) *Ldbg.*

1 *7.*
2 Torc Mtn. 1906—Jones.
3 Bantry (Miss Hutchins)—*2.*
4 Ballinhassig Glen (Murray)—*61.*
5 Lota Wood (Murray)—*61.*
6 L. Coomshigaun 1902—HWL.
13 South of Borris 1911—Tetley.
14 Slieve Bloom 1912—Tetley.
20 Dargle—Templeton *74, 75.* '12 (Taylor) —*2.*
21 *7.*
27 Devil's Mother Mt. 1901—HWL.
28 Ben Bulben—Moore *57.* Truskmore 1910—Tetley.
29 Glencar 1909—Tetley.
30 Slieve Glagh 1908—HWL.
31 Omeath '85—HWL. Carlingford Mtn. '98—HWL.
32 1910—Bingham.
33 Madame Christen. Brookfield 1908 —Tetley.
34 Buncrana—Hunter *25.*
35 Slieve League—HWL *32.*
38 Slievenabrock (HWL)—*69.* Crawfordsburn—Stewart *69.*
39 Gruigan's Glen (Templeton)—*69.* Colin Glen—Stewart *69.*
40 Roe Park Limavady '95 (Stewart)—*79.*

Oncophorus Bruntoni (*Smith*) *Ldbg.*

1 Eagle Mt. 1906—HWL.
5 Glenbower (Carroll)—*57.* Killeagh—Herb. Brit. Museum.
6 Comeragh Mts. 1902—HWL.
20 Powerscourt—Taylor *71.* (G. A. Hunt)—Kew Herb.
30 Cuilcagh Mt. Swanlinbar R. 1911—Tetley.
39 Glenarm Deer Park—Moore *57.* HWL and Waddell '90.

Oncophorus crispatus (*Dicks*) *Ldbg.*

1 Connor Hill Pass (Carroll)—*79.*
2 Torc Waterfall 1906—HWL.
6 Nire Lakes '82 (Nicholson)—*2.* Comeragh Mts. 1902—HWL.
7 L. Muskry 1902—HWL.
20 Glenmalure—Moore *57.*
28 Mullaghmore Rocks 1910—Tetley.
31 Carlingford Mt. '82—HWL *32.*
38 Diamond Mt. (W. Thompson)—*69.* Slievenabrock (HWL)—*69.*
39 Slemish (Moore)—*69.*

Oncophorus crenulatus (*Mitt.*) *Braithw.*

2 Horse's Glen 1906—Jones *103.*
33 Cuilcagh 1914—Tetley.

Oncophorus striatus (*Schrad.*) *Ldbg.*

1 Connor Hill Pass—Waddell *79.*
7 L. Muskry 1902—HWL.
16 Connemara—Moore *57.*
20 Powerscourt—Taylor *71.*
21 Dublin Mts. (Taylor)—*74, 75.*
31 Carlingford Mt. Waddell)—*28.*
35 Errigal—Dixon *17.* L. Salt '65 (Hutton)—*35.*
38 Mourne Mts.—Templeton *74, 75.* HWL and Waddell.
39 Belfast Mts.—Templeton *74, 75.* Moore *120.*
40 Benevenagh—Moore *120.*

Ceratodon purpureum (*L.*) *Brid.*

In all Divisions except 5, 7, 19, 28, 37.

Ceratodon conicus (*Hampe*) *Ldbg.*

21 Howth '73 (Lindberg)—*35.* North Bull—Orr *60.*
27 Mulranny 1909—HWL and Waddell.

Ephemerum serratum (*Schreb.*) *Hampe.*

4 Near Vernonsmount (Alexander)—*61.*
18 '99—C. D. Russell.
34 Bridge End—Hunter *25.*
38 Newcastle Sands—Stewart *69.* Loughbrickland 1912—HWL.
39 Derryaghy '01—Templeton *74, 75.* Near Belfast '29—Drummond *18.*
40 Kilrea 1912—J. D. Houston *97.*

Ephemerum minutissimum *Ldbg.*

38 *7.*
39 Longstone near Lisburn—Davies *12.*

Ephemerum cohaerens (*Hedw.*) *Hampe.*

15 Portumna '65—Moore *54.*

Acaulon muticum (*Schreb.*) *C. Muell.*

1 Dunkerron—Taylor *71.*
4 Kilnap—Power *61.*
21 Near Dublin '30 (Wilson)—*35.* Dalkey '52 (Orr)—*35.*
34 Near Buncrana—Hunter *25.*
35 HWL *35.*
39 Near Belfast 1800—*74, 75.*

Phascum acaulon *L.*

4 Near Cork—*7.* Inchagaggin—*61.*
5 Great Island (Scott)—*61.*
18 Geashill '93—C. D. Russell.
20 Bray—*84.*
21 Near Lucan—Templeton *74, 75.* Glasnevin '52—Orr *35.*
34 Hunter *25.*
37 Ardmore '85—HWL.
38 Giant's Ring—Stewart *69.*
39 Moore *120.* Blackhead '84 (Stewart) —*2.*

var. **piliferum** (*Schreb.*)

21 Howth—Moore *58.*
39 Blackhead—Stewart *69.*

Phascum curvicolle *Ehrh.*

16 Benlettery—Wade *80.*
21 Taylor *71.*

Pottia recta (*With.*) *Mitt.*

4 Near Cork '29 (Wilson)—*35.*
5 Great Island (Scott)—*61.*
21 Rathmines '03—Stokes *74, 75.* (Moore) —*2.*
34 Fahan Pt. '98—Hunter *25.*

Pottia bryoides (*Dicks.*) *Mitt.*

21 Howth—Orr *57.*
39 Near Lisburn—Davies *14.*

Pottia Heimii (*Hedw.*) *Fuernr.*

4 Monarea—*61.* Douglas '79 (Carroll) —*79.*
5 Youghal—Carroll *6.*
9 Inishmore '91—Stewart *68.*
16 *7.*
21 Near North Wall—Moore *57.* Baldoyle '50 (Orr)—*35.*
27 Westport—Moore *57.*
21 Mullaghmore 1910—Tetley.
34 Macamish—Hunter *25.*
38 Mournes—Templeton *74, 75.* Groomsport '87—HWL.
39 Carrickfergus—Stewart *69.* Kilroot 1900—Davies *10.*
40 Portstewart '88 (HWL)—*69.*

Pottia truncatula (*L.*) *Ldbg.*

4 Near Cork—Carroll *6.*
5 Cove—*71.*
8 *7.*
9 *7.*
14 Slieve Bloom 1912—Tetley.
16 *7.*
19 *120.* Curragh '64 (Hutton)—*35.*
20 Moore *58.*
21 Howth (Orr)—*120.* Glasnevin '51 (Orr)—*35.*
27 Achill I. 1901—HWL.
30 Killykeen '93—M'Ardle *43.*
31 Carlingford Mt.—HWL *28.*

33 Portora 1912—Tetley.
34 Hunter *25*.
36 *7*.
37 Ardmore Glebe '88—HWL.
38 Drumcro '84 (Waddell)—*120*. Newcastle—HWL *32*.
39 Lisanoure (Moore)—*120*.
40 *7*.

Pottia intermedia (*Turn.*) *Fuern.*

4 (Taylor)—*2*.
13 Browne's Hill '67 (R. C. Browne)—*120*.
15 Castle Taylor—Moore *57*.
21 '30 (Wilson)—*2*.
26 Near Ballinrobe 1910—Tetley.
27 Achill I. 1904—HWL.
37 Near Lurgan '83 (Waddell)—*35*.
38 Near Bangor—Templeton *74*, *75*. Crossgar—HWL *28*.
39 Bog Meadows Belfast—Stewart 69.

Pottia lanceolata (*Hdw.*) *C. Muell.*

4 Ballinlough—*61*.
5 Glanmire (Alexander)—*61*.
21 Killiney (Stokes)—*74*, *75*. Near Dublin—Drummond *18*.

Pottia Starkei (*Hedw.*) *C. Muell.*

4 Near Cork—*2*.
5 *7*.
21 Killiney—Moore *58*. '56 (Orr)—*35*.
33 Portora 1912—Tetley.
38 Near Holywood '29—Drummond *18*. Crawfordsburn—Stewart *69*.
39 Ballysillan—Stewart *70*.

var. **affinis** (*Hook. Tayl.*).

21 Near Killiney Station—Moore *57*.

var. **Davallii** (*Sm.*).

1 Dunkerron—*71*.
4 Drummond *23*.
5 Youghal '51—Carroll *6*.
15 Portumna '71—Moore *50*.
21 Near Dublin (Mackay)—*22*. Howth Pier '49—*85*. Glasnevin '50 (Orr)—*35*.
38 Holywood (Drummond)—*69*. Lenaderg 1903—Davies *14*.
39 White Park Bay '38 (Moore)—*76*.

Pottia asperula *Mitt.*

21 Howth '56 (Moore)—*2*.

Pottia viridifolia *Mitt.*

12 Balloughton 1913—HWL.
39 Blackhead '84—Stewart *69*.

Pottia Wilsoni (*Hook.*) *Br. Schpr.*

5 Great Island (Carroll)—*57*. Youghal—Carroll *5*.
20 *7*. Bray Head—*95*.
21 Howth—Moore *57*. '55 (Orr)—*35*.

Pottia crinita *Wils.*

1 *7*.
2 Ross I. (Moore)—*2*.
4 Cork Harbour—Carroll *5*.
5 Carrigaloe (Carroll)—*57*. Cork Harbour—Carroll *5*.
21 Howth '56 (Orr)—*57*.
39 Blackhead '82—Stewart *69*.

Tortula pusilla (*Hedw.*) *Mitt.*

4 Near Cork—Taylor *71*. Near Passage (Murray)—*61*.
21 '04 (Stokes)—*74*, *75*. Near Dublin (G. A. Hunt)—Kew Herb.

Tortula lamellata *Ldbg.*

21 Moore *57*.
38 Near Donaghadee '70—Stewart *69*.

Tortula stellata (*Schreb.*) *Ldbg.*

4 Mardyke—Power *61*.
21 Chapelizod—Moore *57*.
38 Cregagh Glen '77—Stewart *69*.
39 Colin Glen (Moore)—*69*.

Tortula ericaefolia (*Neck.*) *Ldbg.*

2 Cromagloun '73 (Moore)—*120*.
4 Moore '74—*2*.
8 Anacotty—Miss Armitage *1*.

19 Curragh '64 (Hutton)—*35.*
21 Near Dublin '*51* (Moore)—*2.* Glasnevin '50 (Orr)—*35.*
23 Near Mullingar 1908—HWL.
31 Carlingford '83 (Waddell)—*120.*
33 Drumrainy Bridge 1912—Tetley.
34 Buncrana—Hunter *25.*
37 Derryadd '85—HWL.
38 Portavo—Stewart *69.* Maralin '86 (HWL)—*69.*
39 Derryaghy—Stewart *69.*

Tortula aloides (*Koch.*) *De Not.*

1 Dingle '60 (Moore)—*120.*
2 *7.*
6 Tramore 1902—HWL.
8 Rathkeale 1907—Dr. Fogerty.
11 Thomastown 1907—Phillips.
12 New Ross 1907—Phillips.
13 Browne's Hill '67—R. C. Browne.
15 Portumna 1907—Phillips.
16 (Moore)—*2.*
17 *7.*
20 (Moore)—*120.*
21 Near Dublin '52 (Moore)—*120.* There Rock Mt. '53 (Orr)—*35.*
27 Moore *57.*
28 Moore *57.*
29 *7.*
30 Blacklion 1909—Tetley.
36 Pomeroy '75 (Stewart)—*79.*
37 *7.*
38 Ballylesson — Stewart *69.* Narrow Water (Waddell)—*28.*
39 Belfast Deer Park—Templeton *74, 75.* Sallagh Braes (Waddell)—*69.*

Tortula atrovirens (*Sm.*) *Ldbg.*

3 Connemara—Taylor *71.*
4 Carroll *2.*
5 Youghal (Sargint)—*5.*
16 *7.*
20 Bray Head—*2.*
21 Killiney (Taylor)—*57.* Howth '52 (Orr)—*35.*
39 Rathlin—Stewart *69.*

Tortula cuneifolia (*Dicks.*) *Roth.*

1 Dingle '96—Binstead.
3 Bantry (Miss Hutchins)—*81.*
4 *7.*
5 Great Island '51—Carroll *6.*
8 Plassey '32—*85.*
14 Portarlington '62—Moore *57.*
21 Howth (Orr)—*57.*

Tortula Vahlii (*Schultz.*) *Wils.*

20 Nr. Bray '51 (Orr)—*57.*
21 Near Dublin '29—*81.* Blanchardstown —*95.*
29 *7.*

var. **subflaccida** *Ldbg.*

20 Bray '56 (Orr)—*120.* Bray '60 (Moore) —*2.*
21 Glasnevin '60—*58.* Dublin '29 (T. Drummond)—*2.*

Tortula marginata (*Br. Sch.*) *Spruce.*

17 Dunmore 1910—Tetley.
38 Lenaderg 1907 (Davies)—*35.*
39 Milltown Derryaghy 1900—Davies *10.* Dunmurry—Davies.

Tortula muralis (*L.*) *Hedw.*

In all Divisions, except 5, 12, 24. Very common.

var. **rupestris** (*Schultz.*).

8 Miss Armitage *1.*
9 *7.*
16 (Moore)—*120.*
21 Howth '50 (Orr)—*120.*
29 L. Allen shore '83 (Stewart)—*79.*
38 Lenaderg 1909—Davies.
39 Black Mt. '80 (Stewart)—*79.*

[var. **aestiva** (*Brid.*).

21 Glasnevin '58 (Orr)—*120*?]

Tortula subulata *(L.) Hedw.*

3 Blarney (Alexander)—*61.*
4 *7.*
5 Near Fermoy '51 (Chandlee)—*6.*
8 Miss Armitage *1.* (M'Calla)—*85.*
9 Ballyvaughan 1907—O'Kelly.
11 *7.* Royal Oak 1911—Tetley.
12 Strokestown 1907—Phillips.
13 Fenagh '67 (R. C. Browne)—*120.* Fermoy '51 (Chandlee)—*6.*
14 Slieve Bloom 1912—Tetley.
16 Connemara '41 (M'Calla)—*85.*
20 Powerscourt '04—Templeton *74, 75.*
21 Moore *58.* Dublin Mts. '54 (Orr)—*35.*
27 Mulranny 1909—HWL.
29 *7.*
30 Dowra 1912—Tetley.
31 *7.*
32 1910—Bingham.
34 Hunter *25.*
37 Ardmore '81—HWL.
38 Banbridge—Stewart *69.* Annalong—HWL *28.*
39 (Templeton) — *69.* (Moore) — *120.* Sallagh Braes (Waddell)—*69.*
40 (Moore)—*69.* Moneymore—Stewart *69.*

Tortula mutica *Ldbg.*

4 By River Lee—Moore *57.*
6 Lismore '79—*120.*
20 Westaston Deer-park—Moore *57.*
21 By River Tolka (Orr)—*57.* Glasnevin '56 (Orr)—*35.*
38 Shawsbridge—Stewart *69.* Drumcro (Waddell)—*2.*
39 Belfast Bog Meadows '74—Stewart *69.* Drumbeg '84—HWL.

Tortula papillosa *Wils.*

9 Ennis—Stewart *66.*
15 Castle Taylor—Moore *57.*
20 Powerscourt—Moore *57.*
21 Glasnevin—Moore *57.* Orr '56—*35.*
31 Ardee '77 (Stewart)—*79.*
34 Buncrana—Hunter *25.*
38 Greyabbey — Stewart *69.* Loughbrickland '87—HWL.
39 Glenavy—Stewart *69.* Near Belfast (Moore)—*2.*
40 Benevenagh '84 (Stewart)—*79.*

Tortula laevipila *(Brid.) Schwaegr.*

2 Killarney '06—Jones.
4 Moore *21.* Carroll *5.*
6 '79 (Moore)—*120.*
8 Miss Armitage *1.* Rathkeale 1907—Dr. Fogerty.
9 Ballyvaughan 1907—O'Kelly.
11 Blancheville 1910—HWL.
12 S.W. of Wexford 1911—Tetley.
14 Mountmellick 1912—Tetley.
20 Moore *58.* Dunlavin '56—Davies 8.
21 Finglas (Moore)—*120.* Santry 1908—M'Ardle.
30 Farnham '93—M'Ardle *43.*
31 Ravensdale '98—HWL.
32 1910—Bingham.
33 Portora 1907—Tetley.
35 Rosapenna 1910—HWL.
36 Pomeroy '75 (Stewart)—*79.*
37 Raughlan '85—HWL. Ardmore Glebe '80—HWL.
38 Aghaderg Glebe 1904—HWL.
39 *7.*
40 Magherafelt '74 (Stewart)—*79.*

Tortula montana *(Nees) Ldbg.*

8 Adare—Miss Armitage *1.*
9 Inishmore I. '91—Stewart *68.* Ballyvaughan 1907—O'Kelly.
12 Great Saltee Island 1913—HWL *102.*
13 *7.*
15 Castle Taylor (Moore)—*2.*
16 Near Cong '72 (Moore)—*120.*
17 Barber's Fort Sq. of Tuam 1910—Tetley.
18 Geashill '95—C. D. Russell.
21 Santry '75 (Moore)—*120.* Dunsink '57 (Orr)—*2.*
23 Mullingar 1909—HWL.
24 Near Granard 1908—HWL.

28 Benbulbin '71 (Moore)—*120.*
31 Greenore 1908—Tetley. 1913—HWL.
33 Belmore Mt. 1909—Tetley.
38 Ballywalter—Stewart *69.* Warrenpoint (Waddell)—*28.*
39 Black Mt.—Stewart *69.* Sallagh Braes '84—HWL.

Tortula ruralis (*L.*) *Ehrh.*

4 Power *61.*
8 *7.*
9 Inishmore—M'Ardle *40.*
10 Aghanan 1907—Phillips.
11 Thomastown 1907—Phillips.
13 Browne's Hill '67 (R. C. Browne)—*120.*
14 Coolaghcross 1912—Tetley.
16 Kilronan—M'Ardle *40.*
17 Headford—*84.*
18 Geashill '90—HWL.
19 *84.* Curragh '64 (Hutton)—*35.*
20 Moore *58.*
21 Dunsink '56 (Orr)—*35.* Cloughran '73 (Moore)—*120.*
27 Achill I. 1901—HWL.
28 Inniscrone 1903—HWL.
30 Lower Cuilcagh 1912—Tetley.
31 Greenore 1912—HWL.
33 Enniskillen 1907—Tetley.
34 Portaw—Hunter *25.*
35 Rosnowlagh 1908—W. F. Johnson. Bundoran 1913—Porter.
37 Derryadd '82—HWL.
38 Newcastle—HWL *28.* Banbridge '87—HWL.
39 (Moore)—*120.*
40 Magilligan 1904—HWL.

var. **arenicola** *Braithw.*

1 Ventry '73 (Lindberg)—*2.*
6 Ardmore '52 (Moore)—*120.*
9 Ballyvaughan 1907—O'Kelly.
16 Roundstone 1911—*94.*
21 Near N. Wall '73 (Lindberg)—*2.*
27 Achill I. 1905—HWL. Curraun Achill 1909—HWL.
28 Inniscrone 1903—HWL. Bunduff strand 1910—Tetley.
31 *7.*
34 *7.*
35 Bundoran '72 (Moore)—*120.* Rossnowlagh 1908—W. F. Johnson.
37 *7.*
38 Newcastle sand dunes—HWL *28.* Greencastle 1906—HWL.
39 Ballycastle—Stewart *69.*
40 Magilligan 1904—HWL.

Tortula princeps *De Not.*

28 Benbulben—Moore *57.*
39 Glenarm deerpark '66—Moore *55.*
40 Benevenagh '85 (Stewart)—*2.*

Pleurochaete squarrosa (*Brid.*) *Ldbg.*

20 Arklow—Moore *57.*
21 Portmarnock (Taylor)—*81.* '52 (Orr)—*35.*

Mollia crispa (*Hedw.*) *Ldbg.*

19 Kilcullen Bridge (R. C. Browne)—*2.*
21 *84.* Glasnevin '56 (Orr)—*35.*
28 Collooney Hill 1910—Tetley.
29 Dartry Hills 1909—Tetley.
35 Melmore 1910—HWL.
38 Lenaderg—Davies. Loughbrickland '88—HWL.
39 Cave Hill—Templeton *74, 75.*

Mollia rostellata (*Brid.*) *Ldbg.*

39 Near Knockmore Junction — Davies *14.* Ballinderry 1906—*118.*

Mollia microstoma (*Hedw.*) *Ldgb.*

4 Passage (Alexander)—*61.*
20 Moore *58.*
21 Killiney '50 (Orr)—*120.*
31 Omeath Glen—HWL *28.*
34 Fahan '65 (Hutton)—*35.*
37 Derryadd '85—HWL.
38 Kilkeel—Templeton *74, 75.* Bloody Bridge—HWL *28.*
39 Cavehill—Stewart *69.* Near Lisburn 1900—Davies *10.*

Mollia tortilis (*Schwaegr.*) *Braithw.*

2 Killarney—*84.*
5 Dodge's Glen—Power *61.*
15 Castle Taylor—Moore *53.*
35 (HWL)—*7.*
39 (Moore)—*120.*

Mollia viridula (*L.*) *Ldbg.*

In all Divisions, except 10, 15, 17, 22, 23, 25, 35.

var. **amblyodon** *Brid.*

39 Glendun—Brenan.

var. **densifolia** (*Wils.*).

1 Kenmare '54 (Wilson)—*2.*

Mollia rutilans (*Hedw.*) *Ldbg.*

35 Rathmullan '65 (Hutton)—*57.*
38 Near Warrenpoint (Waddell)—*69.*

Mollia tenuis (*Schrad.*) *Ldbg.*

1 Brandon—Taylor *71.*
5 Glanmire Road—Carroll *5.* Fermoy '56 (Carroll)—*35.*
21 Glasnevin '60 (Orr)—*120.*
28 Benbulben '71 (Moore)—*120.*
34 Finner Camp 1911—Tetley.
38 Glenmore '80 (Davies)—*69.* Scrabo '86—Stewart *69.*
39 (Drummond)—*69.* Derriaghy—Davies *13.*

Mollia calcarea (*Nees Hornsch.*) *Ldbg.*

4 Goat Island 1903—M'Ardle.
9 Ballyvaughan 1907—Kane.
35 Dunfanaghy 1909 (Hunter)—*59.*
38 Lenaderg 1905—Davies *15.*

var. **mutica** *Boul.*

5 Lota near Middleton, "covering the walls where it grows so closely as to resemble green plush."—Isaac Carroll.

Mr. H. N. Dixon, to whom Mr. J. H. Davies sent some of Carroll's original specimens, replied "The Cork plant is quite correct."—*15.*

Mollia aeruginosa (*Sm.*) *Ldbg.*

1 *7.*
2 Killarney '55 (Orr)—*120.* Cromagloun 1906—HWL.
3 *7.*
6 Lough Coomshigaun 1902—HWL.
7 Galtee Mts. 1902—HWL.
16 Loughnafooey 1907—M'Ardle *46.*
20 Dargle—Taylor *71.*
21 Killakee Glen—Moore *58.* Lambay —M'Ardle *44.*
25 South of Boyle 1910—Tetley.
26 Larganmore cliff 1910—Tetley.
27 Bengorm 1901—HWL. Croaghpatrick —Waddell.
29 1912—Tetley.
31 *7.*
33 Poulaphuca 1905—M'Ardle *45.*
34 Clonmany—Hunter *25.*
35 Slieve League—Dixon *17.*
38 Tollymore Park '83—HWL.
39 The Glens—Moore *57.* Parkmore—(HWL)—*70.*

var. **ramosissima** (*B. S.*).

2 Cromagloun '65 (Hutton)—*35.*
38 Tollymore Park (HWL)—*69.*

Mollia verticillata (*L.*) *Ldbg.*

1 *1.*
2 Cromagloun—Moore *57.* '65 (Hutton)—*35.*
4 Ardrum '51—Carroll *6.*
5 Youghal—Carroll *6.*
13 Milltown Bridge 1911—Tetley.
14 Slieve Bloom 1912—Tetley.
18 Slieve Bloom 1912—Tetley.
20 Dargle—Templeton *74, 75.*
21 Howth '50 (Orr)—*120.*
Howth 1901—Hughes.
26 Near River Robe 1910—Tetley.
28 Benbulben '70 (Moore)—*120.*
Knocknarea Glen—M'Ardle *41.*
29 1912—Tetley.
33 Florencecourt 1911—Tetley.
34 Ballyliffin—Hunter *25.*
34 Dunfanaghy—Templeton *74, 75*
Slieve League—HWL *32.*

37 Benburb—Davies *13.*
38 Tollymore Park (HWL)—*70.*
39 Colin Glen—Templeton *74, 75.* Glenarriff '89—HWL.

Mollia crispula (*Bruch.*) *Ldbg.*

1 Dunkerron—Taylor *71.*
2 Torc Waterfall '97—HWL. Muckross (Moore)—*2.*
3 Bantry — *84.* Ballylickey 1912—HWL.
4 Ardrum—Carroll *6.*
8 Foynes—Stewart *66.*
9 Corofin 1907—Macnamara.
10 Near Roscrea 1911—HWL.
12 Great Saltee I. 1913—HWL *102.*
14 Slieve Bloom 1912—Tetley.
16 Connemara '73 (Moore)—*120.*
17 Near Galway 1911—Tetley.
20 Moore *58.*
21 Howth '53 (Orr)—*120.*
22 Beauparc 1912—HWL.
23 Near Mullingar 1908—HWL.
26 Ballinrobe 1910—Tetley.
28 Benbulben—Moore *57.* Hazelwood 1904—M'Ardle *41.*
30 Near Lough Oughter 1908—HWL. Blacklion 1909—Tetley.
32 Drumsnatt 1910—Bingham.
33 Castlecaldwell 1905—HWL. Castle Archdall 1907—Kane.
34 Near Buncrana—Hunter *25.*
35 Horn Head—Dixon *17.* Bundoran '91—Waddell *78.*
37 Raughlan '85—HWL.
38 *7.*
39 (Moore)—*120.* Glenarriff '89—HWL.
40 (Moore)—*120.* Magilligan 1900—HWL.

var. **elata** (*Schpr.*).

1 *7.*
2 Muckross—*2.* Torc Mt. 1911—Jones.
8 Askeaton 1905—Waddell.
35 Melmore 1910—HWL.
39 Rathlin I. '82—Stewart *69.*

var. **nigro-viridis** *Braithw.*

2 Torc Mt. 1906—Jones.

Mollia litoralis (*Mitt.*).

1 *7.*
2 Cromagloun 1900 — HWL. Near Emalough '99—HWL.
3 Ballylickey 1912—HWL.
6 Tramore 1902—HWL.
8 Foynes—Waddell.
11 Gowran Demesne 1910—HWL.
12 Great Saltee I. 1913—HWL *102.*
16 L. Corrib shore 1907—M'Ardle *46.*
21 *7.*
22 Kells 1912—HWL.
26 By Glendaduff stream 1910—Tetley.
27 Achill I.—HWL.
28 Inniscrone 1903—HWL.
31 Carlingford Mt.—HWL *28.* Clogher Head 1912—HWL.
32 Drumreaske 1907—Kane. 1910—Bingham.
33 Florencecourt 1911—Tetley.
34 Buncrana 1902—Hunter *26.*
35 Poisoned Glen—Dixon *17.* Slieve League—HWL *32.*
38 Newcastle—HWL *28.* Greencastle 1907—HWL.
39 Rathlin I. '82—Stewart *69.* Glendun '90—Brenan.
40 Benevenagh (Hart)—*69.*

var. **angustifolia** *Ldbg.*

2 Cromagloun '73 (Lindberg)—*2.*

Mollia brachydontia (*Bruch.*) *Ldbg.*

1 Gap of Dunloe '20 (Wilson)—*2.* Brandon 1900—HWL.
2 Muckross (Schimper, Wilson and Moore) — *54.* Killarney 1906—Jones.
3 Near Bantry '09 (Miss Hutchins)—*2.* Bere I. '93—M'Ardle.
6 L. Coomshigaun 1902—HWL.
8 *7.*
9 *7.*
12 Great Saltee I. 1913—HWL *102.*
14 Slieve Bloom 1912—Tetley.
15 *7.*

16 Near Cong '73 (Moore)—*120.*
17 Gort 1907—Kane.
21 Howth '54 (Orr)—*120.* Lambay—M'Ardle *44.*
25 Curlew Hills 1910—Tetley.
26 Slieve Gamph 1910—Tetley.
27 Pontoon 1901—HWL. Clare I. 1910—HWL.
28 Benbulben '71 (Moore)—*120.* Knocknarea Glen 1904—M'Ardle *41.*
29 Glencar 1909—Tetley.
30 Slieve Glagh 1908—HWL.
31 Carlingford Mt. '85—Waddell. 1908—Tetley.
33 Rossinuremore 1905—HWL. Knockmore 1907—Tetley.
34 Buncrana—Hunter *25.*
35 Slieve League—HWL *32.*
38 Newcastle (HWL)—*69.*
39 Moore *57.* Sallagh Braes (HWL)—*69.*

var. **cophocarpa** (*Schpr.*).

33 Bar of Whealt 1914—Tetley.

Mollia lutescens *Ldbg.*

1 Glena '75 (Lindberg)—*2.*

Mollia tenuirostris (*Hook. Tayl.*) *Ldbg.*

1 Brandon (Moore)—*2.* Connor Hill Pass '97—HWL.
2 Killarney—*81.* Horse's Glen 1906—Jones.
6 L. Coomshigaun 1902—HWL.
7 L. Muskry 1902—HWL.
16 Connemara—Moore *57.* Illaunaknick I. 1907—M'Ardle *46.*
20 Powerscourt 1812—Taylor *71.* '65 (Hutton)—*35.*
21 Dublin Mts.—Moore *57.* Lambay—M'Ardle *44.*
22 Beauparc 1912—HWL.
27 L. Conn shore 1901—HWL. Nephin—HWL.
28 Benbulben—Moore *57.*
31 Carlingford Mt. (Waddell)—*28.*
33 Enniskillen 1908—Tetley.
34 Portaw Glen—Hunter *25.*
35 Errigal—Dixon *17.* Slieve League 1902—HWL *32.*
38 Rockport (Drummond)—*69.* Mourne Mts. '85 (HWL)—*120.*
39 Orange Grove Belfast (Templeton)—*71.* Lisburn 1901—Davies *13.*

var. **Holtii** *Braithw.*

1 O'Sullivan's Cascade '85 (Holt and Stewart)—*2.*
2 Cromagloun '85 (Holt and Stewart)—*2.* Horse's Glen 1911—Jones.

Mollia hibernica (*Mitt.*) *Ldbg.*

1 Dunkerron (Taylor)—*55.* Brandon 1905—Waddell. Eagle's Nest Mt. '96 (Binstead)—*35.*
2 Cromagloun (Taylor)—*2.* Horse's Glen 1906—Jones.
5 Fermoy '51 (Chandlee)—*6.*

Mollia flavovirens (*Bruch.*) *Ldbg.*

1 Dingle Bay '73 (Lindberg)—*2.* Dingle (Binstead)—*120.*
2 Ross Bay '61 (Carrington)—*120.*
6 Garraris 1902—HWL. Tramore 1907 (Darton)—*59.*
12 Great Saltee I. 1913—HWL *102.*
16 Loughnafooey 1907—M'Ardle *46.*
20 Arklow '59 (Moore)—*2.*
21 Portmarnock '59 (Moore)—*3.* Howth—*84.*
34 Buncrana—Hunter *25.*
38 Slieve Bingian '85—HWL.
40 Magilligan 1904—HWL.

Mollia nitida *Ldbg.*

1 *7.*
2 Innisfallen (Stewart and Holt)—*2.* Muckross 1906—Jones.
6 Garraris 1902—HWL.
7 Galtee Mts. 1902—HWL.
9 Inishmore '91—Stewart *68.*
16 *7.*
17 1910—Tetley.
21 Lambay—M'Ardle *44.*
26 L. Cloon 1910—Tetley.
27 Pontoon 1903—HWL.

28 Knocknarea Glen 1904—M'Ardle *41.*
29 Kinlough Mt. 1909—Tetley.
34 Buncrana—Hunter *25.*
35 Melmore 1910—HWL. Tory Island 1910—HWL.
40 Magilligan 1904—HWL.

Mollia inclinata (*Hedw.*) *Ldbg.*

1 *7.*
9 Ballyvaughan 1907—O'Kelly.
12 Great Saltee Island 1913—HWL *102.*
23 Near Mullingar 1908—HWL.
28 Mullaghmore 1910—Tetley.
31 Omeath—Waddell.
35 Melmore 1910 — HWL. Bundoran 1912—Porter.
38 Groomsport '87 (Waddell)— *120.* Annalong—HWL *28.*
39 Blackhead '84—Stewart *69.*
40 Portstewart '88—HWL.

Mollia tortuosa (*L.*) *Schrank.*

In all Divisions, except 12, 13, 17, 19, 20, 22, 24, 32, 37.

var. **angustifolia** (*Juratz*).

38 Near Bryansford '85 (HWL)—*2.*

Mollia fragilis (*Drumm.*) *Ldbg.*

2 *7.*
9 Inishmore '95—M'Ardle.
16 Roundstone '53—Moore *57.* Dog's Bay Connemara 1912 (Cheetham)—*59.*
28 Knocknarea Glen 1904—M'Ardle *41.*
32 Eskmore 1910—Bingham.
33 Barr of Whealt 1909—Tetley.
35 Slieve League—HWL *28.*

Mollia crispata (*Nees*) *Homs.*

34 Portaw—Hunter *25.*
38 Rather plentiful on "The Rock" in Newcastle—Davies *15.*

Leptodontium flexifolium (*Dicks.*) *Hampe.*

Killarney—*84.* Above Torc Cascade 1911—Jones.

6 L. Coomshigaun 1902—HWL.
12 Blackstairs Mt. 1911—Tetley.
14 Slieve Bloom 1912—Tetley.
21 Near Killiney—Moore *57.*
26 Slieve Gamph 1910—Tetley.
27 Achill I. 1903—HWL.
28 Benbulben—Waddell *78.*
39 Cushendall—Moore *57.*
40 Portstewart sandhills—Davies *14.*

Leptodontium recurvifolium (*Tayl.*) *Hampe.*

1 Knockavohila '42 (Taylor) — *72.* Connor Hill Pass '96 — Binstead. Coomanard '98—HWL. Brandon 1905—Waddell and Scully.

Barbula curvirostris (*Ehrh.*) *Ldbg.*

7.
2 Mangerton—Taylor *71.*
4 Near Cork (Murray)—Herb. Fogerty. Ballinhassig Glen '78 (Carroll)—*79.*
10 Near Roscrea 1911—HWL.
18 Near Tipperary boundary, Roscrea 1911—HWL.
21 Lambay—*95.*
22 Kells 1912—HWL.
23 Mullingar 1909—HWL.
27 Achill I. 1903—HWL.
28 Truskmore 1910—Tetley.
30 Killykeen 1908—HWL.
31 Omeath Glen—HWL *28.*
33 L. Erne shore 1905—M'Ardle *45.*
35 L. Easke 1903—M'Ardle.
38 Cove Mt.—HWL. Moygannon '85 (Waddell)—*120.*
39 Fairhead (Templeton)—*71.* Cave Hill '84—Stewart.
40 (R. Brown)—*74*, *75.* Clontygeragh (Moore)—*69.*

Barbula rubella (*Hoffm.*) *Mitt.*

In all Divisions except 7, 15, 17, 26. Very common.

var. **dentata** (*Schpr.*)

2 Muckross Demesne 1906—Jones.

var. **ruberrima** *Ferg.*

7 Lough Muskry 1902—HWL *35.*
35 Slieve League 1902—HWL *35.*

Barbula lurida (*Hornsch.*) *Ldbg.*

1 Castle Gregory—Moore *57.*
2 Killarney '77 (Carroll)—*79.*
4 '29—Wilson *81.*
5 Lota Wood '59 (Carroll)—*79.*
6 Tramore 1902—HWL.
17 1910—Tetley.
18 Geashill 1907—HWL.
26 L. Carra 1910—Tetley.
33 Enniskillen 1909—Tetley.
35 Melmore 1910—HWL.
38 Scarva—Davies *16.* Shore of L. Brickland 1907—HWL.

Barbula brevifolia (*Dicks.*) *Ldbg.*

In all Divisions, except 2, 3, 7, 11, 13, 19, 22, 24, 30, 32, 36.

var. **acutifolia** (*Schpr.*).

39 Canal bank at Lisburn—Davies *10.*

Barbula fallax *Hedw.*

In all Divisions, except 7, 15, 24. Very common and frequently abundant.

var. **brevifolia** (*Sm.*).

38 Cregagh Glen—Stewart *69.* Dromore —HWL.

Barbula reflexa *Brid.*

1 *7.*
2 Muckross '65 (Schimper, Wilson, and Moore) — *53.* Cromaglaun 1906—HWL.
3 Ballylickey 1912—HWL.
11 Near Kilkenny 1907—Phillips.
16 Connemara—Moore *53.*
21 Malahide—Waddell.
23 1909—HWL.
26 Ballinrobe 1910—Tetley.
28 Benbulben '71 (Moore)—*120.* Inniscrone 1905—HWL.
29 Drumshanbo (Stewart)—*79.* Kinlough Mt. 1909—Tetley.
32 1910—Bingham.
33 Castlecaldwell 1905—HWL.
35 Melmore 1910—HWL.
38 Shimna R. Newcastle — Davies *15.* Killard Point—Waddell.
40 Magilligan 1904—HWL.

var. **robusta** *Braithw.*

28 Benbulben (Moore)—*2.*

Barbula spadicea *Mitt.*

1 Dunkerron—Taylor *71.*
4 Carrigaline '51—Carroll *6.*
5 Glanmire 51—Carroll *6.*
7 Galteemore Mt. '50 (Moore)—*120.*
10 Near Roscrea 1911—HWL.
11 Thomastown 1907—Phillips.
14 Slieve Bloom 1912—Tetley.
20 '48 (Moore)—*120.*
25 Athlone 1910—HWL.
28 Belbulben '71 (Moore)—*120.*
29 Fermoyle Mt. 1909—Tetley.
30 Killykeen 1911—HWL.
31 Omeath (Waddell)—*28.*
32 *7.*
33 L. Erne shore 1907—Tetley.
35 Melmore 1910—HWL.
36 Loughrey (HWL)—*69.*
38 Newcastle (HWL)—*2.* Moygannon Glen '85—HWL.
39 Belfast (Templeton)—*69.* Fair Head '82—HWL.

Barbula rigidula (*Hedw.*) *Mitt.*

1 Brandon Mt. (Moore)—*2.*
2 Torc Mt.—Jones.
4 Blarney '75 (Carroll)—*79.*
5 Great Island (Scott)—*61.*
8 Foynes—Stewart *66.*
10 Aghacor 1907 — Phillips. Roscrea 1911—HWL.
11 Mt. Brandon 1911—Tetley.
12 Strokestown 1907—Phillips.
14 Slieve Bloom 1912—Tetley.
17 Drumbane 1910—Tetley.

20 Powerscourt — Moore *57.* Bray '52 (Orr)—*35.*
21 Dollymount '56 (Orr)—*120.*
23 Mullingar 1909—HWL.
25 Boyle 1910—Tetley.
26 L. Carra 1910—Tetley.
27 Nephin 1901—HWL.
28 Benbulben—Moore *57.*
29 L. Allen shore '83 (Stewart)—*79.*
32 Dartry Hills 1909—Tetley.
34 Buncrana—Hunter *25.*
35 Slieve League—HWL *32.*
37 Ardmore '85—HWL.
38 Belvoir '07 — Templeton *74, 75.* Warrenpoint '85—Waddell.
39 Belfast Deerpark '09—Templeton *74, 75.* Fair Head—HWL.
40 Slieve Gallion—Stewart *69.*

Barbula acuta *Brid.*

4 Near Cork—Drummond *18.*
8 Adare—Miss Armitage *1.*
38 Lenaderg 1905—Davies *16.*
39 (Moore)—*120.*

Barbula cylindrica (*Tayl.*) *Schpr.*

In all Divisions, except 3, 7, 9, 10, 14, 15, 18, 19, 24, 40.

var. **vinealis** (*Brid.*).

4 '51—Carroll *6.*
5 *7.*
1 Thomastown 1909—Phillips. Duninga 1911—Tetley.
14 Slieve Bloom 1912—Tetley.
18 Geashill 1907—HWL.
19 Ballitore '56—Davies *8.* Poulaphuca '56—Davies *8.*
20 Dunlavin '56—Davies *8.*
21 Luttrelstown (Taylor)—*81.* Finglas bridge '56 (Orr)—*35.*
28 Benbulben—Moore *57.*
33 *7.*
34 *7.*
36 Loughrey Demesne '84—HWL.
37 Ardmore Glebe '85—HWL.
38 Warrenpoint—HWL. Slievenabrock 1912—HWL.
39 Carrickfergus Castle — *69.* Drumbridge—Davies *12.*

Barbula sinuosa (*Wils.*).

8 Anacotty—Miss Armitage *1.*
16 Kylemore '72 (Moore)—*120.*
21 Phœnix Park '67 (Orr)—*54.* '65 (Hutton)—*2.*

Barbula Hornschuchii *Schultz.*

3 Glengarriff 1906—Jones.
5 Near Inchiquin—Carroll *5.*
8 Mungret—*84.*
21 Killiney '55 (Orr)—*35.*
37 Drumlin—Davies *115.*
38 Lenaderg—Davies *115.*
39 Carrickfergus Castle—Moore *57.* Lisburn Cath. 1902—HWL. Carrickfergus old town wall 1911—HWL.

Barbula revoluta (*Schrad.*) *Brid.*

In all Divisions, except 3, 5, 6, 15, 26.

Barbula convoluta *Hedw.*

In all Divisions except 6, 9, 10, 19, 22, 24, 28, 32.

var. **sardoa** (*Br. Sch.*).

2 Torc Mt. 1906—Jones.
5 Cloyne '84—HWL.
20 Seven Churches '73 (Lindberg)—*2.* Glendalough (Palgrave)—*2.*
21 Luttrelstown (Taylor)—*57.*
38 *7.*
39 Lisburn canal side—Davies *14.*

Bartula unguiculata (*Huds.*) *Hedw.*

In all Divisions, except 5, 6, 7, 28, 36.

var. **cuspidata** *Schultz.*

23 Near Mullingar 1910—HWL.
31 Carlingford 1908—HWL.
39 Cave Hill '10—Templeton *74, 75.*

var. **apiculata** (*Hedw.*).

21 (Stokes)—*2.*
38 Ballymacarrett Foundry—Templeton *74, 75.* Aghaderg Glebe (HWL)—*70.*
39 Belfast Deerpark—Templeton *74, 75.*

var. **fastigiata** (*Schultz.*).

37 Ardmore, shore of L. Neagh, abundant '85 (HWL)—*2.*

Cinclodotus fontinaloides (*Hedw.*) *P. Beauv.*

In all Divisions, except 3, 11, 14, 18, 19, 31.

[**Cinclodotus riparius** (*Host.*) *Arnott.*

9 Ennis in R. Fergus '84—Stewart *66.* Dixon, Handbook, p. 249, refers this to *fontinaloides.*]

Leersia extinctoria (*L.*) *Leyss.*

1 Cloughan '73 (Moore)—*120.*
2 Ross I. '79—HWL.
4 Blackrock (Alexander)—*61.*
5 Fermoy (Chandlee)—Herb. G. Fogerty.
11 Thomastown 1907—Phillips.
13 Kellstown Hill '67—R. C. Browne. Tinnahinch 1907—Phillips.
16 Moore *57.*
18 Near Birr 1907—Miss Hemphill. Geashill—HWL.
20 *7.*
21 Cloughrane Ch. (Stokes)—*74, 75.* Feltrim Hill '52 (Orr)—*35.*
23 Mullingar 1909—HWL.
27 Achill I. 1909—HWL.
33 Rossinuremore 1905—HWL. Tempo Manor 1907—Langham.
35 Slieve League—HWL *32.*
39 Cave Hill—Templeton *74, 75.* Whitehead 1900—Davies *10.*
40 Benbradagh (Moore)—*69.* Magilligan 1913—Waddell.

Leersia laciniata *Hedw.*

27 *7.*
28 Benbulben (Mackay)—*23.*
39 Cave Hill — Templeton *74, 75.* (Moore)—*120.*
40 Benbradagh—Moore *57.*

Leersia rhabdocarpa (*Schwaegr.*) *Ldbg.*

9 Scariff 1909—Mrs. Hibbert.
27 Mulranny 1909—HWL.
28 Benbulben (Taylor)—*74, 75.*
29 Largydonnell 1909—Tetley.

Leersia contorta (*Wulf.*) *Ldbg.*

In all Divisions, except, 3, 7, 15, 19, 24.

Webera sessilis (*Schmid.*) *Ldbg.*

1 Purple Mt.—Wade *80.* Dunkerron (Mackay)—*71.* Loughanscaul '99—HWL.
2 Horse's Glen 1906—Jones.
16 Maam—Wade *80.* (Moore)—*5.* Leenane 1901—HWL.
20 Powerscourt (Stokes)—*74, 75.* '58 (Orr)—*35.*
27 Bengorm 1901—HWL.
29 Truskmore 1909—Tetley.
31 Carlingford Mt. (Waddell)—*28.*
35 Slieve League—HWL *32.*
37 Carriffkeeny 1913—HWL.
38 Tollymore Park 1804—Templeton *74, 75.* Slieve Donard—HWL *28.*
39 Slemish (HWL)—*69.*
40 Ness Glen—Templeton *74, 75.*

var. **acutifolia** *Ldbg.*

16 Connemara '53 (Moore)—*1.*
20 Luggielaw '73 (Lindberg)—*1.*
21 *7.*
27 *7.*
29 Truskmore 1909—Tetley.
39 Rasharkin—HWL and Waddell.

Grimmia conferta *Funck.*

26 Near Lough Mask 1910—Tetley.
31 Greenore 1912—HWL.
32 Eskmore 1910—Bingham.

var. **pruinosa** *Wils.*

9 Inishmore '91—Stewart *68.*
38 Slieve Donard—HWL *28.*
39 Near Belfast—Moore *57.* Cave Hill '82 (Stewart)—*2.*
40 Benbradagh—Stewart *69.*

Grimmia apocarpa (*L.*) *Hedw.*

In all Divisions, except 5, 24.

var. **rivularis** (*Brid.*) *W. M.*

1 Connor Hill Pass 1907—HWL. Brandon '29 (Wilson)—*2.*
5 Templemichael Glen '51—Carroll 6.
6 Comeragh Mts. 1902—HWL.
13 South of Borris 1911—Tetley.
21 Ballinascorney Glen '56 (Orr)—*35.*
29 *7.*
30 Swanlinbar 1910—HWL.
34 Buncrana—Hunter *25.*
38 Holywood Hill—Stewart *69.* Mourne Mts.—HWL *28.*
39 Carr's Glen—Stewart *69.*

var. **gracilis** (*Schleich.*) *W. M.*

1 *7.*
2 Torc Glen—Moore *57.*
4 Blarney—*61.*
6 *7.*
8 Knock Sentry—Miss Armitage *1.*
18 Geashill 1907—HWL.
30 Swanlinbar (Scott)—*73.*
39 Colin Glen—Templeton *74, 75.*

var. **pumila** *Schpr.*

32 Drumreaske 1907—Kane.

Grimmia maritima *Turn.*

1 Kenmare—*84.*
3 Glengarriff—*84.* Dursey I. '93—M'Ardle.
4 *7.*
5 Haulbowline (Scott)—*61.* Myrtleville '51—Carroll *6.*
8 Foynes 1905—Waddell.
9 Malbay '32—*85.*
20 Moore *58.*
21 Balbriggan (Scott)—*73.* Howth '53 (Orr)—*35.*
27 Achill I. 1901—HWL.
28 Mullaghmore 1910—Tetley.
29 Tullaghan 1909—Tetley.
31 Omeath (Waddell)—*28.*
34 Hunter *25.* Horn Head—Dixon *17.*
35 *7.*
38 Groomsport '87 (Waddell)—*120.* Bloody Bridge—HWL *28.*
39 (Moore)—*120.* Cushendall 1907—HWL.
40 Portstewart—Waddell.

Grimmia funalis (*Schwg.*) *Schpr.*

1 Brandon (Moore)—*5.* Connor Hill—Waddell.
4 Dripsey '51—Carroll *6.*
16 Kylemore—Moore *57.*
20 Upper L. Bray—Moore *57.*
35 *7.*
38 Slieve Donard—Stewart *69.* Slieve Dermot (HWL)—*2.*
39 Slemish—Templeton *74, 75.* '93—HWL.
40 Benbradagh Mt. '69 (Stewart)—*79.*

Grimmia torquata *Hornsch.*

1 Mangerton—Taylor *71.* Carntual—Carroll *5.*
2 Horse's Glen '79 (Carroll)—*79.*
7 Galteemore '55 (Moore) — *120.* L. Muskry 1902—HWL.
20 Powerscourt '59 (Moore)—*120.*

Grimmia pulvinata (*L.*) *Sm.*

In all Divisions, except 5, 7, 22, 24, 26, 32.

Grimmia orbicularis *Bruch.*

4 Near Cork—Carroll *5.*
5 Near Cove—Carroll *5.*
21 Stillorgan—Moore *57.*
38 Spelga Mt. (HWL)—*2.*

Grimmia trichophylla *Grev.*

1 Aooragh near Sneem—Taylor *71.* Blackwater Bridge '77 (Carroll)—*79.*

2 Killarney—*84.*
3 Glengarriff—*84.* Connemara '41 (Macalla)—*85.*
4 Ardrum '50—Carroll *6.*
6 L. Coomshigaun 1902—HWL.
13 Near Milltown 1911—Tetley.
16 Wood near Cong 1908—M'Ardle *46.*
20 Luggielaw (Moore)—*120.*
21 Dublin (Scott)—*71.* (Moore)—*2.*
23 Mullingar 1909—HWL.
26 Slieve Gamph 1910—Tetley.
27 Westport 1908 (Costorphine)—*59.*
30 Slieve Glagh 1908—HWL.
31 Carlingford Mt. 1908—Tetley.
32 1910—Bingham.
34 Buncrana—Hunter *25.*
35 Letterkenny — Dixon *17.* Melmore 1910—HWL.
36 Killymoon '84 (Stewart)—*79.*
37 Carnlough Mt.—HWL *28.*
38 Giant's Ring—Stewart *69.* Fofany—HWL *28.*
39 Fair Head—Moore *57.*

Grimmia Hartmanni *Schpr.*

2 Torc Glen 1906—HWL.
3 Glengarriff 1912—HWL.
26 Wall between Cong and Moytura '72 (Moore)—*2.*
34 Buncrana—Hunter *25.*
38 Altnadua L. 1906—Davies.
39 Fair Head—Dixon *17.* Rasharkin 1912—J. D. Houston *97.*

Grimmia subsquarrosa *Wils.*

11 Mt. Brandon 1911—Tetley.

Grimmia decipiens (*Schultz.*) *Ldbg.*

6 Comeragh Mts. 1902—HWL.
16 Connemara Mts.—Moore *57.*
20 Luggielaw—Moore *57.*
21 The Scalp (Orr)—*50.* Three Rock Mt. '54 (Orr)—*50.*
31 Waddell.
38 Slieve Donard—Stewart *69.* Tievedockaragh—HWL.
39 Fair Head—Moore *57.*

var. **robusta** *Ferg.*

16 Connemara '63—Moore *57.*
21 The Scalp '54 (Orr)—*50.*
38 Spelga Mt. (HWL)—*69.*
39 Fair Head '62—Moore *57.*

Grimmia Donii *Sm.*

2 Horse's Glen 1906—Jones.
34 Scalp Mt.—Hunter *25.*
37 Camlough Mt.—HWL *28.*
38 Slievenamaddy '84 (HWL)—*69.*
39 Sallagh Braes '73—Stewart *69.*

var. **sudetica** (*Spreng.*).

1 Brandon—*84.*
2 Killarney '06—Jones.
3 Priest's Leap Mt. '78 (Carroll)—*79.*
6 L. Coomshigaun 1903—HWL.
35 *7.*
37 *7.*

Grimmia ovalis (*Hedw.*) *Ldbg.*

4 Muskeramore Mt. (Carroll)—*54.*
16 Connemara—*84.*
21 Howth (Orr)—*57.* Killiney '55 (Orr)—*54.*
38 Scrabo—Templeton *74, 75.* Slieve Donard—HWL *28.*

Grimmia microcarpa (*Gmel.*) *Ldbg.*

1 *7.*
6 Comeragh Mts. 1902—HWL.
7 Galtee More Mt.—Carroll *6.*
16 Connemara (Moore)—*2.*
20 L. Bray (Moore)—*58.* Luggielaw '51 (Orr)—*35.*
21 Dublin Mts.—Orr *60.*
27 Nephin 1902—HWL.
31 Carlingford Mt. 1900—HWL.
33 Near Topped Mt. 1905—HWL.
35 *7.*
37 Slieve Gullion—HWL *28.*
38 Slieve Donard '05—Templeton *74, 75.* Shanslieve—HWL.
39 Slemish '09—Templeton *74, 75.*
40 Dart Mt. (Moore)—*69.*

Grimmia campestris *Burch.*

3 *7.*
39 Giant's Causeway '37—Moore *57.*

Grimmia elliptica (*Turn.*) *Arn.*

1 Brandon—Moore *57.* Mangerton—*84.*
3 Bantry (Miss Hutchins)—*71.*
4 Monkstown (Carroll)—*2.* Priest's Leap Mt. '78 (Carroll)—*79.*
16 Maam Turk—Moore *57.*
20 Lugnaquilla—Moore *57.*
21 Glassmuckey Brakes '65 (Hutton)—*35.*
27 1904—HWL.
28 Benbulben (R. Brown)—*73.*
34 Bulbein Mt. (R. Brown)—*73.*
35 Errigal—Dixon *17.*
37 *7.*
38 Mourne Mts.—Templeton *74, 75.* Slieve Donard—HWL *28.*
39 Fair Head — Templeton *74, 75.* Slemish '93—HWL.
40 Clontygeeragh—Moore *69.* Meenard Mt. '70 (Stewart)—*79.*

Grimmia patens (*Dicks.*) *B. S.*

1 Connor Hill Pass 1906 — HWL. Brandon '78 (Carroll)—*79.*
2 Derrymore R. glen '99—HWL.
3 Gouganebarra (Carroll)—*57.* Glengarriff '78 (Carroll)—*79.*
6 Comeragh Mts. 1902—HWL.
7 Galtee More '51—Carroll *6.* L. Muskry 1902—HWL.
16 Connemara Mts.—Moore *57.*
20 Powerscourt—Moore *57.*
21 Kelly's Glen '52 (Orr)—*35.*
27 Achill I. 1904—HWL.
31 Carlingford Mt. '99—HWL.
33 Castlecaldwell 1905—HWL.
35 Errigal—Dixon *17.*
38 Conlig '46 (Orr)—*120.* Slieve Donard '99—HWL.
39 Colin Glen — Templeton *74, 75.* Craigsrock, Rasharkin (HWL)—*70.*
40 Clontygeeragh (Moore)—*69.*

Grimmia acicularis (*L.*) *C. M.*

In all Divisions, except 5, 8, 10, 17, 19, 22, 23, 24.

var. **denticulata** *B. S.*

39 Cave Hill (Templeton)—*69.* Carr's Glen (Davies)—*69.*

Grimmia aquatica (*Brid.*) *C. M.*

1 Connor Hill Pass '97—HWL. Brandon—Moore *57.*
2 Killarney 1906—Jones. Frequent.
3 Glengarriff '64 (Hunt)—*2.* Shrone Hill 1907—Miss Martin.
7 L. Muskry 1902—HWL.
11 Mt. Brandon 1911—Tetley.
12 Aughnabrisky 1911—Tetley.
13 Mt. Leinster 1911—Tetley.
16 Kylemore—Moore *57.* L. Corrib shore 1907—M'Ardle *46.*
18 Near Roscrea 1911—HWL.
20 Turner *73.* Upper L. Bray (Orr)—*57.*
25 1910—HWL. Sheegorey Mt.—Tetley.
26 Slieve Gamph 1910—Tetley.
27 Pontoon 1901—HWL.
28 Collooney 1904—M'Ardle *41.*
29 Cloonaquin Mt. 1909—Tetley.
30 Tents Mt. 1910—Tetley.
31 Carlingford Mt. 1900—HWL.
32 Eskmore 1910—Bingham.
35 Slieve League—HWL *32.* Doochary Bridge—Dixon *17.*
38 Mourne Mts. (Drummond)—*69.* Slieve Donard '87—HWL.
39 Waddell.

Grimmia obtusa (*Sm.*) *Ldbg.*

20 Luggielaw '55 (Orr)—*2.* L. Bray '75 (Lindberg)—*2.*
21 '55 (Orr)—*2.*
38 Drummond *18.* Slieve Donard (HWL) —*2.*

var. **subsimplex** *Ldby.*

20 Glendalough '70 (Orr)—*2.*
21 Dublin Mts. '70 (Orr)—*60.*
38 Slievenamaddy—HWL *28.*

Grimmia affinis (*Schleich.*) *Ldbg.*

1 Eagle Mt. 1906—HWL.
3 Glengarriff 1912—HWL.
6 L. Coomshigaun 1902—HWL.
13 Milltown Bridge '67 (R.C. Browne)—*120.*
20 L. Bray—*95.*
21 Secawn Mt. (Taylor)—*74, 75.*
30 Cuilcagh Mt. 1909—Tetley.
31 Carlingford Mt. (Waddell)—*28.* 1908—HWL *35.*
35 *7.*
38 Mourne Mts. '84—HWL. Slievenabrock 1912—HWL.
39 *7.*

var. **gracilescens** (*B. S.*) *Ldbg.*

2 Killarney (Wilson)—*2.*
3 *7.*
6 Comeragh Mts. 1902—HWL.
11 Mt. Coppanagh 1911—Tetley.
12 Blackrock Mt. 1911—Tetley.
20 L. Bray—*95.*
21 Killakee Glen—*95.*
26 Slieve Gamph 1910—Tetley.
27 Achill I. 1903—HWL.
31 *7.*
37 Cargin Wood '98—HWL.
38 Shanslieve (HWL)—*2.* Slieve Donard '83—HWL.

Grimmia heterosticha (*Hedw.*) *C. M.*

In all Divisions, except 10, 15, 18, 19, 22, 23, 24.

Grimmia fascicularis (*Schrad.*) *C. M.*

In all Divisions, except 5, 8, 9, 10, 17, 18, 19, 22, 23, 24.

Grimmia hypnoides (*L.*) *Ldbg.*

In all Divisions, except 8, 10, 15, 18, 22, 23, 24, 26.

Grimmia canescens (*Timm.*) *C. M.*

2 Killarney '06—Jones.
4 Bandon (Alexander)—*61.*
6 Comeragh Mts. 1902—HWL.
7 Clonmel—*84.*
8 Askeaton 1905—Waddell.
11 Bagnalstown 1911—Tetley.
12 Blackrock Mtn. 1911—Tetley.
14 Slieve Bloom 1912—Tetley.
16 Lough Corrib shore 1907—M'Ardle *46.*
20 Lough Bray '58 (Orr)—*120.*
21 Moore *58.* Kelly's Glen '51 (Orr)—*35.*
27 Achill I. 1909—HWL.
30 Cuilcagh Mtn. 1911—Tetley.
31 Anglesey Mtn.—HWL *28.*
32 Eskmore 1910—Bingham.
33 Correll Glen 1907—Tetley.
34 Hunter *25.*
35 Rosapenna 1910—HWL.
36 *7.*
37 Ferry Hill—Waddell.
38 Mourne Mts. '86 (Waddell)—*120.* Deer's Meadow—HWL *28.*
39 Cave Hill '06 (Templeton)—*69.* Divis '82 (Waddell)—*120.*
40 Ballynascree (Moore) — *69.* Slieve Gallion '76 (Stewart)—*79.*

var. **ericoides** (*Schrad.*) *C. M.*

2 Horse's Glen 1906—Jones.
6 Lough Coomshigaun 1902—HWL.
21 Dublin Mts. '52 (Orr)—*35.*
28 Ben Bulben 1911—Tetley.
31 Anglesey Mt.—HWL *28.*
34 Hunter *25.*
38 Butter Mt.—HWL *28.*

Grimmia retracta *Stirton.*

2 Cromagloun 1911—Jones.

Glyphomitrium Daviesii (*Dicks.*) *Brid.*

1 Brandon Head—Moore *57.*
2 *7.*
3 Bantry (Miss Hutchins)—*71.*
16 Kylemore—Moore *57.* Urrisbeg 1912 (Cheetham)—*59.*
34 Urrisbeg '75 (Stewart)—*79.*
35 Errigal—Dixon *17.*

38 Mourne Mts.—Drummond *18*. Slieve Donard '84—HWL.
39 Fair Head (R. Brown)—*74*, *75*. Fair Head '84—HWL.
40 Dart Mt. (Moore)—*69*. Mullaghmore—Stewart *69*.

Glyphomitrium polyphyllum (*Dicks.*) *Mitt.*

In all Divisions, except 5, 15, 19, 22, 24, 25.

Glyphomitrium saxicola (*W. M.*) *Mitt.*

1 Near Loo Bridge 1906—Jones.
2 Torc Mt. 1906—Jones.
20 Lough Bray—Taylor *71*.
21 Mtns.—*23*. Kelly's Glen—Moore *58*.
29 Truskmore 1909—Tetley.

Anoectangium Mongeottii (*Bruch.*) *Ldbg.*

1 Dingle (Moore)—*120*. Connor Pass '97—HWL.
2 Killarney 1906—Jones.
3 Bantry 1912—HWL.
4 Carroll *5*.
5 Templemichael Glen '50—Carroll *6*.
6 Lough Coomshigaun 1902—HWL.
7 Galteemore '55 (Moore)—*120*. Lough Muskry 1902—HWL.
8 *7*.
9 Foynes—Stewart *66*.
16 Connemara (Moore) — *120*. Twelve Bens—Hart *20*.
20 Luggielaw '51 (Moore)—*120*. Roundwood (Orr)—*120*.
27 Devil's Mother Mtn. 1901—HWL.
28 Lissadill 1904—M'Ardle *41*.
31 Omeath Glen—HWL *28*. Carlingford Mt. 1908—HWL.
33 Marble Arch Glen 1905—HWL.
34 Buncrana—Hunter *25*.
35 Bundoran 1900 — Miss M. Lett. Slieve League—HWL *32*.
36 *7*.
37 Ardmore Glebe '85 (HWL)—*69*.
38 Slieve Donard (HWL)—*69*.
39 Colin Glen '59 (Davies)—*69*. Cave Hill—Stewart *69*.
40 Benevenagh—Stewart *69*.

Pleurozygodon aestivus (*Hedw.*) *Ldbg.*

1 Connor Hill Pass 1906—HWL.
2 (Carroll)—*120*. Torc Waterfall 1906—Jones.
3 Bantry (Miss Hutchins)—*71*.
6 Lough Coomshigaun 1902—HWL.
7 Galtee More—*120*. Lough Muskry 1902—HWL.
8 Glenstal—Hart *20*.
16 Connemara '93—C. D. Russell.
20 Upper Lough Bray—Moore *58*.
27 Achill I. 1909—HWL.
28 Benbulbin '56 (Moore)—*120*.
31 Omeath Glen—HWL *28*.
34 Trillick—Hunter *25*.
35 Poisoned Glen—Dixon *17*.
38 Slieve Commedagh (HWL)—*69*.
39 Glendun (Hooker, Taylor, and Templeton)—*74*, *75*. Carnlough (Moore)—*69*.

Zygodon Stirtoni *Schpr.*

2 Killarney '41(Moore)—*120*. Muckross '73 (Lindberg)—*2*.
3 Ballylickey 1912—HWL.
6 Comeragh Mts. 1902—HWL.
11 Blancheville 1910—HWL.
20 Powerscourt '58 (Moore)—*120*.
21 Dunsink '52 (Moore)—*120*.
22 (Moore)—*120*. New Grange 1912—HWL.
31 Greenore 1912—HWL.
33 Castlecaldwell 1905—HWL.
38 Portavo—Stewart *69*. Bloody Bridge—HWL *28*.
39 Orangefield '38 (Moore)—*120*. Kilroot and Rathlin '80 (Stewart)—*2*.
40 '85 (Davies)—*69*.

Zygodon viridissimus (*Dicks. Brown*).

In all Divisions, except 15, 17, 22, 24, 26, 29. 35.

var. **rupestris** *Ldbg.*

38 Newcastle '84—HWL.

Zygodon conoideus (*Dicks.*) *Hk. T.*

1 Old Weir Bridge 1906—Jones.
2 Muckross '29 (Wilson)—*35*. Killarney '65 (Moore)—*120*.
3 Glengarriff 1912—HWL.
4 *7*.
5 Glanmire (Murray)—*61*. Lota Wood '51—Carroll *6*.
14 Ballyfin—Moore *57*.
16 Oughterard '60 (Nowell)—*2*.
18 Geashill 1907—HWL.
20 Powerscourt—Moore *57*.
25 Rockingham '71—Moore *57*.
26 Near L. Mask 1910—Tetley.
29 Manorhamilton 1909—Tetley.
33 Derryargon 1913—Tetley.
35 Gweedore—Dixon *17*.
38 Near Ballymacarrett Foundry — Templeton *74, 75*. Tollymore — Miss Armitage.
39 Near Belfast '00—Templeton *74, 75*.
40 Magilligan—Waddell.

Zygodon gracilis *Wils.*

16 Connemara (Wilson)—*2*.

Orthotrichum rupestre *Schleich.*

1 Mt. Eagle '98—HWL.
2 Cromagloun (Carrington)—*57*.
16 Marble Hill—Hart *20*.
20 Luggielaw (Moore)—*120*.
21 Dargle—*84*.
26 Near Foxford 1910—Tetley.
27 Achill I.—HWL.
34 Tallagh Point—Hunter *25*.
35 *7*.
37 Kinnego, L. Neagh, '85 (HWL)—*69*.
38 Near Glasdrummon—Davies *12*.
39 Giant's Causeway (Moore) — *69*. Ballintoy 1913—HWL.

var. **rupincola** (*Funck.*) *Haeb.*

20 Luggielaw '51 (Orr)—*35*.
21 Glendalough '52 (Orr)—*35*.
39 (Moore)—*120*.

var. **Sturmii** (*Hsch.*) *Jur.*

1 *7*.
20 Luggielaw '63 — Moore *57*. Seven Churches (Moore)—*2*.
38 Tollymore—HWL.
39 Fairhead—Moore *57*. Knocklayd '82 (Stewart)—*2*.

[**Orthotrichum Shawii** *Wils.*

21 Ballinascorney Gap—Orr *60* ?]

Orthotrichum affine *Schrad.*

In all Divisions, except 7, 15, 22, 23, 24, 25.

var. **rivale** *Wils.*

39 By Lagan River, Lisburn—Davies *12*.

var. **fastigiatum** (*Bruch.*) *Hueb.*

19 *7*.
21 Carton Demesne—Moore *57*.
25 West of L. Key 1910—Tetley.

Orthotrichum striatum (*L.*) *Hedw.*

1 *7*.
2 Killarney (Moore) — *120*. 1906 — Jones.
3 Blarney—Power *61*.
4 Near Cork (Murray)—*6*.
13 Browne's Hill '67—R. C. Browne.
14 Slieve Bloom 1912—Tetley.
20 Luggielaw (Moore)—*120*. Powerscourt '65 (Hutton)—*35*.
21 Carton (Moore)—*120*. Santry '53 (Orr)—*35*.
33 Enniskillen 1908—Tetley.
36 Pomeroy '75 (Stewart)—*79*.
37 (Stewart)—*79*.
38 (Templeton)—*69*. Tollymore Park—HWL *28*.
39 Glenarm Park (Moore)—*69*. Rathlin —Stewart *69*.
40 Near Dungiven—*69* Foot of Slieve Gallion—*69*.

Orthotrichum Lyellii *Hk. T.*

1 *7.*
2 Muckross 1906—Jones.
7 '56—Moore *50.*
11 Graiguenamanagh 1907 — Phillips. Blancheville 1910—HWL.
12 Killaune 1907—Miss Cooper.
13 Near Myshall 1911—Tetley.
18 Cappagh '94—Russell. Geashill 1907 —HWL.
19 Ballitore '56—Davies *8.*
20 Westaston—Moore *57.* Powerscourt '89—HWL.
21 Carton (Moore)—*120.*
22 Kells 1912—HWL.
23 Mullingar 1908—HWL.
30 Farnham 1908—HWL.
31 Ravensdale '99—HWL. Near Collon '77 (Stewart)—*79.*
32 Drumreaske 1907 — Kane. 1910 — Bingham.
33 Marble Arch Glen 1905—HWL.
36 Killymoon '84—HWL.
38 Rademon Demesne — Stewart *69.* Finnebrogue—HWL *28.*
39 Glenarm Park—Stewart *69.* Ballymacash—Davies *8.*

Orthotrichum diaphanum *Schrad.*

1 *7.*
2 Torc Glen 1906—Jones.
4 Near Cork (Murray)—*6.*
5 Great Island (Scott)—*61.*
8 Ennis '84 (Stewart)—*79.*
9 Near Ennis—Stewart *66.*
11 Thomastown 1907—Phillips.
12 Great Saltee I. 1913—HWL *102.*
14 Mountmellick 1912—Tetley.
15 Portumna 1907—Phillips.
17 Drumbane 1910—Tetley.
18 Geashill '92—HWL.
19 Curragh '64 (Hutton)—*35.*
20 '71 (Moore)—*120.*
21 Killiney—*71.* Glasnevin '54 (Orr)—*35.*
23 Mullingar 1908—HWL.
26 L. Carra 1910—Tetley.
27 Louisburgh 1910—HWL.
28 Mullaghmore 1910—Tetley.
30 Dowra 1912—Tetley.
31 Carlingford 1908—Tetley.
33 Portora 1908—Tetley.
34 Bridge End—Hunter *25.*
36 Near Roughan Park 1907—HWL. Pomeroy '75 (Stewart)—*79.*
37 Ardmore Glebe '85—HWL.
38 Drumbo—Stewart *69.* Drumcro '86 (Waddell)—*120.*
39 Leslie Hill, Ballymoney (R. Brown)—*74, 75.* Colin Glen 1905—HWL.

var. **aquaticum** *Davies.*

38 Magheralin—Waddell *114.*

Orthotrichum cupulatum *Hoffm.*

4 Near Cork—Moore *57.*
8 Foynes—Stewart *66.* Thornfield's Wood—Miss Armitage *1.*
16 Near Galway—Moore *57.*
21 The Scalp '54 (Orr)—*120.*
26 Near L. Mask 1910—Tetley.
28 Benbulbin—Moore *57.*
35 Melmore 1910—HWL.
38 Lenaderg—Davies *14.* Loughbrickland 1905—HWL.
39 Fairhead—Moore *57.* Glenarm—Dixon *17.*
40 Moore *57.*

var. **nudum** *Dicks.*

8 Anacotty—Miss Armitage *1.*
9 *7.*
26 L. Carra 1910—Tetley.
33 Devenish Island 1907—Tetley.
39 Orange Grove '13—Templeton *74, 75.*
40 Dungiven—Stewart *69.*

Orthotrichum anomalum *Hedw.*

2 Cromagloun 1905—HWL.
4 Ballinlough (Carroll)—*61.*
9 Inishmore '91 (Stewart)—*79.*
10 Near Roscrea 1911—HWL.
13 Borris 1911—Tetley.
14 Mountmellick 1912—Tetley.

16 Connemara '41 (MaCalla)—*85.*
21 Killakee '72 (Moore)—*120.* Sallygap (Orr)—*83.*
23 Mullingar 1908—HWL.
25 South of Boyle 1910—Tetley.
28 Benbulben (Moore)—*120.*
30 Swanlinbar 1910—Tetley.
31 Greenore 1908—Tetley. 1912—HWL.
32 Drumsnatt 1910—Bingham.
34 Grianan Hill—Hunter *25.*
35 Slieve League 1902—HWL.
36 Near Cookstown (Stewart)—*79.* Ranfurley Park 1909—Porter.
37 Admiral Jones—*120.*
39 (Moore)—*120.* Island Magee (HWL) *69.*
40 Bennedy Glen (Moore)—*69.* Sperrin Mts. (Stewart)—*79.*

var. **cylindricum** *Schpr.*

4 Ballinlough—Power *61.*
8 Knock Sentry—Miss Armitage *1.*
9 Inishmore '91—Stewart *68.* Ballyvaughan 1907—O'Kelly.
10 Dromineer 1909—Mrs. H. Bennis.
11 Near Kilkenny 1908—Phillips.
15 Portumna 1907—Phillips.
16 Ashford 1907—Kane. Connemara—(Moore)—*120.*
18 Geashill 1907—HWL.
19 *120.*
20 Moore *58.*
21 Sallygap (Orr)—*57.* Killakee—Hart *20.*
26 Ballinrobe 1910—Tetley.
27 Achill I.—HWL.
29 Largydonnell 1909—Tetley.
31 Roche Castle '87—HWL.
33 Near Enniskillen 1907—Tetley.
34 *7.*
35 Letterkenny — Dixon *17.* Slieve League—HWL *32.*
36 Desertcreat '84—HWL. Roughan Park 1907—HWL.
37 (Jones)—*57.*
38 Warrenpoint (Waddell)—*69.*
39 Belfast Mts.—Templeton *74, 75.* Maghabery '82 — HWL. Island Magee '84—HWL.
40 Bennedy Glen (Moore)—*69.*

Orthotrichum rivulare *Turn.*

1 Caragh Lake—Carrington *4.*
2 Killarney '55 (Orr)—*35.*
4 Taylor *71.*
6 Coomshigaun 1902—HWL.
20 Dargle—Moore *58.*
21 Balbriggan (Scott)—*73.*
31 Carlingford 1908—HWL.
38 Drumcro '85, Saintfield (Waddell)—*120.* Newcastle—HWL *28.*
39 Derryaghy (Templeton)—*73.* Ram's Island (Davies)—*70.*

Orthotrichum Sprucei *Mont.*

2 Ross's Bay '61 (Carrington)—*2.*
6 Lismore '77 (Moore)—*120.*
38 Near Drumbridge '78 (Davies)—*69.*
39 Drumbridge '79 (Stewart)—*120.* '84—HWL.

The river Lagan divides Down and Antrim at Drumbridge, and this moss has been found in both divisions near the bridge.

Orthotrichum stramineum *Hornsch.*

1 Ross Bay—Carrington *4.*
2 Muckross (Carrington)—*57.*
10 Near Roscrea 1911—HWL.
11 Graiguenamanagh 1907—Phillips.
12 Strokestown 1907—Phillips.
20 Seven Churches—Moore *57.*
38 Tollymore Park '85 (Waddell)—*69.*
39 Fairhead (Moore)—*70.*

Orthotrichum Schimperi *Hamm.*

3 Bantry Bay '64 (Moore)—*120.*
19 Kilcock (R. Brown)—*2.*
21 Near Dublin (Scott)—*74, 75.* On the cromlech in Zoological Gardens, Phœnix Park 1911—HWL.
37 (Stewart)—*79.*

Orthotrichum pallens *Bruch.*

4 Near Cork (Carroll)—*57.*
16 Near Galway—Moore *57.*
20 Westaston—Moore *57.* Seven Churches—*84.*
21 Baldoyle '71 (Moore)—*120.*

Orthotrichum tenellum *Bruch.*

2 Muckross (Carrington)—*57.*
3 Bantry (Miss Hutchins)—*81.*
5 Rostellan (Carroll)—*2.*
8 Tervoe (Carroll)—*57.*
11 Gowran Demesne 1910—HWL.
20 Westaston—Moore *57.*
21 Leixlip '74—Moore *57.*
Ballinascorney Glen '56 (Orr)—*50.*
38 Gilhall Demesne—Stewart *69.*
Moyallan 1901—Davies.

Orthotrichum pulchellum *Brunt.*

2 Muckross '85 (Holt)—*120.*
4 Blarney (Murray)—*57.* Coachford—*84.*
5 Fermoy—Carroll *5.*
8 Thornfield's Wood—Miss Armitage *1.*
9 7.
14 Tonet Bridge 1912—Tetley.
19 Ballitore '56—Davies *8.*
21 Hook. and Tayl. *23.* Ballinascorney Glen—Moore *58.*
25 Rockingham—Moore *57.*
33 Near Enniskillen 1910—Tetley.
37 Bridge End Glen—Hunter *25.*
35 Kilmacrennan—Dixon *17.* Glenalla '85 (Holt)—*2.*
36 Pomeroy '98 (Stewart)—*2.*
37 Kinnego '86 (Waddell)—*120.*
Ardmore Glebe '82—HWL.
38 Hillsborough Demesne '83—HWL.
Ravernet (Davies)—*70.*
39 Colin Glen '68 (Stewart)—*2.*
Parkmore (HWL)—*70.*
40 Faughan—Moore *57.*

Weissia Americana (*P. Beauv.*) *Ldbg.*

1 Brandon '97—HWL.
2 *71.* Mangerton '93—M'Ardle.
3 Bantry (Miss Hutchins)—*22.*
4 Carrickadrohed '51—Carroll *6.*
5 *7.*
6 L. Coomshigaun 1902—HWL.
7 L. Dineen 1902—HWL.
16 Connemara—Moore *57.*
20 Luggielaw—Moore *58.* '51 (Orr) —*35.*
21 Rochester Hill—*85.*
27 Achill I. 1901—HWL.
32 Rossmore 1912—HWL.
34 Portaw Hill—Hunter *25.*
35 Poisoned Glen—Dixon *17.*
37 (Admiral Jones)—*57.*
38 Mournes—Templeton *74, 75.*
40 Kilrea 1913—Houston.

Weissia coarctata (*P. B.*) *Ldbg.*

1 Glena Killarney '61 (Carrington)—*4.*
2 Torc Wood '61 (Carrington)—*4.*

Weissia Drummondii (*Hook. Grev.*) *Ldbg.*

1 Very frequent—Carrington *4.*
2 Torc Mt.—*81.* Killarney (Moore)—*2.*
6 Gurtane Wood (Miss S. Grubb)—*120.*
7 Near Clonmel—Carroll *5.*
20 Powerscourt '58—Moore *57.*
Luggielaw (Moore)—*2.*
33 Correll Glen 1908—Tetley.
39 Colin Glen (Stewart)—*35.*

Weissia Bruchii (*Hornsch.*) *Ldbg.*

1 *7.*
2 Cromagloun (Moore)—*120.*
Torc Mt. '55 (Orr)—*35.*
4 Carroll *5.*
5 Kilmeney '51—Carroll *6.*
7 Near Clonmel—Moore *57.*
8 Rinekirk—Stewart *66.* Miss Armitage *1.*
14 (Moore)—*120.*
16 Connemara (Moore)—*120.*
20 L. Bray (Moore)—*120.*
27 Eriff '77 (Stewart)—*79.*
28 Benbulben '71 (Moore)—*120.*
34 Portaw Glen—Hunter *25.*

35 Glenbeagh '88 (Stewart)—*35.* Rathmullen '86 (Hutton)—*35.*
36 Gortin '86 (Stewart)—*79.*
38 Near Downpatrick—Stewart *69.* Rostrevor Wood—HWL *28.*
39 (Moore)—*120.* Glendun—*70.*
40 Castledawson Wood—Stewart *69.*

Weissia ulophylla *Ehrh.*

In all Divisions, except 7, 10, 15, 22, 23, 24, 29.

var. **intermedia** (*Schpr.*).

1 *7.*
27 Nephin—HWL.
36 Loughrey Demesne '84—HWL.
38 Tollymore Park—HWL *28.*
39 (Moore)—*120.*

var. **crispula** (*Bruch.*) *Hamm.*

1 *7.*
2 Killarney (Moore)—*57.* Ross I., 1906—HWL.
3 Glengarriff 1912—HWL.
5 Fermoy '51—Carroll *6.*
13 Browne's Hill '67 (R. C. Browne)—*120.*
14 Ballyfin Woods—Moore *57.*
15 *7.*
16 Kylemore—Moore *57.*
18 Geashill 1907—HWL.
23 Mullingar 1909—HWL.
27 Achill I.—HWL.
28 Hazelwood 1904—M'Ardle *41.*
29 Truskmore 1909—Tetley.
32 1910—Bingham.
33 Rossinuremore 1905—HWL.
34 *7.*
35 Cratlagh Wood 1910—HWL.
36 Roughan Park 1907—HWL.
37 *7.*
38 Near Downpatrick — Stewart *69.* Slievenamaddy 1912—HWL.
39 Colin Glen—Stewart *69.*
40 Lignapeiste Glen—Stewart *69.*

Weissia vittata (*Mitt.*) *Braithw.*

1 O'Sullivan's Cascade—*2.*
2 Muckross—Carrington *4.* Torc Glen (Schimper, Wilson, and Moore)—*54.*
14 *84.*
18 Slieve Bloom 1912—Tetley.
26 Near Lough Mask 1910—Tetley.
28 Glencar '70—Moore *57.*
29 (Moore '73)—*120.*
33 Correll Glen 1908—Tetley.
35 Glenbeigh—Moore *57.*
39 (Moore)—*120.* Glenshesk '80—Stewart *70.* Glenariff '89 (Stewart)—*2.*

Weissia phyllantha (*Brid.*) *Ldbg.*

In all Divisions, except 4, 5, 15.

Splachnum ampullaceum *L.*

1 *7.*
2 Near Loo Bridge 1906—Jones.
9 Cappanawalla Mt. (T. Johnson)—*40.*
16 L. Corrib shore (T. Johnson)—*40.* Carn Seafin '95—M'Ardle.
17 *7.*
19 Rathangan (Moore)—*120.*
20 (Moore)—*120.*
21 Kelly's Glen '51 (Orr)—*120.*
22 Bogs (Stewart)—*79.*
28 Benbulben '71 (Moore)—*120.* Collooney 1904—M'Ardle *41.*
33 Correll Glen 1907—Tetley.
34 Portaw Glen—Hunter *25.*
35 Knockcurin (R. Brown)—*74, 75.* Killybegs 1911—Cheetham *94.*
38 Near Donaghadee '01 (R. Brown)—*74, 75.* Deer's Meadow—HWL *28.* Fair Head—Templeton *74, 75.* White Mt. 1901—Davies *12.*

Splachnum pedunculatum (*Huds.*) *Ldbg.*

28 Benbulben (Stewart)—*79.*

var. **sphaericum** *Swartz.*

1 Looscanough Lake—Carrington *4.*
20 Moore *58.*
21 Moore *58.* Three Rock Mt. '69 (Hutton)—*35.*
26 Slieve Gamph 1910—Tetley.
29 Glencar Mt. 1909—Tetley.
30 Cuilcagh 1909—Tetley.
35 Poisoned Glen—Dixon *17.*
39 Donaghadee Bog 1797 (Templeton)—*69.* Slieve Bingian—HWL *28.*
39 Belfast Mts.—Templeton *74, 75.* Slievenanee '91—HWL.
40 Comber Clady—Templeton *74, 75.* Benbradagh '84 (Stewart)—79.

Tetraplodon bryoides (*Zoega*) *Ldbg.*

1 Brandon—Moore *57.*
2 Killarney—*84.*
3 Bantry (Miss Hutchins)—*71.*
14 Slieve Bloom 1912—Tetley.
16 Maam Turk—Wade *80.*
20 Lugnaquilla—Moore *57.*
27 Achill I. 1903—HWL.
30 Cuilcagh 1910—Tetley.
35 Muckish '15—Templeton *74, 75.* Dooish Mt.—Hart *20.*
38 Slieve Donard '60—*69.* Crocnafeola '83—HWL.
39 Near Belfast—Templeton *74, 75.* Glenarriff (Brenan)—*70.*

Tayloria tenuis (*Dicks.*) *Schpr.*

40 Benbradagh '68 and '84—Stewart *64.*

Oedipodium Griffithii (*Dicks.*) *Schwaeg.*

1 Brandon—Taylor *71.*
35 Errigal—Dixon *17.*

Discelium nudum (*Dicks.*, *Brid.*

39 [Near Belfast (R. Brown) (*Grimmia nuda* E. Bot. 1421)—*74, 75.*]

Amblyodon dealbatus (*Dicks.*) *P. B.*

21 Between Malahide and Portrane—Moore *57.*
31 Greenore 1908—Davies *118a.*
32 Eskmore 1910—Bingham.
34 Dunree (R. Brown)—*74, 75.*
35 Melmore 1910—HWL *94.*
38 Near Blaris '03—Templeton *74, 75.*
39 Near Ballymoney '37 (Moore)—*120.*

Physcomitrella patens (*Hedw.*) *B. S.*

4 Bailincollig Castle—Carroll *5.*
21 Finglas '51 (Orr)—*120.*
39 Near Belfast 1800—Templeton *74, 75.* Bog Meadows Belfast '29—Drummond *18.*

Physcomitrium pyriforme (*L.*) *Brid.*

3 *7.*
4 Ballyphenane '45—Power *61.* Shrone Hill 1907—Miss Martin.
5 Near Fermoy—*84.*
8 *85.*
11 Near Kilkenny 1907—Phillips. Near Bollerboy 1911—Tetley.
18 Geashill '94—C. D. Russell.
20 The Murrough—Moore *57.*
21 Glasnevin '58 (Orr)—*120.* Howth—*84.*
28 Collooney 1904—M'Ardle *41.*
34 Near Bridge End—Hunter *25.*
36 Dungannon 1909—Porter.
37 Ardmore Glebe—HWL.
38 Warrenpoint '82 (Waddell)—*120.* Loughbrickland—HWL *28.*
39 Cranmore near Belfast (Templeton)—*69.* Kilroot—Stewart *69.*
40 Magilligan 1904—HWL.

Funaria obtusa (*Dicks.*) *Ldbg.*

1 Dingle '60 (Moore)—*120.* Coomanard '98—HWL.
2 Torc Mtn.—Carrington *4.*
4 *7.*
5 *7.*

7 Galtee More '55 (Moore)—*120.*
9 Inishmore '91—Stewart *68.*
16 Connemara—Moore *57.*
20 Wicklow Mts.—Templeton *74, 75.*
21 Kelly's Glen '51 (Orr)—*120.*
27 Achill I. 1901—HWL.
31 Anglesey Mt.—HWL *28.*
34 Near Letterkenny '15—Templeton *74, 75.* Buncrana—Hunter *25.*
35 Rathmullen '65 (Hutton)—*35.* Melmore 1910—HWL.
37 Carriffkeeny '98—HWL.
38 Mourne Mts.—Templeton *74, 75.* Slieve Donard—HWL *28.*
39 Giant's Causeway '36 (Moore)—*120.* Glendun (Brenan)—*35.*

Funaria fascicularis (*Dicks.*) *Schpr.*

1 Dunkerron '20—Taylor. Brandon 1900—HWL.
2 Horse's Glen 1906—Jones.
4 Near Cork (Carroll)—*57.* Douglas 1907—Miss Peyton.
5 Fermoy—Carroll *5.*
8 Ashbourne—*85.*
14 Slieve Bloom 1912—Tetley.
16 Carn Seafin '95—M'Ardle *40.*
21 Dalkey '51—Orr.
27 Pontoon 1903—HWL. Achill 1909—HWL.
31 Carlingford Mt. 1900—HWL.
36 Near Pomeroy '75 (Stewart)—*79.*
38 Ballymaghan—Stewart *69.* Blaris 1900—Davies *10.*
39 The Glens—Moore *57.* Blackhead—Stewart *69.*
40 Near Comber—Templeton *74, 75.*

Funaria attenuata (*Dicks.*) *Ldbg.*

1 Brandon 1900—M'Ardle.
2 Killarney '29—Wilson. Loughanscaul '98—HWL.
3 Bantry (Carroll)—*79.* Glengarriff '45—Woodward *101.*
4 Near Cork (Murray)—*61.*
5 Drumbullogue (Murray)—*61.*
7 L. Muskry 1902—HWL.
9 Carn Seafin—M'Ardle *40.*
16 (Moore)—*120.* Roundstone 1911—Cheetham *94.*
20 Moore *57.* Ovoca '64 (Hutton)—*35.*
21 Kelly's Glen '51 (Orr)—*120.*
27 Achill I. 1901—HWL.
31 Anglesey Mt.—HWL *28.*
33 Correll Glen 1905—M'Ardle *45.*
34 Hunter *25.* Buncrana '92 (Mrs. Leebody)—*79.*
35 Horn Head—Dixon *17.* Slieve League—HWL *32.*
38 Near Bangor (Templeton)—*69.* Slieve Donard—HWL *28.*
39 Agnew's Hill '04—Templeton *74, 75.* Sallagh Braes (Waddell)—*69.*
40 Faughan river '08—Templeton *74, 75.* Benbradagh '94 (Mrs. Leebody)—*79.*

Funaria calcarea *Wahlenb.*

4 Blarney—Drummond.
5 Glanworth '52 (Carroll)—*79.*
39 Cave Hill '47 (Orr)—*120.* Carrick-a-rede—Dixon *17.*
40 Magilligan 1904—HWL.

Funaria microstoma *B. S.*

5 Fermoy—*84.*

Funaria hygrometrica (*L.*) *Sibth.*

In all Divisions, except 3, 5, 6, 10, 12, 15, 16, 20, 22, 23, 24, 25.

var. **calvescens** (*Schwg.*) *Schpr.*

37 Ardmore Glebe '82—HWL.
38 Magheralin—Waddell.

Leptobryum pyriforme (*L.*) *Wils.*

3 Blarney Castle—Carroll *5.*
4 Dunscombe's Wood—Power *61.*
7 Near the Spa, Clonmel (Miss Taylor)—*57.*

21 Glasnevin '59 (Orr)—*120.*
31 Bank of Boyne above Drogheda—Moore *57.*
33 Portora 1909—Tetley.
34 Bulbein (R. Brown)—*74, 75.*
38 Banbridge (HWL)—*69*
39 By canal near Lisburn—Davies *14.*
40 Magilligan sandhills 1913—Houston.

Pohlia acuminata *Hsch.*

1 Brandon '28 (Wilson)—*2.*
20 Toole's Rocks—Moore *57.*
38 Slieve Donard—HWL *28.*

Pohlia polymorpha *Hsch.*

1 Connor Hill Pass '73—Moore *57.*
7 Galteemore '55 (Moore)—*120.*
21 Templeogue '53 (Orr)—*35.*

Pohlia elongata *Hedw.*

1 Brandon—Moore *57.*
7 Galteemore—Moore *57.*
12 Stokestown 1907—Phillips.
20 Glenmalure (Stokes)—*74, 75.*
31 Anglesey Mt. (Waddell)—*28.*
34 Bulbein (R. Brown)—*74, 75.*
36 *7.*
38 Slievenabrock '83 (HWL)—*120.* Slieve Donard '84—HWL.
39 *84.*
40 Sawel '09—Templeton *74, 75.*

Pohlia cruda (*L.*) *Ldbg.*

1 Brandon—Moore *57.*
20 Seven Churches—Moore *58.*
21 Kelly's Glen—Moore *58.*
34 Bulbein (R. Brown)—*74, 75.*
38 Slieve Bingian '09—Templeton *74, 75.* Slieve Donard '84—HWL.
39 Carnlough Glen (Moore)—*69.* Sallagh Braes (Waddell)—*69.*

Pohlia nutans (*Schreb.*) *Ldbg.*

In all Divisions, except 4, 7, 13, 15, 17. 19, 22, 23, 24, 26, 27, 28.

var. **longiseta** *Brid.*

30 Derrywinny Bog 1911—Waddell.
34 Bonnemaine Bog—Hunter *25.*
37 Carriffkeeny '98—HWL.
38 Cotton Moss (Stewart)—*2.*
40 Mullaghcarbetagh Mts. '88 (Stewart)—*79.*

var. **alpina** *Ldbg.*

13 Mount Leinster 1913—R. Ll. Praeger.

Pohlia carnea (*L.*) *Ldbg.*

4 Near Cork (Drummond)—*61.*
5 Queenstown—*84.*
8 1905—Waddell.
9 1905—Waddell.
20 Lough Bray '57 (Orr)—*120.*
21 Moore *58.* Finglas '52 (Orr)—*35.*
27 Waddell.
33 Correll Glen 1905—M'Ardle *45.*
38 Cregagh Glen—Stewart *67.* Maralin '84—HWL.
39 Belfast Deer Park '01—Templeton *74, 75.* Colin Glen—Stewart *69.*
40 Waddell.

Pohlia annotina (*L.*) *Ldbg.*

11 Mt. Brandon 1911—Tetley.
12 Blackstairs Mt. 1911—Tetley.
20 Seven Churches '65—Moore *57.*
21 Killiney Bay '51—Templeton *74, 75.* Portmarnock—Moore *57.*
38 Slieve Donard '85 (HWL)—*121.*
39 Kerr's Glen—Templeton *74, 75.* Derryaghy—Davies *10.*

Pohlia proligera (*Bryhn*) *Ldbg.*

38 Bryansford 1908 (Waddell)—*59.*

Pohlia albicans (*Wahlenb.*) *Ldbg.*

1 Connor Hill Pass—Moore *57.*
8 Askeaton 1905—Waddell.
12 Poulmounty 1907—Phillips.
14 Slieve Bloom 1912—Tetley.
18 Slieve Bloom 1912—Tetley.
20 Seven Churches—Moore *57.*
21 Kelly's Glen—Moore *57.*
31 Anglesey Mt. (Waddell)—*28.*
32 Drumreaske 1907—Kane. Eskmore 1910—Bingham.
34 Hunter *25.*
35 Melmore 1910—HWL.
37 Slieve Gullion—HWL *28.*
38 Banbridge—Stewart *69.* Deer's Meadow '86 (HWL)—*120.*
39 Near Cushendall—Moore *57.* Parkmore '84—HWL.
40 White Mt.—Stewart *69.* Magilligan '89—HWL.

Epipterygium Tozeri (*Grev.*) *Ldbg.*

2 Killarney '75 (Moore)—*120.*
4 Near Cork '64—Moore *57.* Near Queen's College '40 (Alexander)—*81.*
39 Derryaghy—Davies *12.*

Plagiobryum Zierii (*Dicks.*) *Ldbg.*

1 Brandon—Taylor *71.* Connor Hill Pass 1906—HWL.
34 Innishone (R. Brown)—*74, 75.*
39 Near Cushendun—Moore *57.* Sallagh Braes '97—HWL.
40 Clontygearagh near Dungiven (Moore)—*69.*

Bryum filiforme *Dicks.*

1 Knockavohila (Taylor)—*18.* Connor Hill Pass 1906—HWL.
2 Torc Waterfall (Orr)—*35.*
3 Glengarriff '97 (HWL)—*120.*
6 L. Coomshigaun 1902—HWL.
7 L. Dineen 1902—HWL.
16 '72 (Moore)—*120.*
20 L. Bray—Moore *58.*
27 Bengorm 1901 — HWL. Achill I. 1909—HWL.
28 Strandhill 1904—M'Ardle *41.*
30 Swanlinbar R. waterfall 1911—Tetley.
31 Omeath Glen—HWL *28.*
34 Hunter *25.*
35 Poisoned Glen—Dixon *17.*
37 Carriffkeeny '98—HWL.
38 Tollymore Park '08—Templeton *74, 75.* Slieve Donard—HWL *28.*
39 Near Cushendall—Templeton *74, 75.* Sallagh Braes (HWL and Waddell)—*69.*
40 Ness Glen—Templeton *74, 75.* Garvagh 1901 (Stewart)—*79.*

Bryum concinnatum *Spruce.*

1 Knockavohila (Taylor)—*2.*
28 Seafin '92—Waddell *78.* Truskmore 1910—Tetley.
34 (Stewart)—*79.*
39 Sallagh Braes (HWL and Waddell)—*69.*

Bryum inclinatum (*S. W.*) *Bland.*

2 '40 (Taylor)—*120.*
3 Near Cork—Carroll *5.*
4 *7.*
5 Fermoy '51 (Chandlee)—*6.*
6 L. Bolagh 1902—HWL.
8 *7.*
9 *7.*
11 Blancheville 1910—HWL.
15 *7.*
16 Castle Taylor—Moore *57.*
19 Newbliss '64 (Hutton)—*35.*
21 Near Dublin '56 (Orr)—*57.* Santry 1908—M'Ardle.
25 W. of L. Key 1910—Tetley.
26 By Glendaduff stream 1910—Tetley.
27 Achill I. 1909—HWL.
30 Near Swanlinbar 1910—Tetley.
33 Correll Glen 1905—M'Ardle *45.*
35 Letterkenny—Dixon *17.*
37 Brackagh bog 1909—Davies.
38 Portavo—Stewart *69.* Slieve Donard—HWL *28.*
40 Magilligan 1900—HWL.

Bryum pendulum (*Hsch.*) *Schpr.*

1 *7.*
2 Killarney '73 (Moore)—*120.*
4. *7.*
5 Fermoy—Carroll *5.*
7 Clonmel—Moore *57.*
12 Great Saltee I. 1913—HWL *102.*
18 Geashill—C. D. Russell.
19 *120.*
21 Baldoyle—Moore *57.*
29 L. Allan shore '83 (Stewart)—*79.*
33 Portora narrows 1907—Tetley.
38 Benderg Bay 1901 (Stewart)—*79.* Kircubbin 1912—Glover.
39 Near Lisburn—Stewart *69.*
40 Near Toome—Stewart *69.*

Bryum Warneum *Bland.*

21 North Bull '57 (Orr)—*50.* Portmarnock—*95.*
39 Grugan's Glen '14—Templeton *74, 75.*

Bryum cernuum (*Sw.*) *Ldbg.*

2 Ross I.—*84.*
7 Near Cahir (Carroll)—*57.*
18 Geashill—C. D. Russell.
19 *120.*
21 Dublin Mts. (Orr)—*57.* Phœnix Park '56 (Orr)—*50.*
32 1910—Bingham.
33 Near Monea 1905—HWL.
35 Melmore 1910—HWL.
40 Magilligan 1904—HWL.

Bryum Marratii *Wils.*

21 North Bull '73 (Lindberg and Moore) —*58.*

Bryum calophyllum *R. Br.*

21 Malahide '60 (Moore)—*120.* North Bull '60 (Orr)—*120.*

Bryum fallax *Milde.*

20 Enniskerry '73 (Lindberg)—*35.*

Bryum intermedium *Brid.*

4 Near Cork—Carroll *5.*
12 Great Saltee I. 1913—HWL *102.*
21 Malahide '50 (Orr)—*35.* North Bull '64 (Orr)—*120.*
34 Bridge End—Hunter *25.*
37 Maghery '70 (Stewart)—*79.*
38 Ballymaghan—Stewart *69.*
39 L. Neagh shore—Stewart *69.*

Bryum bimum *Schreb.*

1 Brandon 1900—HWL.
2 Killarney '73 (Orr)—*120.*
4 Near Cork—Carroll *5.*
5 *7.*
8 Thornfield's Bog—Miss Armitage *1.*
13 *7.*
14 Slieve Margy '67 (R. C. Browne)—*120.*
18 Geashill 1907—HWL.
20 Mts.—Templeton *74, 75.* Powerscourt '64 (Hutton)—*35.*
21 Malahide '64 (Orr)—*120.*
27 Achill 1909—HWL.
28 Benbulben '71 (Moore)—*120.*
30 '61 (Moore)—*120.*
31 (Waddell)—*120.* Anglesey Mt.—HWL *28.*
33 *7.*
34 *7.*
35 Malinmore (J. B. Parker)—*59.*
37 *7.*
38 Mourne Mts. '05—Templeton *74, 75.* Slieve Donard—HWL *28.*
39 Slemish—Templeton *74, 75.* Corby Rock '61—HWL.
40 *7.*

Bryum affine (*Bruch.*) *Ldbg.*

3 Muckross '72 (Hunt)—*120.*

Bryum torquescens *B. S.*

2 Muckross '72 (Hunt)—*120.*
5 Mallow '85 (Holt)—*2.*

8 Foynes—Stewart *66.*
16 Near Cong—Moore *57.*
21 Sheep Hill Demesne gate (Orr)—*57.* Abbotstown '55 (Orr)—*35.*

Bryum pallescens *Schleich.*

1 Brandon—Moore *57.*
7 Near Clonmel (Sidebotham)—*2.*
21 Three Rock Mt. '54 (Orr)—*120.*
28 *7.*
35 Melmore 1910—HWL.
38 Scrabo Hill 1908—HWL.
39 Parkmore '89—HWL.

Bryum caespiticium *L.*

In all Divisions, except 1, 3, 10, 11, 14, 16, 17, 22, 24, 25, 26, 29.

Bryum argenteum *L.*

2 Killarney 1906—Jones.
3 Power *61.*
4 Evergreen (Carroll)—*61.*
5 Near Fermoy—*84.*
6 Near Carrick-on-Suir 1902—HWL.
8 Annacotty—Miss Armitage *1.* 1907, Dr. Fogerty.
9 *7.*
10 Dromineer 1907—Miss H. Bennis.
11 Near Kilkenny 1907 — Phillips. Paulstown 1911—Tetley.
12 Strokestown 1907—Phillips.
13 Browne's Hill '67 (R. C. Browne)—*120.* Tinnahinch 1907—Phillips.
14 Killeshin 1912—Crawford.
16 Roundstone 1911—Cheetham *94.*
18 Birr 1907—Miss Hemphill.
19 *120.*
20 Powerscourt Waterfall (Stokes)—*73.*
21 Scott—*73.* Glasnevin '54 (Orr)—*35.*
27 Achill I. 1901—HWL.
31 Greenore 1908 — Tetley. Clogher Head 1912—HWL.
34 Hunter *25.*
35 Carrick 1902—HWL. Melmore 1910—HWL.
36 Cappagh 1912—Porter.
37 '82 (Waddell)—*120.* Ardmore Glebe '82—HWL.
38 Donard Demesne—HWL *28.* Aghaderg Glebe '86—HWL.
39 Belfast—Waddell.
40 *7.*

var. **majus** *B. S.*

20 Glendalough '57 (Orr)—*120.*
21 Glendhu '52 (Orr)—*35.*
39 Near Antrim—Stewart *69.*

var. **lanatum** (*P. B.*).

1 Brandon '75 (M'Ardle)—*120.*
2 Killarney 1906—Jones.
34 Bridge End—Hunter *25.*
39 Blackhead—Stewart *69.*

Bryum bicolor (*Dicks.*).

1 Kenmare—*84.*
2 Ross I.—*84.*
4 (Carroll)—*57.*
5 *7.*
8 *7.*
9 Ballyvaughan 1907—O'Kelly.
19 Curragh '64 (Hutton)—*35.*
20 Seven Churches—Moore *57.*
21 Howth—Moore *57.* Finglas '51 (Orr)—*35.*
34 Buncrana—Hunter *25.*
38 Dundonald — Drummond *18.* Magheralin (Waddell)—*69.*
39 Kilcoreg quarry—Stewart *69.* Lisburn '71—Stewart.

Bryum erythrocarpum *Schwg.*

2 Killarney '73 (Moore)—*120.*
3 Shrone Hill 1907—Miss Martin.
4 Near Cork—Carroll *5.*
5 Fermoy—Carroll *5.*
12 Great Saltee I. 1913—HWL *102.*
19 Curragh '64 (Hutton)—*35.*
20 '70 (Moore)—*120.*
21 Howth '54 (Orr)—*50.*

25 Mote Park '97 (T. Johnson)—*120.*
27 Pontoon 1903—HWL.
36 Dungannon 1909—Porter.
37 Brackagh Bog 1909—Davies.
38 *7.*
39 Fairy Well, Lisburn — Davies *14.* Glendun '91—Brenan.

Bryum murale *Wils.*

2 Muckross '85 (Stewart)—*79.*
3 Ballylickey 1912—HWL.
8 Foynes—Stewart *66.* Thornfield's Bog—Miss Armitage *1.*
10 Roscrea 1911—HWL.
12 Great Saltee I. 1903—HWL *102.*
21 Killakee '52 (Orr)—*120.* Lambay—M'Ardle *44.*
23 Mullingar 1908—HWL.
29 L. Allen shore '83 (Stewart)—*79.*
30 Dowra 1912—Tetley.
31 Greenore 1912—HWL.
32 Drumreaske 1907—Kane.
33 Tempo Manor 1907—Langham.
35 Slieve League—HWL *32.*
38 Moira '82 (HWL)—*69.* Gilford 1904—Davies *12.*
39 Lambeg—Davies *10.*

Bryum rubens *Mitt.*

18 Geashill '95—C. D. Russell.
27 Achill Island 1909—HWL.
35 Bundoran 1913—Porter.
39 Longstone at Lisburn—Davies *12.*

Bryum Mildei *Jur.*

2 Horse's Glen 1906—Jones.
21 Kilrock quarry Howth '59 (Orr)—*2.*
39 Slemish (Moore)—*81.*

Bryum alpinum *Huds.*

1 Connor Hill Pass '97—HWL.
2 Mangerton '93—M'Ardle.
3 Brandon (Alexander) — *61.* Glengarriff—*84.*
4 Inniscarra '57—Carroll *6.*
6 Commeragh Mts. 1902—HWL.
7 L. Muskry 1902—HWL. Knockmealdown 1902—M'Ardle.
9 1907—Dr. G. Fogerty.
13 Tinnahinch 1907—Phillips.
14 Slieve Bloom 1912—Tetley.
16 L. Corrib shore 1907—M'Ardle *46.*
20 Luggielaw—Templeton *74, 75.* Seven Churches (Nuttall)—*85.*
21 Dublin Mts.—*84.*
25 Curlew Hills 1910—Tetley.
26 Near Foxford 1910—Tetley.
27 Pontoon 1901—HWL. Achill 1909—HWL.
30 Cuilcagh 1909—Tetley.
31 Carlingford Mt. '82—HWL. 1908—Tetley.
34 L. Swilly shore—Hunter *25.*
35 Doochary Bridge—Dixon *17.* Slieve League—HWL *32.*
37 *7.*
38 Scrabo '02—Templeton *74, 75.* Slieve Donard—HWL *28.*
39 Fairhead—Moore *57.* Carnlough 1910—HWL.
40 Craignashore — Templeton *74, 75.* Slievegallion—Stewart *69.*

Bryum pallens *Sw.*

1 *7.*
4 Kinsale—*84.*
6 L. Coomshigaun 1902—HWL.
7 L. Muskry 1902—HWL.
9 Ballyvaughan 1907—Kane.
11 Blancheville 1910—HWL.
13 Borris 1910—HWL.
16 '72 (Moore)—*120.* Leenane 1901—HWL.
18 Geashill '93—C. D. Russell.
19 Ballitore—Davies *8.* Poulaphuca '56—Davies *8.*
20 Moore *57.* Dunlavin '56—Davies *8.*
21 Kelly's Glen—Moore *57.*
23 Mullingar 1909—HWL.
25 Near Athlone 1910—HWL.
27 (Moore)—*120.* Achill 1909—HWL.
29 Truskmore 1909—Tetley.

30 Killykeen 1911—HWL.
31 Clermont Mt.—HWL *28.*
32 1910—Bingham.
33 Castle Archdall 1907—Kane. Portora Narrows 1908—Tetley.
34 Buncrana Waterworks—Hunter *25.*
35 Slieve League—HWL *32.* Rosnowlagh 1908—W. F. Johnson.
36 Oughtoragor '88 (Stewart)—*79.* Dungannon 1908—Bingham.
37 *7.*
38 '84 (Waddell)—*120.* Deer's Meadow (HWL)—*69.*
39 '61 Glenballyemon '61 (Moore)—*120.* Parkmore '89—HWL.
40 White Mt.—Stewart *69.* Magilligan 1904—HWL.

Bryum Duvalii *Voit.*

6 Near Waterford (Madden)—*57.*

Bryum turbinatum (*Hedw.*) *Schwg.*

21 Near Dublin—*71.*
39 Colin Glen '04 (*Mnium turbinatum* Hedw. Musc. frond. iii, 22, t. 8, 1792)—Templeton *74, 75.* (Moore) —*120.*

Bryum ventricosum *Dicks.*

In all Divisions, except 3, 11, 12, 13, 15, 17, 22, 23, 24, 25, 26, 29.

Bryum capillare *L.*

In all Divisions, except 17.

var. **macrocarpum** *Hueb.*

2 Near Killarney town (Moore)—*2.*
19 Curragh '64 (Hutton)—*35.*

var. **obconicum** *Hueb.*

2 Muckross '67 (Hunt)—*2.* Torc Waterfall '73 (Moore)—*120.*
20 *84.*
21 Croagh Mt. '54 (Orr)—*120.*
33 L. Erne shore 1905—M'Ardle *45*
39 Ballymacash—Davies *8.*

Bryum Donii *Grev.*

3 By River Lee above the Jail—Carroll *5.*
20 Glendalough '61 (Orr)—*120.*
21 Howth '77—Moore *58.*

Bryum proliferum (*L.*) *Sibth.*

1 *7.*
2 Blackwater (Taylor)—*57.*
4 Blarney (Drummond)—*61.*
5 Near Fermoy—*84.*
15 *7.*
34 Portaw—Hunter *25.*
38 Purdysburn—Templeton *74, 75.* Newcastle—Waddell *70.*
39 Sallagh Braes—Templeton *74, 75.* Cave Hill 1902—HWL.
40 Glenlough—*84.*

Bartramia Oederi (*Gunn.*) *Sw.*

1 Brandon Mtn.—Moore *57.*
29 Truskmore 1909—Tetley.
39 Sallagh Braes '08—Templeton *74, 75.* Colin Glen and Glenarm—*57.*

Bartramia pomiformis (*L.*) *Hedw.*

1 Brandon—Waddell.
2 L. Guitane '93—M'Ardle. Killarney 1906—Jones.
4 Rathpeacon—Power *61.* Inniscarra '51—Carroll *6.*
5 Near Fermoy—*84.*
6 L. Coomshigaun 1902—HWL.
11 Graiguenamanagh 1907 — Phillips. Mt. Brandon 1911—Tetley.
12 Killaune 1907—Miss Cooper.
13 Aghade Bridge '67 (R. C. Browne)—*120.* Tinnahinch 1907—Phillips.
19 *120.*
20 '68 (Moore)—*120.* Toole's rocks '64 (Hutton)—*35.*
21 Mts. (Moore)—*120.*
6 Larganmore Cliffs 1910—Tetley.
27 Nephin—HWL.
30 Tents Mt. 1910—Tetley.

31 Carlingford—Waddell.
33 Correll Glen 1905—M'Ardle *45*.
34 Dundrain—Hunter *25*.
36 1907—Henry.
37 Carriffkeeny Mt.—HWL *28*. Goraghwood '99—HWL.
38 Slieve Donard—Stewart *69*. Slieve Bingian—HWL *28*.
39 Colin Glen—Templeton *74, 75*. L. Mourne '82—HWL.
40 Dungiven (Moore)—*69*.

var. **crispa** *Sw.*

1 Brandon—Moore *57*.
2 Cromagloun—Moore *57*.

Bartramia norvegica (*Gunn.*) *Ldbg.*

1 Purple Mt.—Wade *80*.
2 Torc Mt. '55 (Orr)—*120*. Killarney—*84*.
4 Ballinhassig (Alexander)—*61*.
6 L. Coomshigaun 1902—HWL.
7 Galtee Mts. 1902—HWL.
20 L. Bray—Turner *73*.
27 1901—HWL.
36 Strabane Glen—HWL.
39 Colin Glen (Mackay)—*71*. Glenarriff '87—HWL.

Bartramia ithyphylla *Brid.*

1 Eagle's Nest—Carrington *4*.
6 L. Coomshigaun 1902—HWL.
7 L. Muskry 1902—HWL.
20 Dargle—*71*. Powerscourt '65 (Hutton)—*35*.
21 *7*.
27 Pontoon 1903—HWL.
31 Carlingford Mt.—HWL *28*.
34 Trillick—Hunter *25*.
35 Slieve League—HWL *32*.
36 Strabane Glen '83—HWL.
38 Slieve Donard—Stewart *69*. Slievenabrock—HWL *28*.
39 Moore *57*. Cave Hill '82—HWL.

Philonotis Wilsoni (*B. S.*).

1 Connor Hill Pass '29—Wilson *81*. Knockavohila (Taylor)—*2*.

Philonotis rigida *Brid.*

1 Maganabo Glen '29 (Wilson)—*2*. Looscanagh (Taylor)—*4*.
2 Dunkerron (Taylor)—*2*. Torc Waterfall '85—Stewart.
3 Bantry (Miss Hutchins)—*2*. Glengarriff 1900—Binstead.
20 Woodenbridge '67—Moore *57*.

Philonotis caespitosa *Wils.*

20 Glenmalure—Moore *57*. Lugnaquilla '71—Moore *54*.

Philonotis fontana (*L.*) *Brid.*

In all Divisions, except 3, 11, 17, 19, 22, 23, 24, 26, 36.

var. **falcata** *Brid.*

20 Lugnaquilla '67—Moore *57*.
31 Anglesey Mt. (HWL)—*120*. Carlingford 1908—HWL.
34 Hunter *25*.
39 Rasharkin Bog (HWL)—*69*.

var. **compacta** *Schpr.*

31 *7*.
35 Slieve League—HWL *32*.
39 *7*.

Philonotis seriata *Mitt.*

2 Horse's Glen 1906—Jones.
31 Anglesey Mt. '85—HWL.
32 Eskmore 1910—Bingham.
37 Carriffkeeny '98—HWL.

Philonotis calcarea *Schpr.*

1 Looscanagh L. (Carrington)—*57*.
2 Glena—Carrington *4*.
7 Banks of R. Shannon—Miss Armitage *1*.

14 Ballyfin—Moore *57*. Slieve Margy '67 (R. C. Browne)—*120*.
20 Glenmalure—Moore *57*.
21 *84*.
27 Achill I.—Waddell.
28 Benbulben—Moore *57*.
31 Carlingford 1908—HWL.
32 Eskmore 1910—Bingham. Rossmore 1912—HWL.
33 L. Erne shore 1905—Tetley.
35 Slieve League—Dixon *17*.
37 Benburb—Davies *12*.
38 Kilwarlin '82 (HWL)—*120*.
39 Colin Glen—Stewart *69*. '47 (Orr) —*35*.
40 Magilligan—Waddell.

Philonotis adpressa *Ferg.*

38 Eagle Mtn. '90—Stewart.
39 Tor Head 1911—Glover.

Breutelia chrysocoma (*Dicks.*) *Ldbg.*

In all Divisions, except 3, 4, 10, 12, 15, 17, 19, 22, 23, 24.

Catoscopium nigritum (*Hedw.*) *Brid.*

40 Magilligan Sands 1900—HWL and Waddell *89*.

ymnocybe palustris (*L.*) *Fries.*

In all Divisions, except 3, 7, 15, 22, 23, 40.

Orthopyxis androyna (*L.*) *P. B.*

18 Near Birr 1907—Miss Hemphill.
20 L. Bray—Templeton *74, 75*.
37 Ardmore Glebe '83 (HWL)—*120*.
38 Purdysburn (Drummond)—*74, 75*. Isaac's Glen, Holywood '14 — Templeton *75*.
39 Colin Glen '04—Templeton *74, 75*. Cave Hill '09—Templeton *74, 75*.
40 Kilrea 1912—Houston.

[**Timmia norvegica** *Zett.*

20 Powerscourt (Orr)—*2*. ?]

Mnium marginatum (*Dicks.*) *P. B.*

1 Gap of Dunlo (Moore)—*85*.
20 Dargle (Stokes)—*73*. '56 (Orr)—*35*.
28 Benbulben—Moore *57*.
39 Colin Glen '99—Stewart.

Mnium riparium *Mitt.*

26 Near Cong 1907—Kane.
37 *7*.
39 Glenarriff (HWL)—*70*.

Mnium hornum *L.*

In all Divisions, except 5, 22, 23, 30.

Mnium silvaticum *Ldbg.*

2. Killarney—Moore *57*.
9 *7*.
12 Killane 1907—Miss Cooper.
13 *7*.
15 Castle Taylor—Moore *57*.
23 Mullingar 1909—HWL.
26 Near Cong 1907—Kane.
28 Mullaghmore 1912—Tetley.
38 Ballykinler '98—Waddell *76*. Belvoir Park—Waddell.
40 *7*.

Mnium Seligeri *Juratz.*

32 Drumreaske 1909—Miss Kane.

Mnium cuspidatum (*L.*) *Neck.*

1 *7*.
2 Killarney—Moore *57*. Brandon 1900 —HWL.
9 *7*.
11 Duninga Wood 1911—Tetley.
12 *7*.
13 Browne's Hill (R. C. Browne)—*120*.
14 Nealstown 1912—Tetley.
15 Castle Taylor '69—Moore *57*.
16 Near Cong 1907—M'Ardle.
21 Glendough '56 (Orr) — *120*. Ballinascorney '58 (Orr)—*35*.
25 Kilronan Mt. 1910—Tetley.
27 Achill I. 1909—HWL.

28 Mullaghmore 1912—Tetley.
33 Enniskillen 1908—Tetley.
35 Dunfanaghy '68—Moore *55.* Slieve League—HWL *32.*
36 Dungannon 1909—Porter.
37 Croaghan I. '85—HWL.
38 Magheralin (HWL)—*69.* Cregagh Glen '85 - J. J. Andrew.
39 Near Belfast — Templeton *74, 75.* Colin Glen '99—Stewart.
40 Magilligan 1904—HWL.

var. **elatum** *B.*

33 Near Enniskillen 1907—Tetley.
35 Killybegs 1911 (Cheetham)—*94.*

Mnium rostratum *Schrad.*

2 Killarney '57 (Stewart)—*79.*
3 Blarney—Power *61.*
4 Donnybrook— *61.*
5 Glanmire—*61.*
11 Blancheville 1910—HWL.
13 S. of Borris 1911—Tetley.
20 Dargle—Moore *57.*
21 Glasnevin '55 (Orr)—*120.*
26 River Robe 1910—Tetley.
29 Kinlough Mt. 1909—Tetley.
30 Blacklion 1909—Tetley.
32 Drumreaske 1907—Kane.
33 Castle Caldwell 1905—HWL.
34 Bridge End—Hunter *25.*
35 Slieve League—HWL *32.*
36 Dungannon 1909—Porter.
37 Cregagh Glen—Stewart *69.*
38 Tollymore Park—HWL *28.*
39 Kerr's Glen '05—Templeton, *74, 75.* Carnmoney '89—Waddell.
40 Garvagh Demesne (Brenan)—*35.*

Mnium undulatum *L.*

In all Divisions, except 3, 7, 17, 26.

Mnium stellare *Reich.*

2 Torc Waterfall '85 (Holt)—*69.*
6 L. Bolagh 1902—HWL and Waddell.
20 Seven Churches '73 (Moore)—*120.*
33 Boho Caves 1914—Tetley.
36 Dungannon 1909—Porter.
39 Colin Glen '85—Stewart *69.*

Mnium pseudopunctatum *B. S.*

2 Torc Waterfall '99—HWL.
6 Comeragh Mts. 1902—HWL.
12 Ballynastragh 1906—Esmonde. Blackstairs Mt. 1907—Miss Cooper.
21 Howth '58 (Orr)—*120.*
27 Achill I. 1901—HWL.
31 Anglesey Mt.—Waddell.
32 Rossmore 1912—HWL.
36 Ranfurley Park 1909—Porter.
37 Carriffkeeny '87—HWL.
38 Saintfield—Waddell *76.* Moygannon Glen 1900—HWL.
39 Cave Hill (Stewart)—*120.* White Mt. 1901—Davies *12.*

Mnium punctatum *L.*

In all Divisions, except 5, 10, 17, 19, 23, 24, 25. 37.

Thuidium tamariscifolium (*Neck.*) *Ldbg.*

In all Divisions.

Thuidium delicatulum (*L. Hedw.*) *Mitt.*

1 Formoyle—Waddell.
2. Cromagloun '75 (Moore)—*120.* Killarney 1906—Jones.
16 Connemara '72 (Moore)—*120.*
20 L. Bray '92 (Stokes)—*74, 75.*
21 Malahide (Waddell)—*95.*
33 Correll Glen 1905—M'Ardle *45.* Muckross Wood 1912—Tetley.
35 Killybegs 1911 (Cheetham)—*94.*
38 Ballykinler 1900—Waddell *112.*
40 Magilligan 1900—Lett and Waddell *59.*

Thuidium recognitum (*Hedw.*) *Ldbg.*

1 Loughanscaul '98—HWL.
3 Glengarriff '96 (Binstead)—*120.*
8 Thornfield's Bog—Miss Armitage *1.*
25 Near Lough Key 1910—Tetley.

29 Truskmore 1909—Tetley.
31 Anglesey Mt.—HWL *28.*
34 Near Buncrana—Hunter *25.*
L. Easke 1903—M'Ardle.
38 Lenaderg 1906—Davies.

Thuidium abietinum (*L.*) *B. S.*

16 Benlettery—Wade *80.*
21 Portmarnock (Taylor)—*74, 75.*
Malahide I. 1912—HWL.
27 Belmullet—Moore *57.*
28 Inniscrone 1903—HWL.
34 Finner sand-hills 1914—Tetley.
40 Magilligan 1900—Lett and Waddell *59.*

Leskea polycarpa *Ehr.*

1 *7.*
2 Killarney—*84.*
8 Miss Armitage *1.*
20 Poulaphuca (Dr. Barker)—*74, 75.*
25 Rockingham '71 (Moore)—*120.*
29 Drumshambo '83 (Stewart)—*79.*
34 Bulbein Mtn. (R. Brown)—*74, 75.*
35 Errigal—Hart *20.*
37 Kinnego—Waddell *76.*
38 Manyburn '05 (Templeton)—*69.*
Loughbrickland '90—HWL.
39 Colin Glen—Templeton *74, 75.*
Toome '99—HWL.
40 '38—Moore *35.*

Anomodon viticulosus (*L.*) *Hk. T.*

In all Divisions, except 6, 12, 24, 25, 27, 32, 37.

Amblystegium filicinum (*L.*) *D.N.*

In all Divisions, except 3, 12, 15, 19, 22, 23, 24, 25.

var. **trichodes** *Brid.*

21 Luttrellstown (Scott)—*74, 75.*
Lambay—*95.*
33 L. Erne 1905—M'Ardle *45.*
34 Buncrana (Hunter)—*29, 59.*
38 Dundrum—Waddell.

Amblystegium fallax (*Brid.*) *Mildc.*

8. Banks of R. Shannon 1901—Miss Armitage *1.*
18 Geashill—HWL.
21 Skerries '58 (Orr)—*35.*
38 Kilwarlin Quarry '82—HWL.
Ringfad Point—Davies *15.*
39 Colin Glen '82—HWL.

Amblystegium irriguum (*Wils.*) *Schpr.*

1 Brandon 1900—M'Ardle.
5 Glenbower Wood—Carroll *5.*
8 Waddell.
9 Askeaton—Waddell.
21 Kilsaughlin '50 (Orr)—*120.*
25 Rockingham '71—Moore *57.*
28 Collooney 1904—M'Ardle *41.*
33 Florencecourt 1912—Tetley.
37 Ardmore Glebe '85—HWL.
38 Drumbo Glen—Stewart *70.*
Lambeg 1903—Davies *14.*
39 Magheralave—Davies *10.*
Colin Glen—Waddell.

Amblystegium fluviatile (*Swz.*) *Schpr.*

4 Ballinhassig—Taylor *71.*
5 Near Fermoy—Carroll *5.*
Fermoy '52 (Chandlee)—*79.*
15 *7.*
35 Melmore 1910—HWL.
38 R. Bann at Corbett 1900—HWL.
39 '05—Templeton *74, 75.* Colin Glen 1905—HWL.

Amblystegium varium (*Hedw.*) *Ldbg.*

8 Adare—Miss Armitage *1.*
24 (Moore)—*120.*
25 Rockingham '71 (Moore)—*120.*
33 Macan Bridge 1913—Tetley.
35 Killybegs 1911—Cheetham *94.*
37 Croaghan '85—HWL.
39 Kilroot—Davies *10.*
40 Magilligan 1904—HWL.

Amblystegium serpens (*L.*) *B. S.*

In all Divisions, except 5, 6, 7, 15, 17, 26, 27.

var. **depauperatum** *Boul.*

21 Malahide—Waddell.
34 Buncrana and Portaw—Hunter *25.*
38 Ballykinler—Waddell.
40 Portstewart '84 (Stewart)—*2.*

Amblystegium Juratzkae *Schpr.*

38 Lenaderg—Davies *16.*
39 Kilroot 1900—Davies *10.*

Amblystegium confervoides (*Brid.*) *B. S.*

16 Ashford Wood 1907—M'Ardle *46.*
20 Altadore Glen '93 (HWL)—*2.*
21 Lambay 1906—M'Ardle *44.* Santry 1908—M'Ardle.
28 Knocknarea Glen 1904 (Kane)—*41.*

Amblystegium Sprucei (*Bruch.*) *B. S.*

21 Portmarnock '56 (Orr)—*120.*
33 Correll Glen 1905—M'Ardle *45.*

Amblystegium riparium (*L.*) *B. S.*

1 Ross Bay—Carrington *4.*
5 Ballyvolane—Power *61.*
6 L. Bolagh 1902—HWL.
8 Miss Armitage *1.*
11 Kilkenny 1907—Phillips.
12 Great Saltee Island 1913—HWL *102.*
20 Moore *58.*
21 Clontarf '65 (Hutton)—*35.* Glasnevin 1856 (Orr)—*35.*
27 Nephin 1901—HWL.
30 Farnham 1903—M'Ardle *43.*
31 Ravensdale '97—HWL.
35 Slieve League—HWL *32.*
36 Dungannon 1909—Porter.
37 Derryadd '85—HWL.
38 Magheralin '87 (Waddell)—*120.* Moira—Stewart *69.*
39 Shaw's Bridge—Templeton *74, 75.* Parkmore—HWL.

var. **longifolium** *Schultz.*

35 Bundoran 1911—Tetley.
38 Lenaderg 1903—Davies *14.*
39 (Stewart)—*15.*

Amblystegium Kochii (*B. S.*) *Ldbg.*

40 Kilrea 1912—Houston *97.*

Amblystegium elodes (*Spruce*) *Ldbg.*

2 Muckross—Moore *57.*
16 L. Corrib shore—Moore *57.*
20 Black Castle—Moore *57.* The Murrough 1908 (Waddell)—*59.*
21 Killiney '14 (Taylor)—*81.* Malahide '52—Moore *35.*
33 Portora 1910—Tetley.
40 Magilligan sand-hills 1913—Houston and Waddell.

Amblystegium chrysophyllum (*Brid.*) *D. N.*

2 Ross I. '97—HWL.
4 Carroll *5.*
5 Fermoy—*84.* Little Island '52 (Carroll)—*79.*
11 Blancheville 1910—HWL.
12 Great Saltee I. 1913—HWL *102.*
17 Menlough—Moore *57.* Drumbane 1910—Tetley.
18 Geashill '90—HWL.
20 Near Mizen Head—Moore *56.*
21 Dublin (Taylor)—*74, 75.* Malahide (Moore)—*2.*
26 L. Mask 1910—Tetley.
27 Mulranny 1909—HWL.
28 *84.*
29 Glencar 1909—Tetley.
30 Killykeen 1908—HWL.
31 Drogheda '56 (Moore)—*120.* Greenore 1912—HWL.
32 1910—Bingham.
34 Buncrana—Hunter *25.*
35 Melmore 1910—HWL.
36 Roughan Park 1907—HWL.
37 Lurgan '82 (Waddell)—*120.* Ardmore '85—HWL.
38 Glasdrummon—Davies *14.*
39 Near Lisburn—Davies *14.*
40 Magilligan 1904—HWL.

var. **erectum** *Bagnall.*

9 Ballyvaughan 1907—O'Kelly.
10 Near Roscrea 1911—HWL.
34 L. Swilly shore—Hunter *25.*
35 Melmore 1910—HWL.
40 Magilligan 1904—HWL.

Amblystegium protensum (*Brid.*) *Ldbg.*

7 L. Dineen 1902—HWL.
8 Waddell.
9 Waddell.
28 L. Gill shore—Waddell *78.*
31 Waddell.
32 1910—Bingham.
33 L. Carrick 1905—HWL. Castle Archdall 1907—Kane.
34 Portaw—Hunter *25.*
37 Ardmore Glebe—HWL.

Amblystegium stellatum (*Schrb.*) *Ldbg.*

In all Divisions, except 3, 5, 6, 7, 10, 12, 17, 19, 22, 23, 24, 30.

Amblystegium polygamum *B. S.*

12 Great Saltee I. 1913—HWL *102.*
16 Connemara '72 (Moore)—*120.*
20 Near Arklow—Moore *57.*
21 Portmarnock—Moore *57.*
27 Belmullet—Moore *57.*
32 1910—Bingham.
33 Shore of L. Erne 1905—M'Ardle *45.*
34 Tullagh Point—Hunter *25.*
37 Castor's Bay '86 (Waddell)—*120.*
38 Kircubbin 1912—Glover.
39 Lisburn—Davies *12.*

var. **stagnatum** *Wils.*

20 Near Arklow (Moore)—*2.*

Amblystegium glaucum (*Lam.*) *Ldbg.*

2 Killarney—*84.*
4 Dunscombe's Wood (Alexander)—*61.*
5 Glanmire (Murray)—*61.*
6 Comeragh Mts. 1902—HWL.
7 L. Muskry 1902—HWL.
8 Foynes—Stewart *66.* Miss Armitage *1.*
9 Inishmore '95—M'Ardle *40.* Ballyvaughan 1907—O'Kelly.
13 Garry Hill '67 (R. C. Browne)—*120.*
14 Slieve Bloom 1912—Tetley.
15 1907—Mrs. F. Joyce.
16 Ashford '72 (Moore)—*120.* L. Corrib shore 1907—M'Ardle *43.*
18 Slieve Bloom 1912—Tetley.
20 Moore *58.* Bray Head—*85.*
21 Howth '50 (Moore)—*120.* Killakee Glen '53 (Orr)—*35.*
28 Benbulben '71 (Moore)—*120.* Knocknarea Glen 1904—M'Ardle *41.*
29 Truskmore 1907—Tetley.
31 Carlingford—HWL.
32 Monaghan 1910—Bingham.
33 L. Erne shore 1907—Tetley.
34 Inch—Hunter *25.* Barnesmore 1902—M'Ardle.
35 Slieve League—HWL *32.* Mt. Charles 1902—M'Ardle.
36 Dungannon 1911—Porter.
37 Camlough Mt. '98—HWL.
38 Moygannon Glen (HWL)—*120.* Slieve Donard—Stewart *69.*
39 (Moore)—*69.* Colin Glen—Stewart *69.*
40 Slieve Gallion—Stewart *69.*

Amblystegium falcatum (*Brid.*) *De Not.*

2 *7.*
3 Priest's Leap Mt. '78 (Carroll)—*79.*
9 Inishmore '95—M'Ardle.
12 Great Saltee I. 1913—HWL *102.*
15 1907—Mrs. F. Joyce.
16 L. Corrib shore 1907 M'Ardle *46.*
17 Dunmore 1910—Tetley.
21 Dublin Mts. '55 (Orr)—*120.*
29 Truskmore 1909—Tetley. 1913—Porter.
30 Killykeen 1908—HWL.
31 Carlingford Mt.—HWL *28.*
34 Inch road station—Hunter *25.*
35 Slieve League—HWL *32.*
37 Ardmore Glebe—HWL.
38 Slieve Donard—HWL *28.* Annalong '83 (Waddell)—*120.*

39 Colin Glen '59 (Davies)—*69*. Glenarriff '89—HWL.
40 Magilligan 1904—HWL.

Amblystegium Sendtneri (*Schpr.*) *D.N.*

28 Benbulben 1913—Porter.
35 Cratlagh Wood 1910—HWL.
36 Dungannon 1909—Porter.
37 Kinnego '86—HWL.
39 Carnlough 1910—HWL.
40 Magilligan 1904—HWL.

var. **Wilsoni** *Ldbg.*

37 Shore of L. Neagh at Ardmore '86 (HWL)—*2*.

var. **hamatum** *Ldbg.*

37 Kinnego '86 (Waddell)—*2*.

Amblystegium intermedium *Ldbg.*

16 Near Cong—Moore *57*.
21 Kilsaughlin '56 (Orr)—*120*.
27 Nephin—HWL.
28 Seafin Mt.—Waddell *78*.
31 Carlingford Mt. '82 (Waddell)—*28*.
32 (Waddell)—*59*.
34 *7*.
35 Bundoran.
36 Lough Fea—H. L. Orr.
37 Middleton '85—Waddell *76*. Carriffkeeny 1900—HWL.
38 Mourne Mts.—Waddell.
39 Rathlin I.—Stewart *69*. Boghill Mt. '88 (Waddell)—*120*.
40 Near Toome (Andrew)—*69*.

Amblystegium revolvens (*Swz.*) *D. N.*

1 Brandon—Waddell.
2 Killarney—Moore *57*.
3 Near Bandon (Alexander) — *61*. Shrone Hill 1907—Miss Martin.
5 Near Fermoy '88 (Stewart)—*79*.
6 L. Bolagh 1902—HWL.
7 L. Muskry 1902—HWL.
10 Dromineer 1907—Miss H. Bennis.
13 Sandbrook '67 (R. C. Browne)—*120*.
14 Slieve Bloom 1912—Tetley.
16 Kylemore—Moore *57*. Leenane 1901 —HWL.
20 Seafin Mt. (Taylor)—*81*.
21 Near Dublin (Scott)—*74*, *75*. Howth '54 (Orr)—35.
26 L. Glendaduff 1910—Tetley.
27 Pontoon 1903—HWL. Clare I. 1909 —HWL.
28 Benbulben '71 (Moore)—*120*.
29 River Duff 1912—Tetley.
30 Swanlinbar (Scott)—*73*.
31 Carlingford Mt.—HWL *28*. Clermont Cairn 1912—HWL.
32 Drumreaske 1907—Kane.
33 L. Erne 1912—Tetley.
34 Hunter *25*.
35 Slieve League—HWL *32*.
36 Mullaghcarbetagh Mt. 1901 (Stewart) —*79*. Dungannon 1909—Porter.
37 Camlough Mt.—HWL *28*.
38 Slieve Donard—Stewart *69*. Deer s Meadow—HWL *28*.
39 Cave Hill—Stewart *69*. Glenballyemon '87—HWL.
40 Portstewart—Stewart *70*.

Amblystegium lycopodioides (*Neck.*) *De Not.*

20 The Murrough '63 (Moore)—*120*.
21 Moore *58*. '51 (Orr)—*35*.
38 Baily's Moss '08—Templeton *74*, *75*.
39 Rasharkin Bog '35—Moore *49*.

Amblystegium vernicosum *Ldbg.*

2 Killarney—Moore *57*.
20 L. Bray—Moore *57*.
21 Bogs (Orr)—*57*.
28 Benbulben—Moore *57*.
38 Lisburn—Davies *12*.
39 White Mt.—Davies *12*.

Amblystegium aduncum (*L.*) *Ldbg.*

1 Glencar '69 (Moore)—*120*. Gap of Dunloe (Stewart)—*79*.
2 Torc Glen '99—HWL.

4 Frankfort (Alexander)—*61.* Murray—Herb. Fogerty *88.*
6 L. Bolagh 1902—HWL.
7 L. Muskry 1902—HWL.
8 Thornfield's Bog—Miss Armitage *1.*
9 Inishmore '95—M'Ardle *40.*
14 Slieve Bloom 1912—Tetley.
16 Leenane 1901—HWL.
20 L. Bray (Turner)—*74, 75.* Glendalough '54 (Orr)—*35.*
21 Glendough '51 (Moore)—*120.* Howth '57 (Orr)—*35.*
31 *7.* Anglesey Mt.—Waddell.
33 Correll Glen 1907—Tetley.
34 Barnesmore Gap 1905—M'Ardle.
35 Rathmullen '65 (Hutton)—*35.* Mt. Charles 1905—M'Ardle.
37 Ferry Hill—Waddell *28.*
38 Slieve Donard—Stewart *69.* Tollymore Park '83—HWL.
39 Cave Hill—Templeton *74, 75.* Clough '60—HWL.
40 Near Comber—Templeton *74, 75.* Garvagh (Stewart)—*79.*

Amblystegium exannulatum (*Guemb.*) *De Not.*

1 Glencar '69 (Moore)—*120.*
6 Comeragh Mts. 1902—HWL.
8 Thornfield's Bog—Miss Armitage *1.*
21 Howth (Orr)—*57.* G. A. Hunt—Herb. Kew.
27 Erris '59 (Moore)—*120.*
28 L. Gill '72—*120.*
31 Clermont Mt.—Waddell *28.* Clermont Cairn 1912—HWL.
32 Waddell *79.*
33 Portora 1907—Tetley.
34 Grianan Hill—Hunter *25.*
35 Letterkenny — Dixon *17.* Slieve League—HWL *32.*
38 Deer's Meadow '85 (HWL) — *69.* Holywood (Andrew)—*69.*
39 Ballycastle (Moore)—*69.* Cave Hill 1901—HWL.
40 Moore—*69.* Magilligan 1904—HWL.

var. **Rotae** *D. N.*

38 Drumnagally Bog 1904—Davies *15.*

Amblystegium fluitans (*L.*) *D. N.*

1 Brandon—Waddell.
2 Ross I. '97—HWL.
4 Ballyphehane Bog (Alexander)—*61.*
5 Glenville Mtns.—Power *61.*
7 L. Muskry 1902—HWL.
8 Miss Armitage *1.*
12 Great Saltee I. 1913—HWL *102.*
18 Portarlington (Moore)—*120.*
20 Moore *58.*
21 (Taylor)—*74, 75.* Howth '56 (Orr)—*35.*
27 Near L. Conn 1901—HWL.
28 Truskmore 1910—Tetley.
29 Boleyboy Mt. 1909—Tetley.
31 Carlingford Mt. 1900—HWL.
33 Near Poulaphuca 1905—M'Ardle *45.*
34 Hunter *25.*
35 Slieve League—HWL *32.*
37 Raughlan—HWL.
38 Tollymore Park—Templeton *74, 75.* Loughbrickland 1904—HWL.
39 Black Mt. (Andrew)—*69.* Lurigethan '89—HWL.
40 Kilrea 1912—J. D. Houston *97.*

var. **submersum** *Schpr.*

18 Geashill—C. D. Russell.
25 Kilronan Mt. 1910—Tetley.
39 Balmoral 1913—Porter.

Amblystegium Kneiffii *Schpr.*

2 Ross I. '97—HWL.
4 *7.*
12 Great Saltee I. 1913—HWL *102.*
20 Arklow—Moore *57.*
21 Malahide—Moore *52.*
29 Drumshambo '83 (Stewart) — *79.* Drowes River 1913—Porter.
34 Inch Road—Hart *20.*
35 Horn Head — Dixon *17.* Melmore 1910—HWL.

36 Killyquin 1913—Porter.
37 Kinnego—HWL.
38 Loughbrickland '88—HWL.
39 Glendivis—Stewart *69.*

var. **polycarpon** *Bland.*

34 *7.*
35 Tory Island 1910—HWL.
39 *7.*

Amblystegium scorpioides (*P.*) *Ldbg.*

1 Dunkerron—Taylor *71.*
3 Caher Mts. '93—M'Ardle.
4 Cork (Murray)—*61.*
8 *7.*
15 1907—Mrs. F. Joyce.
16 Leenane 1901—HWL.
20 '63 (Moore)—*120.*
21 Howth—Taylor *71.* Howth '52 (Orr) —*35.*
23 Multyfarnham—Moore *57.*
27 Pontoon 1903—HWL. Clare I. 1909 —HWL.
30 Belturbet—Moore *57.*
31 Anglesey Mt.—HWL. Carlingford Mt. 1908—HWL.
32 *7.*
33 Castleton 1905—HWL.
34 Fahan Hill—Hunter *25.*
35 Killybegs 1911—Cheetham *94.*
37 Camlough Mt.—HWL *28.*
38 Slieve Croob—Stewart *69.* Slievenabrock '85—HWL.
39 Turf bogs (Templeton)—*69.* Glenarriff (HWL)—*70.*
40 Glenchain (Moore)—*69.* Magilligan 1904—HWL.

Amblystegium dilatatum (*Wils.*) *Ldbg.*

1 Connor Hill Pass '97—HWL.
2 Torc Waterfall '65 (Hutton)—*35.*

Amblystegium ochraceum (*Turn.*) *Ldbg.*

1 O'Sullivan's Cascade—Moore *57.*
2 Killarney—Carrington *4.*
3 Bantry (Miss Hutchins)—*2.*
6 L. Bolagh 1902—HWL.
9 *7.*
12 Mt. Leinster 1911—Tetley.
16 Connemara—Moore *57.*
20 Seafin Mt. (Taylor)—*81.* Rathdangan '56—Davies *8.*
21 Kelly's Glen '49 (Moore)—*81.* '57 (Orr)—*35.*
31 Omeath Glen—HWL *28.*
34 Buncrana—Hunter *25.*
38 Deer's Meadow '86 (HWL)—*120.* Tollymore '95 (Waddell)—*59.*
39 Colin Glen (Waddell)—*69.* Glenarriff HWL—*70.*
40 Mullaghmore—Stewart *69.*

Amblystegium palustre (*Huds.*) *Ldbg.*

1 Loughanscaul '98—HWL.
2 Torc Waterfall—*81.*
3 Glengarriff (Hunt) — Kew Herb. Bantry 1912—HWL.
4 Sunday's Well (Alexander)—*61.*
8 R. Shannon at Hermitage — Miss Armitage *1.*
13 Near Borris 1911—Tetley.
14 Slieve Bloom 1912—Tetley.
16 Leenane 1901—HWL.
20 Moore *58.* Dargle '90—HWL.
21 Rathmines—*73.* Ballinascorney Glen '54 (Orr)—*35.*
23 Mullingar 1909—HWL.
26 River Robe 1910—Tetley.
27 Bengorm 1901—HWL.
28 Benbulben '79 (Stewart)—*79.*
29 L. Allen shore '83 (Stewart)—*79.* Truskmore 1909—Tetley.
30 Near Swanlinbar 1910—Tetley.
31 Ravensdale '99—HWL.
32 Drumsnatt 1910—Bingham. Rossmore 1912—HWL.
33 L. Erne 1905—M'Ardle *45.*
35 Slieve League—HWL *32.* Bundoran 1913—Porter.
36 Loughrey '84 — HWL. Dungannon 1908—Bingham.

38 Slieve Donard—HWL *28*. Saintfield 1911—Waddell.
39 Carr's Glen '10—Templeton *74, 75*. Kenbane '84—HWL.
40 White Mt. '84 (Stewart)—*79*.

var. **subsphæricarpon** *Schleich.*

2 Muckross—*84*. Torc—Carrington *4*.
39 Between Cushendall and Ballymena —Moore *57*. Near Carrickfergus (C. A. Johns)—*2*.

Amblystegium eugyrium (*Schpr.*) *Ldbg.*

1 Brandon—Waddell.
2 Torc Glen (Wilson)—*2*. 1906—HWL.
6 L. Coomshigaun 1902—HWL.
31 Omeath Waterfall '83 (Waddell)—*120*. Anglesey Mt. '83 (Waddell)—*76*.
33 Correll Glen 1907—Tetley.
34 Castleross River—Hunter *25*.
35 Slieve League—HWL *32*.
38 Lisburn—Davies *12*.
39 Parkmore '89—HWL. Colin Glen—Waddell.

var. **Mackayi** *Schpr.*

2 Torc Waterfall (Mackay)—*2*. Derrycunihy—Carrington *4*.
3 Glengarriff (Binstead)—*2*.

Amblystegium giganteum (*Schpr.*) *D.N.*

21 Howth (Orr)—*69*.
27 L. Conn shore 1901—HWL.
32 Drumreaske 1907—Kane.
34 Carradoan Wood—Hunter *25*.
35 *7*.
36 Dungannon 1909—Porter.
38 Slieve Croob—Stewart *69*. Maralin '87—Waddell.
39 Carrickfergus Common '75—Stewart *69*. Lurgethan—HWL.
40 Magilligan—HWL.

Amblystegium cordifolium (*Hed.*) *D. N.*

1 Carrington *4*.
2 *7*.
4 Ballyphehane Bog (Alexander)—*61*.
8 Miss Armitage *1*.
16 Connemara (Moore)—*120*. Leenane 1901—HWL.
20 Glencree '51 (Orr)—*120*.
21 Howth '50 (Orr)—*120*.
27 L. Conn shore 1901—HWL. Achill I. —Madame Christen.
29 Drowes River 1913—Porter.
31 Drogheda (Moore)—*120*.
34 Galliagh—Hunter *25*.
36 Eglish 1913—Porter.
37 Castor's Bay '86—HWL.
38 Near Rathfriland '87—HWL.
39 Ballycastle (Moore) — *69*. Bog Meadows, Belfast (Templeton)—*69*.

Amblystegium sarmentosum (*Wahl.*) *D. N.*

1 Between Kenmare and Killarney (Taylor) — *81*. M'Gillycuddy's Reeks '53 (Carroll)—*79*.
2 Killarney (Taylor)—*2*. Mangerton '55 (Orr)—*35*.
16 Leenane 1901—HWL. Kylemore '90 —Russell.
20 Luggielaw '55 (Orr)—*120*.
34 Grianan Hill—Hunter *25*.
38 White Water Glen (HWL)—*69*. Slieve Donard—Waddell.
39 Ballycastle '36 (Moore)—*76*.

Amblystegium stramineum (*Dicks.*) *D. N.*

1 Brandon (Waddell)—*79*.
5 Kildorrery '57—Carroll *6*.
14 Stradbally (Bradbury)—*80*.
20 L. Bray '02 (Stokes)—*74, 75*.
21 Castlekelly Glen (Drummond)—*81*. Howth '54 (Orr)—*35*.
31 Clermont Mt. (Waddell)—*28*.
33 Tempo '18—Templeton *74, 75*.
34 Bridge End—Hunter *25*.
36 Cappagh 1912—Porter.
37 Derryinver Bog—HWL.
38 Glenaveagh (HWL)—*69*. Brown Bog Loughbrickland—HWL.
39 Glenmakerron '36 (Moore)—*69*.
40 Magilligan '35—Moore *57*. Kilrea 1912—J. D. Houston *97*.

Hypnum purum *L.*

In all Divisions, except 5, 10, 14, 19.

Hypnum illecebrum *P. B.*

1 *7.*
2 Muckross Demesne 1906 (Jones)—*108.*
4 Passage '65 (Carroll)—*56.* Kinsale (Carroll)—*79.*
5 Queenstown (Carroll)—*57.*
7 Clonmel—Moore *57.*
12 Great Saltee I. 1913—HWL.
21 Killiney—Moore *57.* Ballinascorney Gap—*95.*
37 Ardmore Glebe '85—HWL.
39 Black Mt. '04—Templeton *74*, *75.* Sallagh Braes '84 (Waddell and HWL)—*69.*

Hypnum striatum *Schreb.*

In all Divisions.

Hypnum striatulum *Spruce.*

1 Clogher Head—Hart *20.*
2 Muckross—Wilson *81.*
8 Askeaton 1905—Waddell.
20 Devil's Glen—Moore *57.*

Hypnum circinatum *Brid.*

1 *7.*
2 Innisfallen—Carrington '67. 1906—HWL.
5 Fermoy (Chandlee)—*5.* Castle Martyr—Moore *57.* Tower of Youghal Church '94—HWL.
8 Shannon banks—Miss Armitage *1.* Askeaton 1905—Waddell.
9 Ballyalahan Mt. 1907—O'Kelly.

Hypnum pallidirostre *Braun.*

2 Carrington *4.*
4 Douglas '29 (Wilson)—*57.*
5 Great I.—Carroll *5.*
11 South of Royal Oak 1911—Tetley.
16 Pigeon Hole Cave 1907—M'Ardle *46.*
20 Altadore Glen '93—HWL.
21 Glasnevin—Moore *57.* Santry 1908—M'Ardle.
29 Kinlough Wood 1909—Tetley.
32 1910—Bingham.
33 Shore of L. Erne 1905—M'Ardle *46.*
37 *7.*
38 Dundrum '87—Waddell. Aghaderg Glebe (HWL)—*69.*
39 (Templeton)—*57.* Glenarriff '89—HWL.

Hypnum praelongum *L.*

In all Divisions, except 10, 14, 31.

var. **Stokesii** (*Turn.*) *Brid.*

2 Cromagloun (Wilson)—*2.*
7 Clonmel—*2.*
13 South of Borris 1911—Tetley.
17 N.E. of Tuam 1910—Tetley.
18 Near Birr 1907—Miss Hemphill.
20 L. Bray (Stokes)—*73.*
21 Howth (Moore)—*120.*
25 Rockingham—*2.* Kilronan 1911—Tetley.
26 Larganmore Cliffs 1910—Tetley.
27 *7.*
28 L. Melvin 1909—Tetley.
29 Kinlough Wood 1909—Tetley.
31 Greenore 1912—HWL.
32 Eskmore 1910—Bingham.
33 Near Enniskillen 1907—Tetley.
34 Hunter *25.*
36 Cappagh 1912—Porter.
37 Ardmore Glebe '85—HWL.
38 Saintfield woods '96—Waddell *76.* Aghaderg Glebe 1908—HWL.
39 Glendun (Brenan)—*35.*
40 Ben Evenagh 1913—Waddell.

Hypnum Swartzii *Turn.*

1 O'Sullivan's Cascade—Carrington *4.*
2 Killarney—Moore *57.* Ross I. '97—HWL.
4 Carroll *5.* Douglas 1907—Miss Peyton.
5 *7.*
8 Foynes—Stewart *66.*

11 Blancheville 1910—HWL.
12 Strokestown 1907—Phillips.
13 Borris 1911—Tetley.
14 Slieve Bloom 1912—Tetley.
15 Castle Taylor—Moore *57.*
17 Near Tuam 1910—Tetley.
21 Near Dublin (Stokes)—*73.* Howth '53 (Orr)—*35.*
23 Mullingar 1909—HWL.
26 Near Foxford 1910—Tetley.
27 Pontoon 1901—HWL. Achill I. 1909—HWL.
28 Lissadill 1904—M'Ardle.
29 Glencar 1904—M'Ardle *41.* Truskmore 1909—Tetley.
32 Near Aughnacloy 1905—Kane.
33 Correll Glen 1905—M'Ardle *45.*
34 Hunter *25.*
36 Dungannon 1909—Porter.
37 *7.*
38 '92 (Waddell)—*120.* Rostrevor Glen—*69.*
39 Colin Glen—Stewart *69.* Glendun '90—Brenan.
40 Magilligan 1904—HWL.

Hypnum speciosum *Brid.*

2 Killarney—Moore *57.*
4 Ballyphehane Bog—Carroll 5.
20 Altadore Glen '73 (Moore)—*120.*
21 Dunsink—*84.* Lambay—*95.*
38 Drumbo Glen—Stewart *69.* Lenaderg 1904—Davies *15.*
39 Glenarm (Moore)—*76.* Rathlin I.—Stewart *69.* Knockagh '89 (Waddell)—*120.*

Hypnum hians *Hedw.*

20 Sallygap—Moore *58.*
21 Ballinascorney Glen '67 (Orr)—*2.*

Hypnum crassinerve *Tayl.*

1 Kenmare (Wilson)—*2.*
2 Muckross—Wilson *81.* Killarney '85 (Orr)—*35.*
4 Near Cork (Taylor)—*81.*
5 Fermoy—Carroll 5.
8 Askeaton (Stewart)—*79.*
9 Ballyvaughan 1907—O'Kelly.
10 Dromineer 1907—Mrs. H. Bennis.
12 Strokestown 1907—Phillips.
15 Castle Taylor—Moore *57.*
16 *7.*
20 Dargle 1864 (Hutton)—*35.*
22 Beauparc 1912—HWL.
26 Near Cong 1907—Kane.
27 Mulranny 1909—Waddell. Westport—Waddell.
36 Loughrey Demesne—HWL.
39 Cave Hill—Drummond *18.* Glenarriff (HWL)—*70.*

Hypnum Teesdalii *Sm.*

3 Bantry (Miss Hutchins)—*57.*
16 Illaunaknick 1907—M'Ardle *46.*
20 *7.*
21 Glasnevin (Orr)—*57.* Phœnix Park—*95.*
33 Correll Glen 1905—M'Ardle *45.* Florencecourt 1911—Tetley.
38 Purdysburn (Templeton)—*69.*
39 Colin Glen (Templeton)—*69.* Woodburn Glen '90 (Waddell)—*120.*
40 Ness Glen '09—Templeton *74, 75.*

Hypnum curvisetum *Brid.*

39 Whiterocks, Portrush '85 (C. H. T. Lett)—*35.*

Hypnum Algirianum *Brid.*

1 *7.*
2 Ross I. '97—HWL. Innisfallen 1907—HWL.
4 Douglas and Carrigaline—Power *61.*
5 Hyde Park—Power *61.*
8 Askeaton — Stewart *66.* Adare — Miss Armitage *1.*
11 Thomastown 1907—Phillips.
12 Killanne 1907—Miss Cooper.
13 S. of Borris 1911—Tetley.
16 (Moore)—*120.* Pigeon Hole cave 1907—M'Ardle *46.*

17 Belclare 1910—Tetley.
18 Geashill 1907—HWL.
20 (Moore)—*58.*
21 Glasnevin '54 (Orr)—*120.*
22 Kells 1912—HWL.
23 Mullingar 1908—HWL.
27 *7.*
30 Farnham 1908—HWL.
31 Carlingford Mt. 1908—HWL.
33 Castle Caldwell 1905—HWL. Muckross Wood 1912—Tetley.
38 Dundrum Castle—Stewart *69.* Tollymore Park (HWL)—*70.*
39 Carr's Glen '06—Templeton *74, 75.* Parkmore—HWL '06.

Hypnum piliferum *Schreb.*

1 *7.*
4 Vernonsmount (Alexander) — *61.* Blarney '51—Alexander.
5 Fermoy—Carroll 5.
6 Comeragh Mts. 1902—HWL.
7 *7.*
9 Corofin 1907 — Macnamara. Ballyvaughan 1907—O'Kelly.
11 Near Kilkenny 1907—Tetley. Gowran 1910—HWL.
12 Killanne 1907—Miss Cooper.
14 Slieve Margy '67—R. C. Browne.
15 1907—Mrs. F. Joyce.
20 (Moore)—*120.*
21 Glasnevin (Orr)—*120.*
28 Hazelwood 1904—M'Ardle *41.*
29 Kinlough Wood 1907—Tetley.
33 Tempo Manor 1907—Langham.
34 Hunter *25.*
35 Rathmullen '65 (Hutton)—*35.*
37 Silverwood '85—HWL.
38 Drumcro '86 (HWL)—*120.* Banbridge—Stewart *69.*
39 '08 — Templeton *74, 75.* Glendun (Brenan)—*70.*

Hypnum rusciforme *Neck.*

In all Divisions, except 15, 22, 23.

var. **Atlanticum** *Brid.*

1 Near Dingle '98—HWL.
7 L. Muskry 1902—HWL.
8 In river Shannon—Miss Armitage *1.*
21 Finglas '65 (Hutton)—*35.*
33 Marble Arch Glen 1905—HWL.
35 Slieve League 1902—HWL.

var. **alopecuroides** *Brid.*

19 Leixlip—*81.*
35 Slieve League—HWL *32.*

Hypnum murale *Neck.*

4 Blackrock '50—Carroll *6.*
5 Hyde Park and Summer Hill—Power *61.*
7 Near Clonmel—Moore *57.*
8 Thornfield's bog—Miss Armitage *1.*
12 Great Saltee Island 1913 — HWL *102.*
18 Geashill 1907—HWL.
20 Luggielaw '51 (Moore)—*120.*
21 Near Dublin (Stokes)—*74, 75.* Hillbrook '59 (Orr)—*35.*
23 Mullingar 1908—HWL.
26 Ballinrobe 1910—Tetley.
28 Benbulben '71 (Moore)—*120.*
34 Bridge End—Hunter *25.*
36 Coalisland—Davies *14.*
37 Lurgan (Waddell) — *120.* Ardmore Glebe—HWL.
38 Near Lisburn—Davies.
39 Near Belfast — Templeton *74, 75.* Lambeg 1900—Davies.
40 (Moore)—*69.*

Hypnum confertum (*Dicks.*) *B. S.*

In all Divisions, except 6, 7, 15, 16, 22, 23, 24, 25, 26, 35.

Hypnum megapolitanum *Bland.*

1 Dingle Bay '68 (Carrington)—57.
21 Woodlawn '56 (Orr) — *35.* Portrane '58—Moore *57.* Malahide 1904—Waddell.

Hypnum velutinum *L.*

1 Dunkerron—*84.*
2 Muckross—Wade *80.* Torc Glen '99—HWL.
5 Middleton—Power *61.*
6 Comeragh Mts. 1902—HWL.
7 *7.*
8 *7.*
9 Ballyvaughan 1907—Kane.
12 Great Saltee I. 1913—HWL *102.*
13 Borris 1910—HWL.
16 Illaunaknick 1907—M'Ardle *46.*
21 Howth—Moore *57.* (Orr)—*35.*
22 Beauparc 1912—HWL.
23 Mullingar 1909—HWL.
24 Granard 1908—HWL.
26 Glendaduff 1910—Tetley.
27 Nephin 1901 — HWL. Near Cong 1907—Kane.
28 Hazelwood 1904—M'Ardle *41.*
30 Bracklagh 1908—HWL.
32 Drumreaske 1907 — Kane. 1910—Bingham.
33 Near Monea 1905—HWL.
34 Hunter *25.*
35 Melmore 1910—HWL.
36 Roughan Park 1907—HWL.
37 Ardmore Glebe '84—HWL.
38 Purdysburn—Templeton *74, 75.* Newcastle—HWL *28.*
39 Glendun '90—Brenan.
40 *7.*

var. **praelongum** *Schpr.*

38 Saintfield 1912—HWL.

Hypnum pseudoplumosum *Brid.*

1 Brandon 1900—HWL.
2 Killarney 1906—Jones.
3 Rathpeacon (D. Murray)—*61.*
4 Ballinhassig (Alexander)—*61.*
6 L. Bolagh 1902—HWL.
7 L. Muskry 1902—HWL.
8 Askeaton (Stewart)—*79.*
9 *7.*
10 Near Roscrea 1911—HWL.
12 Strokestown 1907—Phillips. Aughnabrisky R. 1911—Tetley.
13 Burren '67 (R. C. Browne) — *120.* Tinnahinch 1907—Phillips.
14 Slieve Bloom 1912—Tetley.
18 Slieve Bloom 1912—Tetley.
20 Mts.—Moore *58.*
21 Mts.—Moore *58.* Santry 1908—M'Ardle.
27 Nephin 1901—HWL. Croaghpatrick 1909—Waddell.
28 Truskmore 1901—Tetley.
29 Glencar 1904—M'Ardle *41.*
31 Anglesey Mt.—HWL *28.*
32 1910—Bingham.
33 Correll Glen 1905—M'Ardle *45.*
34 Buncrana—Hunter *25.*
35 Poisoned Glen — Dixon *17.* Slieve League 1902—HWL *28.*
36 *7.*
38 Belvoir '04—Templeton *74, 75.* Slieve Donard—HWL *28.*
39 Templeton *74, 75.* Parkmore '89—HWL.
40 Ness Waterfall (Moore)—*69.* Benevenagh 1900—HWL and Waddell.

var. **homomallum** *Lank.*

36 Strabane Glen—HWL '97. (J. B. Parker)—*59.*

Hypnum viride *Lamk.*

In all Divisions, except 3, 9, 14, 16, 17, 18, 19, 23, 24, 26, 29, 31.

var. **majus** *Schpr.*

27 Mulranny—HWL and Waddell.
30 Killykeen 1911—HWL.

Hypnum rutabulum *L.*

In all Divisions.

var. **robustum** *Schpr.*

22 Kells 1912—HWL.

Hypnum rivulare *Bruch.*

In all Divisions, except 3, 4, 14, 17, 19, 22, 23, 24, 25, 36.

var. tenue *Dixon.*

21 Lambay 1905—M'Ardle *95.*

Hypnum plumosum *Huds.*

1 Connor Hill Pass 1906—HWL.
4 Cork (Carroll)—*57.*
5 Near Youghal—Carroll *5.*
6 Comeragh Mts 1902—HWL.
12 Enniscorthy 1907—Miss Cooper.
16 (Moore)—*120.*
20 L. Bray—Taylor *71.*
21 Portrane—Moore *57.* Near Glasnevin (Orr)—*50.*
27 '52 (Moore)—*120.* Nephin 1901—HWL.
30 *84.* Swanlinbar 1910—Tetley.
32 1910—Bingham.
33 Marble Arch 1905—HWL.
35 Dunfanaghy—Moore *57.*
Slieve League—HWL *32.*
37 Camlough Mt. '98—HWL.
38 Narrow Water—HWL *28.*
39 Derriaghy—Davies *10.*
40 Magilligan 1904—HWL.

Hypnum albicans *Neck.*

1 Fermoyle 1905—Waddell.
4 Dunscombe's Wood—Power *61.*
5 Near Cove (Alexander)—*61.* Carroll *5.*
21 Portmarnock—Taylor *71.* '50 (Orr)—*35.*
27 Achill I. 1903—HWL.
31 '82 (Waddell)—*120.*
34 Portaw and Buncrana—Hunter *25.*
35 Bundoran—Waddell. Rathmullen '65 (Hutton)—*35.*
37 Derrytrasna '82 (HWL)—*120.*
Near Moyallon 1901—Davies *12.*
38 Donaghadee—Templeton *74, 75.*
Newcastle Sands—HWL *28.*
39 Carrickfergus—Templeton *74, 75.* (Moore)—*120.*
40 Magilligan—Waddell.

Hypnum glareosum *Bruch.*

1 *7.*
3 Glengarriff 1900 (Binstead)—*2.*
16 Connemara—Moore *57.*
20 Moore *57.*
21 Glasnevin—Moore *57.*
28 Benbulben—Tetley.
29 L. Allen shore '83 (Stewart)—*79.*
31 Anglesey Mt. HWL—*28.*
33 Kinade Quarry 1904—Tetley.
38 Kilwarlin Quarry '84 (Waddell)—*69.*
Tollymore Park—HWL *28.*
39 Glendun (Moore)—*69.*
40 Magilligan 1904—HWL.

Hypnum lutescens *Huds.*

In all Divisions, except 3, 7, 17, 22, 26, 36.

Hypnum sericeum *L.*

In all Divisions, except 5, 31.

Isothecium myosuroides (*L.*) *Brid.*

In all Divisions, except 8, 15, 19, 23, 24.

var. rivulare *Holt.*

1 O'Sullivan's Cascade '97 (Binstead)—*2.*
2 *7.*
3 *7.*

var. tenuinerve *Kindb.*

25 West of Lough Key 1910—Tetley.
35 Slieve League (Dixon)—*2.*

var. brachythecioides *Dixon.*

1 Connor Hill—Mackay.
34 L. Swilly 1902—Hunter.
See Dixon in "Journal of Botany," 1902, p. 380.

Isothecium viviparum (*Neck.*) *Ldbg.*

In all Divisions, except 3, 7, 15, 18, 19, 22, 23, 28, 36, 37.

Pterogonium ornithopodioides (*Huds.*) *Ldbg.*

1 Loughadoon '97—HWL. Brandon —Waddell.
2 Killarney '55—Moore *35*.
3 Glengarriff 1906 — Jones. 1912 — HWL.
4 Inniscara—*84*.
5 L. Coomshigaun 1902—HWL.
20 Luggielaw (Mackay)—*120*. [Powerscourt (Orr)—*120*. There is in the National Museum, Dublin, a specimen, named in Orr's handwriting "*Pterog. ornithopodioides* Glen of Downs, D. Orr." On examining this with a pocket lens, I concluded it was not correctly named, and I sent it to Mr. H. H. Dixon, who returned it with this report:—"David Orr's plant is, I should think, a very good example of that botanist's method—or absence of method. It is *Anomodon rostratus*, and it may have come from the U.S.A., or from the Alps, or the Caucasus, but scarcely, I think, from Co. Wicklow, the rather because there is a fragment of *Heterocladium dimorphum* mixed with it, and I do not know that even D. Orr himself recorded that from Ireland."]
21 Killakee Glen—Moore *58*.
31 Clogher Head 1912—HWL.
39 Below Grugan's Glen '02 (Templeton) —*69*. Ballygally Head—Stewart *69*. Murlough Bay 1913—HWL.

Pterigynandrum filiforme (*Timm.*) *Hedw.*

1 Torc Mt. '55—Orr *35*.
20 Dargle—Templeton *74, 75*. Moore *58*.
21 Killakee Glen—Moore *58*.
38 Mourne Mts. (Mackay)—*74, 75*. Tollymore Park—Drummond *18*.
40 Sawel Mt.—Templeton *74, 75*.

Myurella julacea (*Vill.*) *B. S.*

6 Bolagh L. 1902—HWL.
16 Connemara (as *Hypnum moniliforme*) (Mackay)—*71*.

Heterocladium heteropterum (*Bruch.*) *B. S.*

1 O'Sullivan's Cascade—Moore *57*. Barnanageeha '98—HWL.
2 Torc Mt. '55 (Orr)—*35*. Torc Waterfall 1906—Jones.
3 Glengarriff 1912—HWL.
4 Ballinhassig Glen (Alexander)—*61*.
6 L. Coomshigaun 1902—HWL.
7 L. Dineen 1902—HWL.
13 Mount Leinster '67 (R. C. Browne)—*120*. S. of Borris 1911—Tetley.
15 Woodford 1907—Phillips.
16 Connemara—Moore *57*.
20 Dargle *23*. Altadore Glen '93—HWL.
21 Kelly's Glen (Taylor)—*81*.
27 Nephin 1901—HWL. Bengorm—HWL.
31 Anglesey Mt.—HWL *28*.
34 Near Buncrana—Hunter *25*.
35 Cratlagh Wood 1910—HWL.
38 Holywood (Templeton)—*69*. Rostrevor '83 (Waddell)—*120*.
39 Belfast (Drummond)—*81*. Slemish (HWL)—*70*.

var. **flaccidum** *B. S.*

33 Correll Glen 1912—Tetley.
35 Slieve League 1902—HWL.
38 Tollymore Park—Waddell.
39 Colin Glen 1901—Davies *12*.

Hylocomium umbratum (*Ehr.*) *B. S.*

1 Connor Hill Pass '96—Binstead.
27 Achill I., Slievemore 1910—HWL *31*.

Hylocomium brevirostre (*Ehr.*) *B. S.*

1 Glena woods—Carrington *4.*
2 Killarney—Wilson *81.* Torc Glen '97 —HWL.
3 Glengarriff '43—Woodward *101.*
4 Blarney (Murray)—*61.*
5 Glanmire Woods (Murray)—*61.*
8 Foynes—Stewart *66.* Rathkeale 1907 —Fogerty.
10 Near Roscrea 1911—HWL.
12 Strokestown 1907—Phillips.
13 South of Borris 1911—Tetley.
14 Ballyfin—Moore *120.* Slieve Bloom 1912—Tetley.
15 Woodford 1907—Phillips.
16 Kylemore—Moore *57.* Connemara '41 (M'Calla)—*85.*
18 Clonad Wood '99—HWL.
20 Moore *58.*
21 Holly Park (Orr)—*120.*
25 Near L. Key 1910—Tetley.
26 Near Foxford 1910—Tetley.
27 Achill I. 1901—HWL.
28 Glencar—Moore *57.*
30 L. Macnean 1909—Tetley.
32 Creaghan 1907 — Kane. Eskmore 1910—Bingham.
33 L. Carrick 1905—HWL. Castle Archdall 1907—Kane.
34 Hunter *25.*
35 Rathmullen '65 (Hutton)—*35.* Cratlagh Wood 1910—HWL.
38 Slieve Croob—Stewart *69.* Narrow Water '83—HWL.
39 Colin Glen—Drummond *18.* Cushendall—Moore *57.*
40 Carndaisy Glen—Stewart *69.*

Hylocomium proliferum (*L.*) *Ldbg.*

In all Divisions, except 3, 19.

var. **Lambayensis** *M'Ardle.*

21 Lambay—M'Ardle *95.*

Hylocomium parietinum (*L.*) *Ldbg.*

In all Divisions, except 3, 5, 10, 15, 19, 22, 24.

Hylocomium triquetrum (*L.*) *B. S.*

In all Divisions.

Hylocomium squarrosum (*L.*) *B. S.*

In all Divisions, except 5, 16, 19.

Hylocomium loreum (*L.*) *B. S.*

In all Divisions, except 4, 10, 15, 19, 22, 23, 24.

Hylocomium rugosum (*L.*) *D. N.*

40 Magilligan 1900—HWL and Waddell *89.* Ben Evenagh 1913—Waddell.

Campylium hispidulum (*Brid.*) *Mitt.* var. **Sommerfeltii** (*Myrin*) *Ldbg.*

16 Galway, Oughterard, and Cong — Moore *57.*
23 (Moore)—*120.*
21 Portmarnock (Moore)—*120.*
26 *7.*
39 Glenballyemon—HWL.
40 Umbra Rocks—HWL.

Ctenidium molluscum (*Hedw.*) *Mitt.*

In all Divisions, except 5, 19, 24.

var. **croceum** *Tayl.*

1 Knockavohila (Taylor)—*81.*
6 Comeragh Mts. 1902—HWL.
38 Pigeon Rock Mt. '85—HWL.

var. **condensatum** (*Schpr.*).

1 Eagle's Nest Rocks 1906—Jones.
2 Horse's Glen 1906—Jones.
3 Ballylickey 1912—HWL.
6 Comeragh Mts. 1902—HWL.
33 Correll Glen 1907—Tetley.
38 *7.*
39 White Mt. 1903—Davies *14.*

Hyocomium flagellare (*Dicks.*) *Schpr.*

1 Cahirconree Mts. '79 (Carroll)—*79.*
2 Cromaglaun — Wilson *81.* Torc Waterfall '97—HWL.

3 Glengarriff '43 — Woodward *101.* Bantry 1912—HWL.
4 Ballinhassig Glen (Alexander)—*61.*
6 Comeragh Mts. 1902—HWL.
7 L. Muskry 1902—HWL.
11 Mt. Brandon 1911—Tetley.
12 Aughnabrisky R. 1911—Tetley.
13 Mt. Leinster '67 (R. C. Browne)—*120.*
16 Connemara '77 (Stewart)—*79.*
20 Seafin Mt. (Taylor)—*81.* L. Bray—Moore *58.*
21 Secawn Mt. — Taylor *71.* Kelly's Glen—Moore *58.*
26 Slieve Gamph 1910—Tetley.
27 Achill I. 1904 — HWL. Mulranny 1909—HWL.
28 Rockwood—Tetley.
30 1908—HWL. Cuilcagh 1911—Tetley.
31 Anglesey Mt. '83—HWL.
33 Correll Glen 1907—Tetley.
34 Hunter *25.* Barnesmore Gap 1903 —M'Ardle.
35 Muckish '15 — Templeton *74, 75.* Errigal 1902—M'Ardle.
36 Pomeroy '75 (Stewart)—*79.*
37 Carriffkeeny—HWL.
38 Tollymore Park—Templeton *74, 75.* Slieve Donard—HWL *28.*
39 Templeton *74, 75.* Glenarriff (HWL) —*70.*
40 Dog's Leap—Templeton *74, 75.*

[**Ptilium crista-castrensis** (*L.*) *De. Not.*

39 Colin Glen '47—Orr *120* and *57* ?]
There are very fine specimens of this moss in the British Museum, the National Museum, Dublin, and H. W. L.'s Herbarium, all labelled in Orr's handwriting. Stewart, Davies, and others searched the locality given at different times for this plant, but did not find it. The authority is not accounted sufficient to establish the record by Orr.

Sematophyllum demissum (*Wils.*) *Mitt.*

1 O'Sullivan's Cascade '29 (Wilson)—*2.* (Taylor)—*22.*
2 Cromagloun '29—Wilson *81.* '99—HWL.
3 Glengarriff—Wilson *81.*

Sematophyllum micans (*Wils.*).

1 O'Sullivan's Cascade '29 (Wilson)—*2.* Derrycunnihy Cascade 1906 — HWL. Binstead.
2 Cromagloun — Wilson *81.* Torc—Carrington *4.*
3 Glengarriff (Miss Hutchins) — *81.* 1912—HWL.

Stereodon Lindbergii *Mitt.*

1 Connor Hill Pass—Waddell.
2 Cromagloun '73 (Moore)—*120.*
3 Bantry (Miss Hutchins)—*2.*
4 *7.*
8 Askeaton—Waddell.
12 Strokestown 1907—Phillips.
19 *84.*
20 L. Bray—Moore *57.*
33 Correll Glen 1907—Tetley.
34 Birt—Hunter *25.*
36 Ardmore—HWL.
38 Moygannon Glen—HWL.
39 Wolf Hill '82 (Waddell)—*120.* Glendun (Brenan)—*70.*

Stereodon imponens (*Hedw.*) *Brid.*

1 O'Sullivan's Cascade 1906 — Jones *103.*
38 Corbet (Tullyconnaught) 1907 — Davies *16.*

Stereodon cupressiformis (*L.*) *Brid.*

In all Divisions, except 17, 23.
The most common and abundant of mosses, but not very profuse along the West Coast, where its place is often occupied by *Isothecium myosuroides.*

var. **ericetorum** *B. S.*

1 *7.*
4 *7.*

9 1907—Fogerty. Scariff 1909—Mrs. Hibbert.
10 Riverstown 1907—Miss Hemphill.
11 Mt. Brandon 1911—Tetley.
12 Pollmounty 1907—Phillips. Blackstairs Mt. 1911—Tetley.
13 Mt. Leinster 1911—Tetley.
14 Slieve Bloom 1912—Tetley.
16 Wood near Cong 1907—M'Ardle *46.*
17 Drumbane 1910—Tetley.
18 Near Birr 1907—Miss Hemphill.
24 Ballymorris Bog 1908—HWL.
25 Kilronan Mt. 1910—Tetley.
26 Slieve Gamph 1910—Tetley.
27 Achill I. 1901—HWL.
28 Truskmore 1910—Tetley.
29 *7.*
30 Slieve Glagh 1908—HWL. Lenliss 1909—Tetley.
31 Anglesey Mt.—Waddell.
32 1910—Bingham.
33 Near Topped Mt. 1905—HWL. Belmore Mt. 1907—Tetley.
34 Hunter *25.*
35 Rosapenna 1910—HWL.
36 Near Dungannon 1906—Miss Boyd.
37 Ferry Hill—Waddell.
38 Slieve Donard (HWL)—*69.*
39 *7.*

var. **longirostris** *B. S.*

9 Ballyvaughan 1907—Kane.

var. **elatus** *B. S.*

1 Kenmare (Taylor)—*2.*
2 Fermoyle 1905—Waddell.
8 Foynes (Stewart)—*79.*
12 Great Saltee I. 1913—HWL *102.*
21 Portmarnock—*84.* '52 (Orr)—*35.*
23 Mullingar 1909—HWL.
25 S. of Boyle 1910—Tetley.
26 L. Carra 1910—Tetley.
27 Nephin '01—HWL. Mulranny 1909—HWL.
28 Strandhill 1904—M'Ardle *41.* Benbulben 1913—Porter.
29 L. Allen (Stewart)—*79.* R. Drowes 1911—Tetley.
30 Lenliss 1909—Tetley. Swanlinbar 1910—Tetley.
31 *7.*
33 1908—Tetley.
34 Portaw Hill—Hunter *25.*
35 Carrick—HWL.
37 Ferry Hill '83—HWL.
38 Ballykinler—Waddell.
39 Portrush—Davies.
40 Magilligan 1902—HWL.

var. **mamillatus** (*Brid.*).

1 Connor Hill Pass—Wilson *81.*
2 Killarney (Wilson)—*2.*
38 *7.*

var. **filiformis** *Huds.*

1 Near Aniscaul '98—HWL.
2 Killarney 1906—Jones.
3 Dunboy Wood '93—M'Ardle.
5 Lota Wood—Power *61.*
9 *7.*
10 Near Riverstown 1907—Miss Hemphill.
11 Gowran 1910—HWL.
13 Mt. Leinster '67 (R. C. Browne)—*120.*
14 Slieve Bloom 1912—Tetley.
16 Illaunaknick 1907—M'Ardle *46.*
17 Clonbrock—M'Ardle *42.*
22 1912—HWL.
24 Derrycasson 1907—Miss Hepenstall.
27 Nephin 1901—HWL. Mulranny 1909—HWL.
28 Hazelwood 1904—M'Ardle *41.*
29 Glencar 1904—M'Ardle *41.*
30 Ballyhaise '93—M'Ardle *43.* Killykeen 1908—HWL.
31 Carlingford Mt.—HWL *28.*
32 Near Aughnacloy 1905—Kane. Drumsnatt 1910—Bingham.
33 Castle Caldwell 1905—HWL. Tempo 1907—Langham.
34 Hunter *25.*

35 Cratlagh Wood 1910—HWL.
36 Killymoon '84—HWL, Dungannon 1908—Bingham.
38 Tollymore Park—HWL.

Stereodon resupinatus (*Wils.*).

1 Dunkerron—*84*.
2 Killarney 1906—Jones.
4 Rathpeacon—Power *61*.
8 Miss Armitage *1*.
9 *7*.
12 Killanne 1907—Miss Cooper.
13 Tinnahinch 1907—Phillips. South of Borris 1911—Tetley.
14 Near Roscrea 1911—HWL. Slieve Bloom 1912—Tetley.
16 Cornamona 1907—M'Ardle *46*.
18 Geashill 1907—HWL.
21 Killiney '57 (Orr)—*35*. Phœnix Park '65 (Hutton)—*35*.
22 1912—HWL.
24 Derrycasson 1907—Miss Hepenstall.
27 Achill I. 1901—HWL.
29 Truskmore 1909—Tetley.
30 Ballyhaise '93—M'Ardle *43*. Farnham 1908—HWL.
32 Drumreaske 1907—Kane.
33 Tempo Manor 1907—Langham.
34 Hunter *25*.
35 Rosapenna 1910—HWL. Dunfanaghy 1911—Tetley.
36 Roughan 1907—HWL.
37 Ardmore Glebe '84—HWL.
38 Ballyholme—Stewart *69*. Loughbrickland 1910—HWL.
39 Glendun (Moore)—*69*. Fair Head—Stewart *69*.
40 Killymoon—Stewart *69*. Magilligan 1904—HWL.

[**Stereodon canariensis** *Mitt.*

1 O'Sullivan's Cascade '73 (Lindberg)—*2*.
2 Torc '29 (Wilson)—*2*. Cromaglaun '67 (Hunt)—*2*.
Mr. H. N. Dixon, Handbook, p. 538, regards these records as indecisive in the absence of fruit.]

Stereodon circinalis (*Hook.*) *Brid.*

1 Near Galway's Bridge 1900 (Binstead)—*2*.
2 Cromaglaun (Moore)—*2*. '67 (Hunt)—*2*. With fruit 1906 (Jones)—*103*.

Stereodon callichrous *Brid.*

1 Brandon 1905—Scully & Waddell.
2 Cromaglaun 1906—Jones.
16 [Cong 1907—M'Ardle *46*, sub nomine *Hypnum hamulosum*].

Stereodon subrufus (*Wils.*) *Ldbg.*

1 Mangerton '55 (Orr)—*35*.
2 Killarney '57 (Orr)—*120*, *84*.
28 Benbulben '56 (Moore)—*5*. Seefin—Waddell *78*.
29 Truskmore 1909—Tetley.
34 Bulbein 1907 (Hunter)—*59*.
35 Slieve League—HWL *32*.

Stereodon rufescens (*Dick.*) *Mitt.*

28 Benbulben—Moore *49*. Seefin Mt.—Waddell *78*.
29 Truskmore 1909—Tetley.

Isopterygium depressum (*Bruch.*) *Mitt.*

2 Killarney—Moore *57*.
13 Near Borris 1911—Tetley.
16 Curranamona 1907—M'Ardle *46*.
21 Killakee '68 (Orr)—*120*.
38 Killeen Glen—Stewart *69*.

Isopterygium elegans (*Hook.*) *Ldbg.*

1 O'Sullivan's Cascade 1906—Jones.
2 Torc Waterfall (Taylor)—*81*. Cromagloun 1912—Jones.
3 Near Bantry (Miss Hutchins)—*81*.
6 Comeragh Mts. 1902—HWL. 1910—Kane.
7 Galtee Mts. 1902—HWL.
8 *7*.
9 *7*.
11 Mt. Brandon 1911—Tetley.

12 Killanne 1907—Miss Cooper. Blackstairs Mt. 1911—Tetley.
13 S. of Borris 1911—Tetley.
20 Powerscourt—Moore *57*. Lugnaquilla —Hart *20*.
25 Kilronan Mt. 1910—Tetley.
26 Slieve Gamph 1910—Tetley.
27 Achill I. 1901—HWL.
28 Near L. Gill—Waddell *78*.
29 Truskmore 1907—Tetley.
30 Farnham '93—M'Ardle *43*. Tents Mt. 1911—Tetley.
31 Anglesey Mt.—HWL.
33 Rossinuremore 1905—HWL. Correll Glen 1907—Tetley.
34 Portaw Woods—Hunter *25*.
35 Errigal—Dixon *17*.
36 Pomeroy (Brenan)—*35*. Dungannon 1909—Porter.
37 Carriffkeeny 1904—HWL.
38 Slieve Donard—Stewart *69*. Tollymore '87 (Waddell)—*120*.
39 Glendun (Brenan)—*35*. Near Colin Glen 1901—Davies *12*.

Isopterygium pulchellum (*Dicks.*) *Ldbg.*

1 Brandon—Waddell.
2 Torc Waterfall — Taylor *71*. '99—HWL.
7 Galteemore (Moore)—*120*. L. Muskry 1902—HWL.
20 Powerscourt—Taylor *71*.
21 *7*.
27 Pontoon 1903—HWL.
34 Bulbein (R. Brown)—*74*, *75*. Finner Sandhills 1914—Tetley.
35 Glenveagh 1910—Praeger.
38 Tollymore Park (Waddell)—*28*.
39 Sallagh Braes—Moore *57*. Parkmore '89—HWL.
40 Sawel Mt. '09—Templeton *74*, *75*.

Plagiothecium undulatum (*L.*) *B. S.*

In all Divisions, except 10, 15, 17, 18, 19, 22, 23, 37.

Plagiothecium denticulatum (*L.*) *B. S.*

1 Brandon '97 — HWL. Fermoyle (Moore)—*120*.
2 Killarney—*84*.
4 *7*.
5 Ballyvolane—Power *61*.
6 Comeragh Mts. 1902—HWL.
9 Scariff 1909—Mrs. Hibbert.
11 Graiguenamanagh 1907—Phillips.
13 Mount Leinster '67 (R. C. Browne)—*120*. Tinnahinch 1907—Phillips.
14 Slieve Bloom 1912—Tetley.
16 Twelve Bens—*120*. Urrisbeg '91 (Stewart)—*79*.
19 *120*.
20 Powerscourt '59 (Moore)—*120*. Altadore '93—HWL.
21 Dundrum '51 (Orr)—*120*.
27 Pontoon 1901—HWL.
28 Benbulben—Templeton *74*, *75*. Mullaghmore 1910—Tetley.
29 L. Allen '83 (Stewart)—*79*.
30 Farnham '93—M'Ardle *43*. Tents Mt. 1911—Tetley.
31 *7*.
32 Rossmore 1912—HWL.
33 Correll Glen 1912—Tetley.
34 Hunter *25*.
35 Slieve League—HWL *32*.
36 Dungannon 1909—Porter.
38 Mourne Mts. — Templeton *74*, *75*. Chimney Rock Mt.—HWL *28*.
39 Woods—Templeton *74*, *75*. (Moore) —*120*.
40 Sawel Mt. (Moore)—*69*.

var. **Donii** (*Sm.*) *Ldbg.*

7 L. Dineen 1902—HWL.
34 Bulbein (R. Brown)—*73*. (Sub nomine var. *obtusifolium*.)

Plagiothecium silvaticum (*Huds.*) *B. S.*

1 Dunkerron—*84*.
2 Killarney — Moore *57*. Torc Glen 1906—Jones.
6 L. Bolagh 1902—HWL.
7 L. Dineen 1902—HWL.

9 Scariff 1909—Mrs. Hibbert.
13 Borris 1910—HWL.
20 Luggielaw—Moore *57*.
21 St. Catherine's — Wade *80*. Howth '65 (Hutton)—*35*.
25 Kilronan Mt. 1910—Tetley.
26 Larganmore Cliff 1910—Tetley.
27 Pontoon 1901 — HWL. Bengorm—HWL.
29 Boleyboy Mt. 1909—Tetley.
30 Killykeen '93—M'Ardle *43*.
32 1910 — Bingham. Rossmore 1912—HWL.
33 Rossinuremore 1905—HWL.
35 Slieve League—HWL *32*.
36 Dungannon 1909—Porter.
38 Rostrevor Wood—Stewart *69*. Slieve Donard—HWL *28*.
39 Lisburn (Creeth) — *69*. Ballygally Head—Stewart *69*.

Acrocladium cuspidatum (*L.*) *Ldbg.*

In all Divisions, common and often very abundant; varies in height from two to nine inches, as it happens to have a dry habitat or to be submerged; ascends to sub-alpine regions.

Entodon orthocarpus (*La Pyl.*) *Ldbg.*

1 Dingle '73 (Moore)—*120*.
6 L. Coomshigaun 1902—HWL.
20 *7*. Sallygap—*95*.
21 Portmarnock (Orr)—*57*.
34 Buncrana—Hunter *25*.
35 Dunfanaghy '66 — Moore *55*. Rossnowlagh 1908—W. F. Johnson.
40 Magilligan Sands 1900—HWL. Portstewart—Davies *14*.

Pterygophyllum lucens (*L.*) *Brid.*

1 Brandon — Waddell. O'Sullivan's Cascade '85 (Stewart)—*79*.
2 Killarney '55 (Orr)—*120*. Muckross '99—HWL.
4 Vernon's Mt.—Power *61*.
6 Comeragh Mts. 1902—HWL.
7 Galtee Mt. 1902—HWL.
8 Glenstal—Miss Armitage *1*.
9 Corofin 1907 — Macnamara. Scariff 1909—Mrs. Hibbert.
11 Graiguenamanagh 1907—Phillips.
13 *7*.
14 Slieve Margy '67 (R. C. Browne)—*120*.
15 Woodford 1907—Phillips.
16 Connemara '41 (MaCalla)—*85*.
20 Moore *58*. L. Bray (MaCalla)—*85*.
21 Near Killakee '54 (Orr)—*120*.
27 Achill I. 1904 — HWL. Mulranny 1909—HWL.
28 Hazelwood 1904—M'Ardle *41*.
29 Glencar 1904—M'Ardle *41*. L. Melvin 1909—Tetley.
31 Carlingford Mt.—HWL.
32 Near Aughnacloy 1905—Kane.
33 Castle Archdall 1907—Kane.
34 Hunter *25*.
35 Rathmullen '65 (Hutton)—*35*. Slieve League—HWL *32*.
36 Ranfurley Park 1913—Porter.
38 Tollymore Park — Templeton *74, 75*. Slieve Donard—HWL *28*.
39 Carr's Glen—Templeton *74, 75*. Sallagh Braes (Waddell)—*69*.
40 Ness Glen (Templeton)—*69*. Limavady (Moore)—*69*.

*[**Hypopterygium immigrans** *H. W. Lett.*

21 Easton Lodge, Monkstown. '87 (G. Pim)—*113*.
On surface of earth in pots and on rock-work of walls, in a cold fern house where it has flourished and fruited freely for some years. An immigrant.
Described and figured in "Journal of Botany," vol. xlii (1904), pp. 249-252.]

Cyclodictyon laete-virens (*H. T.*) *Mitt.*

1 O'Sullivan's Cascade '31 (Taylor and Harvey)—*2.* 1906 (Jones)—*35.*
2 Torc Waterfall '31 (Harvey and Taylor)—*81.*
4 Dunscombe's Wood—Drummond *18.* (D. Murray)—*120.* Power *61.*
6 Glendine Wood (Thos. Wright)—*57.*

Daltonia splachnoides (*Sm.*) *H. T.*

1 Brandon (Moore)—*2.* Pedlar's Lough —M'Ardle.
2 Torc Glen '97—HWL. Eagle's Nest 1906—Jones.
21 Seecawn Mt. (Taylor)—*23.*

Porotrichum alopecurum (*L.*) *Mitt.*

In all Divisions, except 16, 24.

var. **acutum** *Ldbg.*

1 O'Sullivan's Cascade '73—Lindberg *2.*

Porotrichum augustifolium (*Holt.*) *Dix.*

2 Derrycunnihy 1906—HWL.

Homalia trichomanoides (*Schrb.*) *Brid.*

3 Blarney—Power *61.*
4 Ballincollig '51—Carroll *6.*
5 *7.*
6 Comeragh Mts. 1902—HWL.
8 Foynes (Stewart)—*79.*
9 Ballyvaughan 1907—O'Kelly.
13 Browne's Hill '67 (R. C. Browne)—*120.* South of Borris 1911—Tetley.
14 Ballyfin (Moore)—*120.*
16 Illaunaknick 1907—M'Ardle *46.*
18 Geashill '91—C. D. Russell.
20 Moore *58.* Dargle '90—HWL.
21 Ballinascorney Glen '55 (Orr)—*120.*
26 Near Cong 1907—Kane.
28 Hazelwood 1904—M'Ardle *41.*
29 Glencar 1904—M'Ardle *41.*
34 Hunter *25.*
35 Bundoran—Waddell *79.*
36 Desertcreat '81—HWL. Dungannon 1909—Porter.
37 Cargin Wood—HWL.
38 Loughbrickland—HWL. Magheralin '92 (Waddell)—*120.*
39 Clough '60—HWL. (Moore)—*120.*
40 Garvagh '91—Brenan.

This moss is not so common nor abundant as some botanists have stated.

Neckera complanata (*L.*) *Hook.*

In all Divisions, except 3, 7, 29, 35.

Much more frequent and plentiful in the Midland and Western divisions than in the East and North.

Neckera crispa (*L.*) *Hedw.*

1 Dunkerron—Taylor *71.*
2 Torc Waterfall '99—HWL.
4 Blarney (Scott)—*61.*
5 Great I. (Scott)—*61.* Fermoy (Chandlee)—*5.*
6 Comeragh Mts. 1902—HWL.
7 Galtee Mts. 1902—HWL.
8 Miss Armitage *1.*
9 Ballyvaughan—M'Ardle *40.*
15 *7.*
16 Ashford 1907—Kane.
17 Castle Hacket 1910—Tetley.
26 L. Mask 1910—Tetley.
28 Knocknarea Glen 1904—M'Ardle *41.* Benbulben 1913—Porter.
29 L. Allen '91 (Stewart)—*79.*
30 Killykeen '93—M'Ardle *43.*
31 Carlingford Mt.—HWL *28.*
33 Marble Arch Glen 1905—HWL. 1907—Tetley.
34 *7.*
35 Bundoran (Moore)—*120.* Melmore 1910—HWL.
38 Slieve Donard—Stewart *69.* Tollymore Park (Waddell)—*69.*
39 Cave Hill—Templeton *74, 75.* Parkmore '85—HWL.
40 Benbradagh—Stewart *69.*

Neckera fontinaloides (*Lam.*) *Ldbg.*

1 Kenmare—Taylor *71.*
4 Blarney (Murray)—*61.*
5 Carroll *5.* Fermoy (Chandlee)—*56.*
6 1910—Kane.
9 Delmege's Glen 1907—Dr. G. Fogerty.
14 Ballyfin '56 (Moore)—*120.* Cappard '91—C. D. Russell.
18 Geashill—C. D. Russell.
20 Westaston—Moore *57.* Enniskerry '56 (Orr)—*35.*
22 Beauparc 1912—HWL.
33 Portora 1910—Tetley.

var. **Philippei** (*B. S.*) *Ldbg.*

14 Slieve Bloom 1912—Tetley.
22 Beauparc 1912—HWL.
30 Kilmore 1911—HWL and Waddell.

Neckera pennata (*L.*) *Hedw.*

[39 Colin Glen '49 (Orr)—*81* ?
There are undoubted specimens of *Neckera pennata* in the British Museum, National Museum, Dublin, and H. W. L.'s Herbarium, all labelled in Orr's own handwriting—"Neckera pennata, Colin Glen '49, David Orr." But though several bryologists have searched the locality given, during the past sixty years, the plant has not been found; and, consequently, doubt has been cast on this record.]

Climacium dendroides (*L.*) *W. M.*

1 Brandon—Waddell.
2 Killarney—Moore *57.*
3 *7.*
4 Ballyphehane Bog—Power *61.*
6 Carrick-on-Suir 1902—HWL.
8 Thornfield's Bog—Miss Armitage *1.*
13 Sandbrook '67 (R. C. Browne)—*120.* South of Borris 1911—Tetley.
14 Maryborough 1907—Phillips. Clonaslee 1912—Tetley.
15 1907—Mrs. F. Joyce.
17 N. of Tuam 1910—Tetley.
21 Near Dublin—*84.*
24 Derrycasson 1907—Miss Hepenstall.
25 Near L. Key 1910—Tetley.
26 Glendaduff 1910—Tetley.
27 Achill I. 1903—HWL. Mulranny 1909—HWL.
28 Inniscrone 1903—HWL. Lissadill 1904—M'Ardle *41.*
29 Glencar 1904—M'Ardle *41.*
30 Blacklion 1909—Tetley. Killykeen 1911—HWL.
32 Drumreaske 1907—Kane. 1910—Bingham.
33 Castle Caldwell 1905—HWL. Castle Archdall 1907—Kane.
34 Galliagh—Hunter *25.*
35 Rathmullen '65 (Hutton)—*35.*
36 Dungannon 1906—Miss Boyd. 1908—Bingham.
37 Ardmore Glebe '80—HWL.
38 Loughbrickland '87—HWL.
39 Lisburn (Davies)—*69.* (Moore)—*120.*
40 Magilligan 1904—HWL.

Fontinalis antipyretica *L.*

In all Divisions, except 3, 5, 10, 12, 15, 22, 23, 24, 29.

var. **gigantea** *Sull.*

22 Boyne near Drogheda (Moore)—*120.*
26 Claremorris 1909—Kane.
36 Roughan 1907—HWL.
38 L. Mann 3 miles S.E. of Ballynahinch—Waddell.
39 Glendun (Brenan)—*35.*
40 Magilligan 1904—HWL.

Fontinalis gracilis *Ldbg.*

1 Brandon 1900—HWL.
12 Aughnabrisky 1911—Tetley.
21 *7.*
38 Bann River at Corbet—Davies *10.*
39 Glendun (Brenan)—*35.*

Fontinalis squamosa *L.*

1 Mangerton—Wade *30*. O'Sullivan's Cascade—Moore *57*.
2 Horse's Glen 1906—Jones.
4 Moore *57*.
5 Dunbulloge—*61*.
6 L. Coomshigaun 1902—HWL.
8 Miss Armitage *1*.
16 Connemara—Moore *57*.
20 L. Bray — Wilson *81*. Glenmalure '56—Davies *8*.
21 Glendough '53 (Orr)—*120*.
27 Lakes in Curraun Peninsula—HWL *96*.
38 Rostrevor (HWL)—*59*. Ballyroney—Davies *14*.
40 Near Cumber 1800—Templeton *74, 75*.

Antitrichia curtipendula (*Hedw.*) *Brid.*

1 Brandon — Moore *57*. Connor Hill Pass 1906—HWL.
6 L. Bolagh 1902—HWL.
12 Near Strokestown 1907—Phillips.
20 L. Bray—Taylor *71*. Powerscourt '58 (Orr)—*35*.
21 '56 (Orr)—*120*.
28 Seafin '92—Waddell *78*.
32 Eskmore 1910—Bingham.
34 Buncrana—Hunter *25*.
39 (Moore)—*120*. Mts. near Belfast—Davies, *Phytologist*, vol. iii.
40 Dungiven '97 (Parker)—*76*. Ben Evenagh—Waddell.

Leucodon sciuroides (*L.*) *Schwg.*

3 Bantry—Moore *57*.
9 Ballyvaughan '95 (O'Kelly)—*40*.
11 Near Kilkenny 1907—Phillips. Blancheville 1910—HWL.
14 Mountmellick 1912—Tetley.
16 Salthill '91 (Stewart)—*79*.
18 Geashill 1903—HWL.
20 Enniskerry—Templeton *74, 75*.
21 Loughlinstown—Wade *80*. Longford Bridge (Orr)—*57*.
22 Beauparc—Moore *57*. Kells 1912—HWL.
39 Lambeg—Templeton *74, 75*.

Cryphaea arborea (*Huds.*) *Ldbg.*

2 Killarney (Moore)—*120*.
4 The Mardyke—Power *61*.
8 Foynes—Stewart *66*. Thornfield's Bog—Miss Armitage *1*.
9 Ennis — Stewart *66*. Ballyvaughan 1907—O'Kelly.
10 Near Roscrea 1911—HWL.
11 Gowran Demesne 1910—HWL. Duninga Wood 1911—Tetley.
12 Kilgibbon '82—HWL. Balloughton 1913—HWL.
13 Browne's Hill '67 (R. C. Browne)—*120*.
14 Mountmellick 1912—Tetley.
16 Near Galway—*79*.
18 Geashill 1903—HWL. Near Roscrea 1911—HWL.
19 Kilcock — Wade *80*. Ballysax '54 (Hutton)—*35*.
20 Moore *57*.
21 Moore *57*. Santry '54 (Orr) — *35*. 1908—M'Ardle.
23 Mullingar 1908—HWL.
28 Lissadill 1904—M'Ardle *41*.
30 Farnham '93—M'Ardle *43*. 1908—HWL.
32 Drumreaske 1907—Kane. Rossmore 1912—HWL.
33 Enniskillen 1909—Tetley.
37 Raughlan '85—HWL.
38 Gilhall—Stewart *69*. Loughbrickland—HWL *28*.
39 Cranmore—Templeton *74, 75*. Woodburn Glen '85—HWL.
40 Mt. Sandal—Stewart *69*.

Hedwigia imberbis (*Sm.*) *Spr.*

1 Brandon—Moore *57*.
3 Glengarriff (Miss Hutchins)—*81*. Bantry 1912—HWL.
20 Lugnaquilla—Moore *57*.
39 Fair Head—Moore *57*. '84—HWL.

Hedwigia albicans (*Web.*) *Ldbg.*

In all Divisions, except 5, 9, 15, 17, 18, 19, 22, 23, 24, 26, 32.

var. **secunda** *B. S.*

20 Luggela and L. Bray—*95.*

var. **viridis** *B. S.*

20 Luggela and L. Bray—*95.*

var. **striata** *Wils.*

3 Glengarriff (Wilson)—*61.*

INDEX TO GENERA.

VIII.

STUDIES IN THE DIFLAVONE GROUP.

II.—Derivatives of Diflavanone.

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Read June 14. Published August 28, 1915.

In a previous paper (Ryan and O'Neill, Proc. Royal Irish Acad., 1915, B, p. 48), we described two syntheses of diflavone. In the one synthesis we condensed diacetoresorcinol-dimethylether with benzoic ester, and by acting with concentrated hydriodic acid on the diketone thus formed we obtained diflavone. The other synthesis consisted of the condensation of diacetoresorcinol-dimethylether with benzaldehyde and the demethylation of the product by the aid of anhydrous aluminium chloride. In this way we obtained dibenzylidene-diacetoresorcinol, or dihydroxy-dichalkone, which after acetylation and addition of bromine gave the tetrabromide of dihydroxy-dichalkone-diacetate. The latter compound interacted with warm alcoholic potash to form diflavone.

The preparation of dihydroxy-dichalkone from its dimethylether is troublesome; and as we required a considerable quantity of the former for attempts to synthesize diflavanone and diflavonol, we tried, but without success, to obtain it by heating resorcinol-dicinnamate with fused zinc chloride and anhydrous aluminium chloride respectively. We also attempted its preparation by the direct condensation of benzaldehyde with diacetoresorcinol in the presence of alkali.

Eijkman, Bergema, and Henrard (Chemisch Weekblad I (1905), p. 453), by allowing a solution of diacetoresorcinol and benzaldehyde in alcoholic sodium hydroxide to stand in a warm place, obtained a reddish-yellow substance, which crystallized in needles and melted at 202° C. As this dibenzylidene-diacetoresorcinol is quite different in crystalline form and somewhat different in other properties from the dibenzylidene-diacetoresorcinol which we obtained (*loc. cit.*) from dihydroxy-dichalkone-dimethylether, we shall refer to it in future as α-dibenzylidene-diacetoresorcinol, and to the dihydroxy-dichalkone which we got from the dimethylether as β-dibenzylidene-diacetoresorcinol.

In our previous communication we stated that the latter compound—

β-dibenzylidene-diacetoresorcinol—is also formed when benzaldehyde is shaken for a few weeks (one month) with a solution of diacetoresorcinol in dilute, aqueous sodium hydrate.

An attempt to improve the yield of β-dibenzylidene-diacetoresorcinol by shaking benzaldehyde and diacetoresorcinol with dilute alkali for about three months gave a third isomeride, and the latter we have named γ-dibenzylidene-diacetoresorcinol.

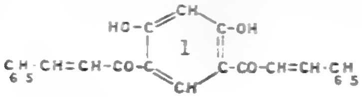
This substance, which melts at 218° C., is nearly white in colour, and crystallizes in equilateral triangles with hexagonal symmetry, thus differing markedly from the other two in melting-point, colour, and crystalline form.

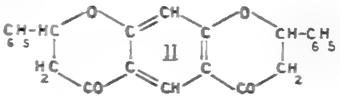
By heating diacetoresorcinol and benzaldehyde with alcoholic sodium hydroxide for a short time we obtained orange-yellow prisms, which melted at 204° C. We regard this compound, from its appearance, method of preparation, and properties, as identical with the α-dibenzylidene-diacetoresorcinol mentioned above as previously described by Eijkman, Bergema, and Henrard.

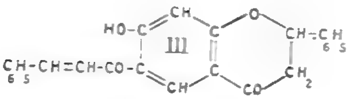
The method most frequently employed for the preparation of monoflavanones consists (von Kostanecki, von Lampe, and Tambor Ber 37 (1904), p. 784) of heating an alcoholic solution of a chalkone for several hours with a mineral acid. Owing to the sparing solubility of α-dibenzylidene-diacetoresorcinol in hot alcohol, we heated a solution of it in glacial acetic acid for a few days with hydrochloric acid, in the hope that it would change to the isomeric diflavanone. The reaction gave, however, as product a bright yellow solid, which crystallized in diamond-shaped plates, and melted at 205° C. A mixture of it with the parent substance—α-dibenzylidene-diacetoresorcinol—melted much lower than either of the two pure substances. As the properties of the compound indicated that it was not diflavanone, we have named it δ-dibenzylidene-diacetoresorcinol.

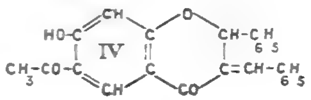
The existence of several dibenzylidene-diacetoresorcinols may be explained on structural and stereochemical grounds.

Thus, by the condensation of diacetoresorcinol (one molecule) with benzaldehyde (two molecules) we may get four structural isomerides, viz. dihydroxy-dichalkone (I), diflavanone (II), hydroxy-chalkone-flavanone (III), and hydroxy-aceto-benzylidene-flavanone (IV).

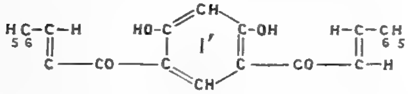


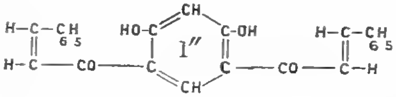


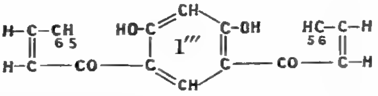




Again, dihydroxy-dichalkone (I) may exist in three stereoisomeric modifications (I′, I″, I‴) :—





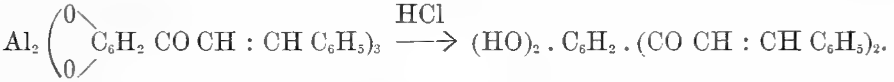


Since flavindogenides of the type IV are not formed by the condensation of ortho-hydroxy-ketones with aldehydes in the presence of alkalis, although readily formed, as we shall show later, in the presence of acids, it is unlikely that any of the four isomers isolated by us can have that formula. We are therefore limited to a consideration of the remaining five formulae.

The *a*, *β*, and *δ* isomerides on acetylation with sodium acetate and acetic anhydride give oily acetates (or acetate), which on addition of bromine form the same tetrabromide of dihydroxy-dichalkone-diacetate, and therefore on treatment with alcoholic potash yield the same diflavone.

The method by which the *β*-isomeride was first obtained by us—i.e. the action of aluminium chloride on dihydroxy-dichalkone-dimethylether—shows that it must be dihydroxy-dichalkone :—

$$C_6H_2\,(OCH_3)_2\,(CO\,CH_3)_2 \xrightarrow{C_6H_5CHO} C_6H_2\,(OCH_3)_2\,(CO\,CH:CH\,C_6H_5)_2 \xrightarrow{AlCl_3}$$



$$Al_2\left(\begin{array}{l}O\diagdown\\ \quad C_6H_2\,CO\,CH:CH\,C_6H_5)_3\\ O\diagup\end{array}\right. \xrightarrow{HCl} (HO)_2\,.\,C_6H_2\,.\,(CO\,CH:CH\,C_6H_5)_2.$$

The behaviour of the substance towards warm dilute alkali and towards alcoholic ferric chloride is in agreement with this formula, as also is the fact that it can be readily converted into the tetrabromide of dihydroxy-dichalkone-diacetate :—

$$C_6H_2(O\,OCCH_3)_2\,(CO\,CHBr\,.\,CHBr\,.\,C_6H_5)_2.$$

Moreover, since the *a* and *δ* isomerides can also be readily converted into the same diacetate-tetrabromide, it is evident that the latter substances are either polymorphic or stereoisomeric modifications of the *β* compound.

As the three substances crystallize from chloroform and alcohol in distinct crystalline forms, and as each form retains its individuality even when a saturated solution of it is inoculated with crystals belonging to the other forms, the differences between the compounds can scarcely be due to polymorphism.

It seems to us, therefore, that the three substances are the three theoretically possible stereoisomeric forms—cis-cis, cis-trans, trans-trans—of dihydroxy-dichalkone.

In the case of the dibenzylidene-succinic acids, Stobbe (Verh. d. Ges. deutsch. Naturforsch. u, Aerzte, Munich, 1899, p. 88) prepared three substances corresponding to the three possible stereoisomerides, the phenomenon observed by him being very similar to that met here by us.

The conversion of the three stereoisomeric modifications of dihydroxy-dichalkone into the same diacetate-tetrabromide is probably due to changing of the two labile isomers into the stable one during the acetylation and addition of the bromine.

We found, indeed, that the α isomeride, in chloroform solution in the presence of a trace of bromine, on prolonged exposure to light changes into the β isomeride—the latter being probably the most stable of the three forms.

The γ modification seems to be a structural isomeride of the other three. When subjected to the process of acetylation and bromination, it formed an oily bromine derivative, which did not give diflavone when treated with alcoholic potash. It cannot, therefore, be a dihydroxy-dichalkone. As the quantity of the substance (about one gramme) at our disposal was very small, we were not able to examine it as fully as is desirable.

Its colour is lighter and its melting-point higher than those of the dihydroxy-dichalkones; and since flavanones are always lighter in the colour and generally higher in the melting-point than the corresponding chalkones, we were at first inclined to regard the substance as diflavanone (II), all the more as it is nearly insoluble in dilute alkali, and gives only a very faint coloration with alcoholic ferric chloride.

An attempt to convert a small quantity of it by bromination and treatment with alcoholic potash into diflavone not being successful pointed to the chalkone-flavanone formula (III) rather than the diflavanone formula (II), as that which must be given to the compound.

Although γ-dibenzylidene-diacetoresorcinol is probably not diflavanone, we have found that diacetoresorcinol condenses readily with aldehydes in the presence of alcoholic hydrochloric acid to form derivatives of diflavanone. Thus with benzaldehyde it forms dibenzylidene-diflavanone (V), and with piperonal we obtained dipiperonylidene-3′. 4′. 3′. 4′.-dimethylenedioxy-diflavanone (VI).

The method, which has not hitherto been employed for the preparation of similar substances in the monoflavone group, we have found equally applicable to the latter group, and is probably the best and simplest method for the preparation of flavindogenides. Gallacetophenone-dimethylether, under the conditions mentioned above, condensed almost quantitatively with benzaldehyde to form benzylidene-3.4-dimethoxy-flavanone (IX), and with anisaldehyde to give the corresponding anisylidene-3. 4. 4′-trimethoxy-flavanone (X).

As piperonylidene-chalkones are only sparingly soluble in alcohol, the condensation in the presence of hydrochloric acid of diacetoresorcinol and piperonal gives mainly, even after addition of chloroform, in which the chalkone is more soluble, piperonylidene-3. aceto-4. hydroxy-piperonylidene-3′. 4′.-methylenedioxy-flavanone (VII). In the case of gallacetophenone-dimethylether and piperonal in alcoholic hydrochloric acid the main product is the chalkone, piperonylidene-gallacetophenone-dimethylether (XII), but at the same time some piperonylidene-3. 4. dimethoxy-3′. 4′. methylenedioxy-flavanone (XI) is formed.

The diflavindogenide, dibenzylidene-diflavanone, has been already obtained by Eijkman, Bergema, and Henrard (*loc. cit.*) from *a*-dibenzylidene-diacetoresorcinol by condensation with benzaldehyde in a solution of anhydrous hydrochloric acid in a mixture of alcohol and benzene. We have also utilized this method, which differs essentially from ours by requiring the previous preparation of the dichalkone, for the preparation of dibenzylidene-diflavanone, dianisylidene-diflavanone (XIII), and dipiperonylidene-diflavanone (XIV), and found it convenient for the purpose.

EXPERIMENTAL PART.

A. *Isomeric Forms of Dibenzylidene-diacetoresorcinol.*

1. *Action of Aqueous Alkali on Diacetoresorcinol and Benzaldehyde.*

We have shown (*loc. cit.*) that by shaking a solution of diacetoresorcinol in dilute aqueous alkali with benzaldehyde, for about one month, a yellow substance, which melts at 198–201° C., is formed.

β-Dibenzylidene-diacetoresorcinol.

The substance consists of yellow crystals, which very closely resemble cubes in appearance, but nevertheless are probably short monoclinic prisms, the angles between the faces being very nearly right angles. The crystals are doubly refractive, and have oblique extinction.

In chloroform solution its diacetate reacted with bromine to form the tetrabromide of dihydroxy-dichalkone-diacetate, which melted at 176–178° C., and which was converted into diflavone by interaction with alcoholic potash. Furthermore, as the same compound was produced by demethylating dimethoxy-dichalkone by means of aluminium chloride, it must be dihydroxy-dichalkone.

We tried to increase the yield of the compound by allowing the condensation of the diacetoresorcinol with the benzaldehyde to continue for a much longer time, and obtained a quite different product.

A mixture of diacetoresorcinol and benzaldehyde with dilute aqueous sodium hydroxide, to which some alcohol was added, was allowed to stand for three months at the laboratory temperature.

The yellow solid, which separated, was filtered and washed with water, acid, and alcohol. It was recrystallized a few times from chloroform and alcohol. When dried at 110° C., it melted at 218° C., and gave on analysis the following results:—

0·1655 substance gave 0·4744 CO_2 and 0·0722 H_2O,
corresponding to C 78·1, H 4·85.
$C_{24}H_{18}O_4$ requires C 77·84, H 4·86.

γ-Dibenzylidene-diacetoresorcinol crystallizes in light yellow equilateral triangular plates, with some diamond-shaped crystals formed by the juxtaposition of pairs of triangular plates. The crystals had hexagonal symmetry. The substance is quite different in crystalline form and melting-point from the isomeric β-dibenzylidene-diacetoresorcinol got by the demethylation of dihydroxy-dichalkone-dimethylether. A mixture of the two compounds softens at about 155°—a temperature much lower than the melting-point of either substance. This modification of dibenzylidene-diacetoresorcinol is nearly insoluble in dilute alkali, alcohol or ether, readily soluble in warm chloroform and sparingly soluble in boiling benzene. The crystals turn a transient orange colour on contact with concentrated sulphuric acid in which they dissolve to a yellow solution, which has a green fluorescence. When the sulphuric acid solution is diluted by addition of water, only a faint white precipitate is obtained.

Scarcely any coloration is produced by adding ferric chloride to boiling alcohol saturated with the compound.

The amount of γ-dibenzylidene-diacetoresorcinol at our disposal being small, we were unable to examine it so fully as seemed desirable.

When dissolved in dry chloroform, γ-dibenzylidene-diacetoresorcinol interacts very slowly with bromine to form a crystalline derivative, which, however, on warming with alcoholic potash, does not form diflavone.

Since it seemed probable, therefore, that the substance was not diflavanone, we heated 0·5 gramme of it with 0·5 gramme of anhydrous sodium acetate and 5 ccs. of acetic anhydride to gentle boiling for a few minutes. The mixture was cooled, water was added, and the oily layer was extracted with chloroform. The chloroform layer was washed with dilute sodium bicarbonate, and then passed through a dry filter paper. A solution of 0·45 gramme of bromine in chloroform was added, and the mixture was let stand over-night in a stoppered flask. The chloroform was evaporated, and the residue, which was oily, could not be obtained in a crystalline form. On warming it with alcoholic potash, potassium bromide separated. The oily reaction-product was soluble in alkali, and gave a brownish-red colour with concentrated sulphuric acid without any blue fluorescence. Since, after addition of a very small amount of diflavone to the brownish-red sulphuric acid solution, a blue fluorescence was easily observed, it is evident that the action of potash on the bromine derivative of γ-dibenzylidene-diacetoresorcinol does not form diflavone.

2. *Action of Alcoholic Alkali on Diacetoresorcinol and Benzaldehyde.*

We experienced at first some difficulty in preparing the dibenzylidene-diacetoresorcinol, which Eijkman, Bergema, and Henrard (*loc. cit.*) obtained by the condensation of diacetoresorcinol with benzaldehyde in the presence of alcoholic sodium hydroxide, and which they said consisted of reddish-yellow needles melting at 202° C.

We found ultimately that the substance is best got by slowly adding some concentrated sodium hydroxide to a solution of diacetoresorcinol and benzaldehyde in boiling alcohol.

About 25 ccs. of 50 per cent. sodium hydroxide were added, drop by drop, to a solution of 9·7 grammes of diacetoresorcinol and 20 ccs. of benzaldehyde in 300 ccs. of boiling alcohol. During the heating, which was maintained for a quarter of an hour, a reddish-orange solid separated, and this, after filtration, was washed with alcohol. On further washing with dilute hydrochloric acid, its colour changed to orange-yellow. The solid was dried, and recrystallized from boiling benzene. It melted at 204° C.

a-Dibenzylidene-diacetoresorcinol crystallizes in elongated rhombic prisms, the angles of the prismatic face being approximately 144° and 36°. The prisms had pyramidal ends and straight extinction in the direction of the elongation.

The crystals are coloured dark-red by concentrated sulphuric acid, in which they dissolve, giving an orange-red solution. On adding water to the sulphuric acid solution, a yellowish-white precipitate was obtained.

Ferric chloride gives a brownish-red coloration with a saturated solution of the substance in boiling alcohol.

The compound is probably identical with that previously described by Eijkman, Bergema, and Henrard (*loc. cit.*).

On acetylation and bromination it forms the same diacetate-tetrabromide as the β-derivative.

A mixture of 0·5 gramme of α-dibenzylidene-diacetoresorcinol, 0· gramme of anhydrous sodium acetate, and 5 ccs. of acetic anhydride wa heated for a few minutes to gentle boiling, cooled, mixed with water, and extracted with chloroform. The chloroform solution was washed with dilute sodium bicarbonate, and passed through a dry filter paper into a small dry flask. After addition to it of a chloroform solution of 0·45 gramme of bromine the colour of the latter rapidly became lighter without the evolution of hydrobromic acid. After standing twelve hours the solvent was evaporated, and the residue was recrystallized from boiling xylene. The yield was nearly quantitative. The tetrabromide melted at 176–178° C., and a mixture of it with the tetrabromide of the diacetate of β-dibenzylidene-diacetoresorcinol also melted at 176–178° C. The identity of this bromide with that previously described by us (*loc. cit.*) was further confirmed by its conversion into diflavone.

On shaking 0·5 gramme of the tetrabromide with 7·8 ccs. of semi-normal alcoholic potash, the solid dissolved; the colour of the solution changed from yellow to red, and potassium bromide separated. When heated for a short time on the water-bath, felted needles of diflavone were obtained. The crystals dissolved in concentrated sulphuric acid, giving a yellow-coloured solution, which had the intense blue fluorescence characteristic of diflavone.

3. *Action of Hydrochloric Acid on a Solution of α-Dibenzylidene-diacetoresorcinol in glacial Acetic Acid.*

About 5 grammes of α-dibenzylidene-diacetoresorcinol were dissolved in 150 ccs. of boiling glacial acetic acid, and about 10 ccs. of concentrated hydrochloric acid were added. The mixture was heated under a reflux condenser to gentle boiling for several days, with occasional cooling and saturation with gaseous hydrochloric acid. An equal volume of hot water was added to the orange solution, which was cooled and filtered. The solid was dried, and then recrystallized several times from chloroform and alcohol.

When dried at 110° C., it melted at 205° C., and gave on analysis the following results:—

0·1415 substance gave 0·4032 CO_2 and 0·0625 H_2O,
corresponding to C 77·71, H 4·91,
$C_{24}H_{18}O_4$ requires C 77·84, H 4·86.

δ. *Dibenzylidene-diacetoresorcinol* crystallizes in yellow diamond-shaped crystals, which are sparingly soluble in boiling alcohol, and readily soluble in warm chloroform.

The crystals are coloured orange by concentrated sulphuric acid, in which they dissolve, giving an orange solution, which has a strong green fluorescence. When this solution is diluted with water, a yellowish-white precipitate forms.

Ferric chloride imparts a slight brownish-red coloration to boiling alcohol which has been saturated with the substance.

Mixtures of the δ modification with the α, β, or γ-compounds soften about 185° C., and gradually melt as the temperature rises. Thus a mixture of the δ-isomeride with the α-compound from which it was formed began to melt about 185° C., and was almost completely melted below 195° C.

With a view to determining the structural relationship of it and the three dibenzylidene-diacetoresorcinols described above, we acetylated it by heating 0·3 gramme of the substance with 0·3 gramme of anhydrous sodium acetate and 3 ccs. of acetic anhydride. The acetyl derivative, which was oily, was treated with bromine in the manner described above. About 0·3 gramme of the diacetate-tetrabromide was obtained. It crystallized in colourless needles, which melted at 176–178° C. A mixture of it with the tetrabromide of β-dibenzylidene-diacetoresorcinol-diacetate also melted at 176–178°, and, like the latter tetrabromide, with which it is identical, it was converted by alcoholic potash into diflavone.

Of the four modifications of dibenzylidene-diacetoresorcinol, the β-compound is the most soluble in alcohol, and gives a deep red coloration with alcoholic ferric chloride; the coloration got from the α modification is much fainter, that from the δ-modification still fainter, while the γ isomeride gives almost no coloration with the ferric chloride.

Sulphuric acid colours the crystals of the α modification dark red, the β and γ modifications orange, giving an orange solution, while the solution in the case of the γ compound has a yellow colour. The melting-points of mixtures of the α and γ, α and δ, β and γ, β and δ, γ and δ isomerides were not sharp, and in each case the mixture melted below the melting-point of that component in the mixture which had the lower melting-point.

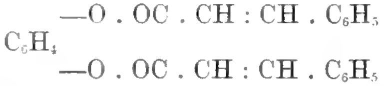
Notwithstanding the marked difference between the crystalline form of the α and β isomerides and the differences in their behaviour towards concentrated sulphuric acid and alcoholic ferric chloride respectively, a mixture of the α and β isomerides showed no appreciable lowering of melting-point.

4. *Conversion of the α into the β Isomeride.*

We dissolved about a gramme of α-dibenzylidene-diacetoresorcinol in chloroform, added a couple of drops of a 40 per cent. solution of bromine in chloroform, and let the solution stand for several days in a bright place. The chloroform solution was concentrated and alcohol was added. The separated solid consisted mainly of the short prisms of the β compound, very similar to cubes in appearance, with some prisms having pyramidal ends, which probably consisted of unchanged *a* compound.

A chloroform solution of the β isomeride when similarly treated gave mainly unchanged β dibenzylidene-diacetoresorcinol. Inoculation of a saturated solution of the *a* compound in chloroform and alcohol with crystals of the β compound did not convert the *a* compound into the β form; nor conversely were we able to change the β form into the *a* isomeride by inoculation of a saturated solution of the former with crystals of the latter.

5. *Resorcinol-dicinnamate*



$$C_6H_4\left\langle\begin{array}{l}—O\,.\,OC\,.\,CH:CH\,.\,C_6H_5\\ —O\,.\,OC\,.\,CH:CH\,.\,C_6H_5\end{array}\right.$$

While seeking for a convenient method of preparing dibenzylidene-diacetoresorcinol we combined cinnamoyl chloride with resorcinol in the hope that the dicinnamate by interaction with zinc chloride or aluminium chloride would give the desired compound.

Cinnamic acid (30 grammes) and thionyl chloride (18 ccs.) were heated in a round flask under a reflux condenser until fumes ceased to be evolved. The excess of thionyl chloride was then removed by distillation, and to the residue, which consisted of cinnamoyl chloride, 11 grammes of resorcinol and 16 grammes of pyridine were added. The mixture was heated in an oil-bath to 120° C. for half an hour. The product was cooled, washed first with dilute hydrochloric acid, afterwards with dilute sodium bicarbonate, and finally with water and alcohol.

After recrystallization from boiling alcohol about 35 grammes of resorcinol-dicinnamate were obtained.

When dried at 110° C., it melted at 122–124° C., and gave on analysis the following results:—

0·1580 substance gave	$0·4482\,CO_2$	and	$0·0723\,H_2O$,
corresponding to	C 77·4		H 5·1,
$C_{24}H_{18}O_4$ requires	C 77·84		H 4·86.

Resorcinol-dicinnamate crystallizes in colourless prisms which are sparingly soluble in alcohol, soluble in ether or benzene, very soluble in chloroform, and scarcely soluble in ligroïn.

Ferric chloride gives no coloration with a solution of the substance in boiling alcohol.

The percentage composition of the substance is nearly the same as that of cinnamic anhydride; and as we were unable to convert it by heating with either zinc chloride or aluminium chloride into dibenzylidene-diacetoresorcinol, we thought it necessary to examine the compound in detail.

The melting-point of a mixture of resorcinol-dicinnamate (MP 122–124° C.) and cinnamic anhydride (MP 135° C.) was indefinite, lying between 110° and 130° C.

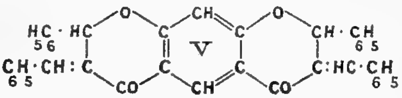
We hydrolysed the substance by heating it on the water-bath with moderately concentrated potash. The alkaline solution was acidified, cooled, and filtered from the separated cinnamic acid. The filtrate was neutralised with sodium bicarbonate, and extracted with ether. When the residue, which was left on evaporating the ether, was dissolved in water, it gave a dark violet coloration with ferric chloride indicating the presence of resorcinol.

Resorcinol-dicinnamate was heated to 140° C. with one-fourth of its weight of anhydrous zinc chloride for half an hour, but from the tarry product of the reaction no dibenzylidene-diacetoresorcinol could be isolated. Variations in the quantity of zinc chloride and in the length of heating did not enable us to prepare the desired compound.

Similarly by heating resorcinol-dicinnamate in xylene solution with anhydrous aluminium chloride, we did not succeed in converting the ester into dibenzylidene-diacetoresorcinol.

B. *Condensation of Hydroxy-ketones with Aldehydes in the Presence of Hydrochloric Acid.*

6. *Dibenzylidene-diflavanone.*



A mixture of 5 grammes of diacetoresorcinol, 25 ccs. of benzyaldehyde, and 200 ccs. of alcohol on saturating with anhydrous hydrochloric acid became hot, and turned a red colour as the diacetoresorcinol dissolved. The solution was cooled, again saturated with hydrochloric acid, and then let stand in a stoppered flask for a week. It was heated on the water-bath for a short time, cooled, and filtered. The brown residue was dissolved in chloroform, and the solution after washing with dilute potash was filtered. The chloroform solution was concentrated, mixed with an equal volume of alcohol, and let stand in a dish. The solid which separated was recrystallized a few times from boiling ligroïn.

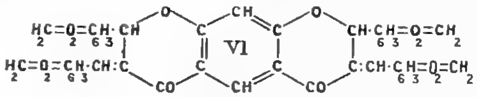
When dried at 110° C., it melted at 268° C., and gave on analysis the following results:—

0·2765 substance gave	0·8450 CO_2	and	0·1254 H_2O,
corresponding to	C 83·4		H 5·0,
$C_{38}H_{26}O_4$ requires	C 83·5		H 4·8.

Dibenzylidene-diflavanone crystallizes from ligroïn in almost colourless needles, which are insoluble in water or dilute potash, scarcely soluble in alcohol, ether, or ligroïn, and readily soluble in warm chloroform.

The crystals are coloured dark-red by concentrated sulphuric acid, in which they dissolve to a cherry-red solution.

7. *Dipiperonylidene-3′. 4′. 3′. 4′.-dimethylenedioxy-diflavanone.*



Diacetoresorcinol (5 grammes) and piperonal (20 grammes) were dissolved in a hot mixture of alcohol (200 cc.s.). Anhydrous hydrochloric acid was passed into the solution until the latter was saturated with the gas. The mixture was let stand in a stoppered flask for several days. The solid which separated was filtered and washed with alcohol. By warming the yellow product with chloroform it was separated into a more soluble yellow part and a sparingly soluble much lighter-coloured one. The more soluble compound was formed by the condensation of three molecules of piperonal with one molecule of diacetoresorcinol and the less soluble by the condensation of four molecules of piperonal with one of the ketone. When the latter was recrystallized from boiling xylene, in which it was sparingly soluble, it melted at 289° C., and gave on analysis the following results:—

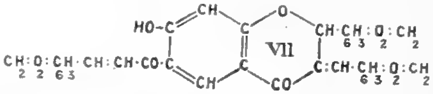
0·1499 substance gave 0·3814 CO_2 and 0·0476 H_2O
corresponding to C 69·4, H 3·56.
$C_{42}H_{26}O_{12}$ requires C 69.78 H 3·63.

Dipiperonylidene-dimethylenedioxy-diflavanone crystallizes from xylene in light yellow prisms, which are scarcely soluble in alcohol, ether, ligroïn, or benzene, and sparingly soluble in boiling xylene or chloroform.

The crystals are coloured deep blue by concentrated sulphuric acid, in which they dissolve to a violet solution.

No coloration was observed when ferric chloride was added to a suspension of the substance in boiling alcohol.

8. *Piperonylidene-3. aceto-4. hydroxy-piperonylidene-3′. 4′-methylenedioxy-flavanone.*



The yellow more soluble compound obtained during the preparation of dipiperonylidene-dimethylenedioxy-diflavanone was dissolved in hot chloroform, and the solution was shaken with warm dilute potash. As the yellowish potash solution on acidification gave only a small precipitate, the chloroform solution was passed through a dry filter paper, concentrated, and mixed with an equal volume of absolute alcohol. The solid which separated was filtered and boiled for a short time with pyridine, in which it dissolved readily. The substance was reprecipitated from the pyridine solution by addition of xylene, and recrystallized, first from xylene, afterwards from benzene. After drying at 106° C. it melted at 240–242° C., and gave on analysis the following results:—

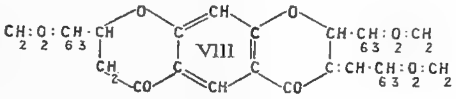
0·1550 substance gave 0·3921 CO_2 and 0·0515 H_2O
corresponding to C 69·0 H 3·7
$C_{34}H_{22}O_{10}$ requires C 69·15 H 3·7.

Piperonylidene-3. aceto-4 hydroxy-piperonylidene-3'.4'. methylenedioxy-flavanone crystallizes from benzene in small yellow prisms, which are insoluble in cold alcohol, ether, or ligroïn, sparingly soluble in cold benzene or xylene, soluble in hot benzene, and readily soluble in warm chloroform.

On addition of ferric chloride to a suspension of the substance in boiling alcohol, no coloration was produced.

The crystals are turned a dark bluish-red colour by contact with concentrated sulphuric acid, in which they dissolve to a cherry-red solution.

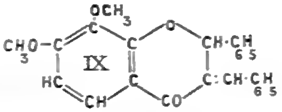
As the compound is nearly insoluble in hot dilute alkali, and as it, when suspended in boiling alcohol, gives no coloration with ferric chloride, it would seem to be a diflavanone derivative, having the formula:—



rather than a chalkone-flavanone with the formula ascribed to it above.

Since ortho-hydroxy-chalkones are often sparingly soluble in alkali, and since our compound is so slightly soluble in alcohol that a marked coloration with ferric chloride could scarcely be expected in alcoholic solution, we do not consider the behaviour of the substance towards dilute alkali and ferric chloride sufficiently strong grounds for proposing the diflavanone formula for the substance. If the compound were a diflavanone, we should expect from analogy with the monoflavanones that it would be completely or nearly colourless, and that its bromo-derivative should be easily convertible into a diflavone.

9. *Benzylidene-3 . 4 dimethoxy-flavanone.*



Two grammes of gallacetophenone-dimethylether and four cubic centimetres of benzaldehyde were dissolved in twenty cubic centimetres of alcohol, which had been previously saturated in the cold with anhydrous hydrochloric acid. The solution, which turned a brown colour, was let stand for a few days in a stoppered flask. The contents of the flask, which in the interval had become semi-solid, were transferred to an open dish, and the solvent was allowed to evaporate spontaneously.

After recrystallization from alcohol, about 2·2 grammes of a colourless crystalline solid were obtained. When dried at 105° C., it melted at 125–126° C.

The same substance was got by the condensation of 1·5 grammes of benzylidene-gallacetophenone-dimethylether with an equal weight of benzaldehyde in the presence of alcoholic hydrochloric acid.

It gave on analysis the following results:—

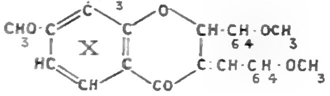
0·1603 substance gave 0·4557 CO_2 and 0·0788 H_2O
corresponding to C 77·5, H 5·46
$C_{24}H_{20}O_4$ requires C 77·4, H 5·42.

Benzylidene-3 . 4 . dimethoxy-flavanone crystallizes in colourless needles, which are soluble in alcohol or ether, and very readily soluble in benzene or chloroform.

Its alcoholic solution is not coloured red on addition of ferric chloride.

The crystals are coloured red by concentrated sulphuric acid, in which they dissolve to an orange solution.

10. *Anisylidene-3.4.4′ trimethoxy-flavanone.*



On allowing a solution of 2 grammes of gallacetophenone-dimethylether and 4 cc.s of anisaldehyde in 30 cc.s of alcohol, saturated with hydrochloric acid gas, to stand for several days, it turned a dark red colour and deposited a dark-coloured oil. The oil was dissolved in a mixture of chloroform and alcohol, which was then boiled with animal charcoal, filtered, and let evaporate spontaneously in a dish. The crystalline solid which separated weighed 2·5 grammes. It was heated with pyridine for half an hour and then recrystallized a few times from boiling alcohol.

When dried at 105° C., it melted at 142–143° C., and gave the following results on analysis :—

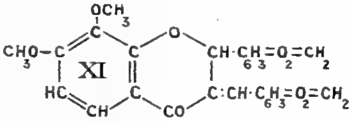
0·2108 substance gave 0·5585 CO_2 and 0·1044 H_2O,
corresponding to C 72·2 H 5·5.
$C_{26}H_{24}O_6$ requires C 72·2 H 5·5.

Anisylidene—3.4.4′ trimethoxy-flavanone crystallizes from alcohol in nearly colourless prisms, which are sparingly soluble in cold, and readily in hot, alcohol, sparingly soluble in ether, soluble in carbon disulphide, and very soluble in benzene or chloroform.

Its solution in warm alcohol gave no coloration with ferric chloride.

The crystals turned a dark red colour on contact with concentrated sulphuric acid, in which they dissolved to a red solution.

11. *Piperonylidene*-3.4. *dimethoxy-3′.4′. methylenedioxy-flavanone.*



Piperonal reacts with gallacetophenone-dimethylether in the presence of alcoholic hydrochloric acid to form a mixture of piperonylidene-3.4. dimethoxy-3′.4′.methylenedioxy-flavanone and piperonylidene-gallacetophenone-dimethylether. The flavanone derivative being less soluble in a mixture of chloroform and alcohol than the chalkone, was separated from the latter by recrystallization. It was obtained in the form of colourless crystals, which melted at 184–186° C., and gave on analysis the following results :—

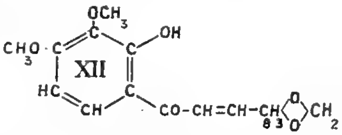
0·1198 substance gave 0·2957 CO_2 and 0·0441 H_2O,
corresponding to C 67·3 H 4·1,
$C_{26}H_{20}O_8$ requires C 67·8 H 4·3.

Piperonylidene-3 . 4 . *dimethoxy-3′ . 4′ . methylenedioxy-flavanone* crystallizes from boiling alcohol in colourless needles, which are sparingly soluble in ether, soluble in benzene, and very soluble in chloroform.

Its solution in boiling alcohol gave no coloration with ferric chloride.

The crystals dissolve in concentrated sulphuric acid, forming a cherry-red solution.

12. *Piperonylidene-gallacetophenone-dimethylether.*



(*a*) Piperonylidene-gallacetophenone-dimethylether is formed as an intermediate compound in the preparation of piperonylidene-3.4. dimethoxy-3′.4′. methylenedioxy-flavanone, and can be separated from the latter by taking advantage of its greater solubility in alcohol, and also by its solubility in warm dilute potash.

It was dissolved in chloroform and extracted from the solution by shaking with warm dilute alkali. Hydrochloric acid was added to the orange-yellow alkaline extract, and the solid which separated was extracted with chloroform. After evaporation of the solvent the residue was recrystallized from boiling alcohol.

When dried at 105° C., it melted at 174–176° C., and gave on analysis the following results:—

0·1517 substance gave 0·3642 CO_2 and 0·0616 H_2O,
corresponding to C 65·5, H 4·54,
$C_{18}H_{16}O_6$ requires C 65·8, H 4·9.

Piperonylidene-gallacetophenone-dimethylether crystallizes in yellow prisms, which are somewhat soluble in cold alcohol or ether, readily soluble in benzene, and very soluble in chloroform.

An alcoholic solution of the substance gave a red coloration with ferric chloride.

Crystals of the substance dissolve in concentrated sulphuric acid, forming an orange solution.

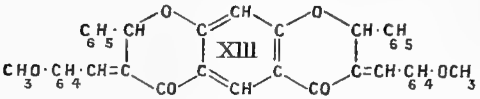
(*b*) Piperonylidene-gallacetophenone-dimethylether was also obtained by the action of 2 ccs. of 50 per cent. sodium hydrate on a solution of 2 grammes of piperonal and 1 gramme of gallacetophenone-dimethylether in 10 ccs. of alcohol. The product of the reaction was dissolved in warm, dilute, aqueous potash. The alkaline solution was washed with ether, and after separation was acidified by addition of dilute hydrochloric acid. After a couple of recrystallizations from alcohol it melted at 174–176° C.

C. *Condensation of a-Dibenzylidene-Diaceto-Resorcinol with Aldehydes in the presence of Hydrochloric Acid.*

13. *Dibenzylidene-diflavanone.*

About 40 ccs. of alcohol saturated with gaseous hydrochloric acid were added to a solution of 2 grammes of *a*-dibenzylidene-diacetoresorcinol and 4 ccs. of benzaldehyde in 60 ccs. of chloroform. The mixture, which turned a red colour, was let stand a few days, and then warmed on the water-bath for a short time. On allowing the solvent to evaporate, a crystalline residue was left. The latter was washed with alcoholic potash, and then recrystallized a few times from chloroform and alcohol. When dried at 105° C., it melted at 268–270° C.

14. *Dianisylidene-diflavanone.*



Two grammes of α-dibenzylidene-diacetoresorcinol and four cubic centimetres of anisaldehyde were dissolved in a mixture of chloroform and alcoho saturated with anhydrous hydrochloric acid. On heating the solution to gentle boiling for several hours under a reflux condenser, it turned a dark brownish-red colour. When the solution was concentrated and mixed with alcohol, about 2·7 grammes of yellow crystals separated. After two recrystallizations from chloroform and alcohol the solid melted at 278–279° C. and gave on analysis the following results :—

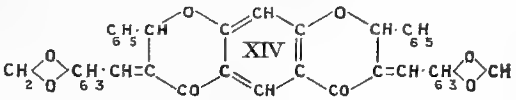
0·1342 substance gave 0·3904 CO_2 and 0·0579 H_2O,
corresponding to C 79·33, H 4·8,
$C_{40}H_{30}O_6$ requires C 79·21, H 4·95.

Dianisylidene-diflavanone crystallizes in faint yellow rhombs, which are scarcely soluble in alcohol, ether, or ligroïn, soluble in benzene, and very readily soluble in warm chloroform.

When suspended in boiling alcohol, it gave no coloration with ferric chloride.

The crystals dissolve in concentrated sulphuric acid to a deep blue solution, which changes to violet, and finally, after some time, becomes red.

15. *Dipiperonylidene-diflavanone.*



In a manner similar to that described for dianisylidene-diflavanone we obtained about 1·2 grammes of dipiperonylidene-diflavanone from 2 grammes of α-dibenzylidene-diacetoresorcinol and a slight excess of piperonal. The solid was recrystallized from pyridine and xylene, and washed with alcohol. When dried at 110° C., it melted to a reddish liquid at 296° C., and gave on analysis the following results :—

0·1306 substance gave 0·3600 CO_2 and 0·0505 H_2O
corresponding to C 75·18, H 4·29
$C_{40}\,H_{26}\,O_8$ requires C 75·68, H 4·12.

Dipiperonylidene-diflavanone crystallizes in light yellow prisms, which are sparingly soluble in boiling xylene or chloroform, nearly insoluble in alcohol or ether, and readily soluble in hot pyridine.

The crystals dissolve in concentrated sulphuric acid to a deep blue solution, the colour of which rapidly changes to purple.

NOTE FOR BINDER.

In the signature lines [2 *E*], [2 *F*], [2 *G*], [2 *H*], "VOL. XXXIII" was printed in error for "VOL. XXXII."

IX.

STUDIES IN THE DIFLAVONE GROUP.

III.—Derivatives of Dicoumaranone and of Diflavanone.

By HUGH RYAN, D.Sc., and JOSEPH ALGAR, M.Sc.,
University College, Dublin.

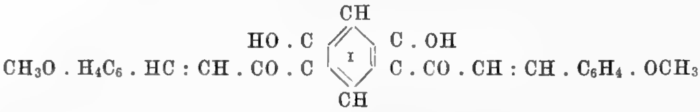
Read December 13, 1915. Published March 28, 1916.

It has been shown by Ryan and O'Neill (Proc. Royal Irish Acad., xxxii (1915), B, p. 48) that dibenzylidene-diacetoresorcinol, which was prepared by the condensation of benzaldehyde with diacetoresorcinol, can be converted into an oily diacetate, and that the latter by interaction with bromine forms a crystalline tetrabromide of dibenzylidene-diacetoresorcinol-diacetate. They found that alcoholic potash converted the tetrabromide into diflavone, and that probably at the same time there was formed a small quantity of dibenzylidene-dicoumaranone. The reaction is similar to that which takes place in the conversion of the dibromide of resacetophenone-monoethylether-monacetate into 3-ethoxy-flavone. [St. v. Kostanecki, A. Rozycki, and J. Tambor, Ber., xxxiii (1900), p. 3410.]

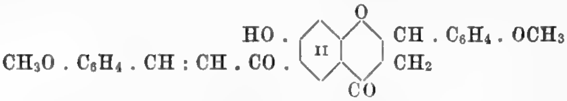
Since diflavone, which is nearly colourless, contains no auxochromic radicals, it cannot function as a mordant dye. It is, therefore, of importance, especially with reference to the relation between the colours of this group and those of the corresponding members of the monoflavone group, to obtain and examine derivatives of diflavone which contain auxochromic radicals.

By the action of potash on an alcoholic solution of diacetoresorcinol and anisaldehyde, Eijkman, Bergema, and Henrad (Chemisch Weekblad I (1905), p. 453), prepared dianisylidene-diacetoresorcinol. The compound consisted of golden-yellow needles, which melted at 204° C. We obtained by a similar method elongated, orange, hexagonal crystals, which melted at 205–206° C., and which we term α-dianisylidene-diacetoresorcinol in order to distinguish it from an isomeric compound which we prepared under other experimental conditions.

The second modification, β-dianisylidene-diacetoresorcinol, was obtained by the long-continued action of dilute aqueous sodium hydroxide on a mixture of diacetoresorcinol and anisaldehyde. It consists of yellow diamond-shaped crystals, which melt at 195–196° C., and since it, like the *a*-modification, gives a brownish-red coloration with alcoholic ferric chloride, it must contain at least one hydroxyl radical in the ortho position to a keto group. Moreover, the two compounds must contain unsaturated ketone groupings, since they give red colorations with concentrated sulphuric acid. They are probably stereoisomeric forms of dihydroxy-dimethoxy-dichalkone (I). The manner in which we prepared the β-derivative led us at first to assign it the chalkone-flavanone formula (II), but the latter formula became untenable when we

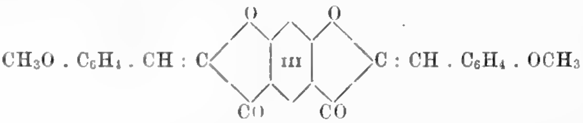


$$\begin{array}{c} \text{HO . C} \quad \overset{\text{CH}}{} \quad \text{C . OH} \\ \text{CH}_3\text{O . H}_4\text{C}_6\text{ . HC : CH . CO . C} \quad \underset{\text{CH}}{\text{I}} \quad \text{C . CO . CH : CH . C}_6\text{H}_4\text{ . OCH}_3 \end{array}$$



$$\begin{array}{c} \text{HO .} \quad \overset{\text{O}}{} \quad \text{CH . C}_6\text{H}_4\text{ . OCH}_3 \\ \text{CH}_3\text{O . C}_6\text{H}_4\text{ . CH : CH . CO .} \quad \underset{\text{CO}}{\text{II}} \quad \text{CH}_2 \end{array}$$

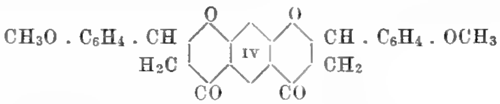
found that the two isomerides formed dihydroxydichalkone-diacetate tetrabromides which reacted with alcoholic potash to give the same crystalline derivative. The product of this treatment must be regarded as a derivative of dicoumaranone (III) rather than of diflavone, since its solution in concentrated sulphuric acid has a deep purple-red colour.



$$\text{CH}_3\text{O . C}_6\text{H}_4\text{ . CH : C} \overset{\text{O}\qquad\text{O}}{\underset{\text{CO}\qquad\text{CO}}{\text{III}}} \text{C : CH . C}_6\text{H}_4\text{ . OCH}_3$$

We also found that diacetoresorcinol condenses with anisaldehyde in the presence of alcoholic hydrochloric acid to form anisylidene-2-p.methoxy-cinnamoyl-3-hydroxy-4′-methoxy-flavanone and dianisylidene-4′.4′-dimethoxy-diflavanone.

It has been commonly assumed that aldehydes condense to unsaturated ketones, with the methyl radical of compounds having the general formula $CH_3CO . X$ only in the presence of alkali, and that in the presence of an acid, such as hydrochloric, this condensation does not take place. In the formation of diflavone derivatives, like dianisylidene-diflavanone and dibenzylidene-diflavanone (Ryan and O'Neill, *loc. cit.*), it is evident that in the first stage of the reaction, which is carried out by means of alcoholic hydrochloric acid, the aldehyde must condense with the aceto radicals to form a dichalkone derivative such as (I), which is afterwards converted by the alcoholic hydrochloric acid into a derivative of diflavanone (IV).



By further condensation with anisaldehyde the latter compound forms dianisylidene-4′.4′-dimethoxy-diflavanone (X).

Experimental Part.

A. *Derivatives of Dichalkone.*

1. *Dianisylidene-diacetoresorcinol-dimethylether* (V).

Two grams of diacetoresorcinol-dimethylether were dissolved in 25 c.cs. of hot absolute alcohol and 4 c.cs. of anisaldehyde were added. To the warm solution 2 c.cs. of 25 per cent. sodium hydrate were added, and the mixture was heated on a water-bath until, after a few minutes, a yellow solid separated. The solid was filtered, washed first with alcohol, next with water, dried, and finally recrystallized from a mixture of chloroform and alcohol.

The yield was nearly quantitative.

The substance, when dried at 105° C., melted at 204–205° C., and gave on analysis the following results;—

0·1553 substance gave 0·4176 CO_2 and 0·0804 H_2O
corresponding to C 73·34, H 5·75
$C_{28}H_{26}O_6$ requires C 73·36, H 5·68

Dianisylidene-diacetoresorcinol-dimethylether crystallizes from benzene in light yellow, long needles, which are insoluble in petroleum ether, nearly insoluble in cold alcohol, sparingly soluble in cold chloroform or benzene, and dissolve more readily in the latter solvents on warming.

The crystals are coloured red by concentrated sulphuric acid, in which they dissolve to a red solution.

A solution of the substance in hot alcohol gives no coloration with ferric chloride.

An attempt was made to demethylate the compound by heating it with concentrated hydriodic acid, but the product was so resinified that no crystalline compound could be isolated from it. Similarly, demethylation by means of anhydrous aluminium chloride in boiling xylene gave unsatisfactory results.

2. *Dibromide of Dianisylidene-diacestoresorcinol dimethylether.*

This compound was the only product isolated in an attempt which was made to prepare the corresponding tetrabromide.

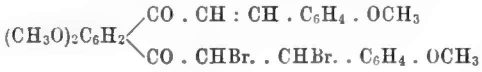
One gram of the dimethylether was dissolved in 10 c.cs. of chloroform, and 0·7 gram of bromine (four atoms) was added to the solution. The colour of the bromine disappeared almost immediately, apparently without evolution of hydrobromic acid. The colourless solid which separated after addition of absolute alcohol was recrystallized several times from a mixture of chloroform and alcohol.

A determination of bromine in the compound by Stepanow's method gave the following results:—

0·2121 substance on treatment with sodium and alcohol gave an amount of sodium bromide which required 6·7 c.cs. of $\frac{N}{10}$ $AgNO_3$ for complete precipitation

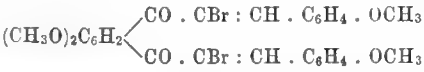
corresponding to Br 25·2
$C_{28}H_{26}O_6Br_4$ requires Br 41·1
$C_{28}H_{26}O_6Br_2$ requires Br 25·8
$C_{28}H_{24}O_6Br_2$ requires Br 25·95

The bromine percentage 25·8 corresponds to the formula (VI .



$$(CH_3O)_2C_6H_2\left\langle\begin{array}{l} CO\ .\ CH : CH\ .\ C_6H_4\ .\ OCH_3 \\ CO\ .\ CHBr.\ .\ CHBr.\ .\ C_6H_4\ .\ OCH_3 \end{array}\right.$$

and the bromine percentage 25·95 to the formula (VII).



$$(CH_3O)_2C_6H_2\left\langle\begin{array}{l} CO\ .\ CBr : CH\ .\ C_6H_4\ .\ OCH_3 \\ CO\ .\ CBr : CH\ .\ C_6H_4\ .\ OCH_3 \end{array}\right.$$

It is probable that an unstable tetrabromide is first formed, and that in the subsequent crystallizations it splits off two molecules of hydrobromic acid forming the dibromide. A similar phenomenon, observed by Miss O'Neill in the case of dipiperonylidene-diacetoresorcinol-dimethylether, will be described later.

The dibromide crystallizes from a mixture of chloroform and alcohol in colourless needles, which melt at 166–168° C. It is almost insoluble in cold alcohol, ether, or ligroin and sparingly soluble in chloroform.

On heating the substance with concentrated hydriodic acid an almost black resinous solid was obtained which did not crystallize.

Isomeric Forms of Dianisylidene-diacetoresorcinol.

3. *α-Dianisylidene-diacetoresorcinol* (I).

This compound is apparently identical with that obtained by Eijkmann, Bergema, and Henrard (*loc. cit.*) by the condensation of diacetoresorcinol with anisaldehyde in the presence of alcoholic sodium hydroxide.

About 35 c.cs. of 50 per cent. aqueous sodium hydroxide were added, drop by drop, to a solution of 10 grams of diacetoresorcinol, and 20 c.cs. of anisaldehyde in 300 c.cs. of boiling alcohol. After addition of the sodium hydroxide the mixture was further heated for about twenty minutes, when a considerable quantity of an orange-coloured solid separated, which was filtered and washed with cold alcohol. The solid was then shaken with dilute hydrochloric acid, its colour changing from orange to yellow. It was re-crystallized first from chloroform and alcohol, and afterwards from a small quantity of acetone.

The yield was seven grams.

The substance crystallized from acetone in orange, somewhat elongated hexagonal crystals, which melted at 205–206° C., and gave on analysis the following results:—

0·1618 substance gave 0·4325 CO_2 and 0·0775 H_2O
corresponding to C 72·89, H 5·32
$C_{26}H_{22}O_6$ requires C 72·55, H 5·11

α-Dianisylidene-diacetoresorcinol is almost insoluble in cold alcohol, slightly soluble in cold acetone, and soluble in cold chloroform.

Concentrated sulphuric acid colours the crystals dark red, and dissolves them to a bright red solution.

A solution of the substance in hot alcohol is coloured brownish-red by ferric chloride.

4. *β-Dianisylidene-diacetoresorcinol.*

Anisaldehyde (21 c.cs.), diacetoresorcinol (17·5 grams), and sodium hydrate (6 grams) were mixed in a flask with 1200 c.cs. of water, and the mixture was allowed to stand in a warm place, with occasional shaking, for six months. A crystalline, yellow solid gradually separated. The solid was filtered, washed with dilute hydrochloric acid, and crystallized from a mixture of chloroform and alcohol. After re-crystallization from a mixture of chloroform and acetone, it was obtained in the form of yellow diamond-shaped crystals, which melted at 195°–196° C. A mixture of it with α-dianisylidene-diacetoresorcinol melted between 170° and 190° C.

$$\begin{gathered}0{\cdot}1505 \text{ substance gave } 0{\cdot}4003\ CO_2 \text{ and } 0{\cdot}0726\ H_2O\\ \text{corresponding to C } 72{\cdot}54, \text{ H } 5{\cdot}35\\ C_{26}H_{22}O_6 \text{ requires C } 72{\cdot}55, \text{ H } 5{\cdot}11.\end{gathered}$$

β-Dianisylidene-diacetoresorcinol is soluble in cold chloroform or hot benzene, and almost insoluble in cold alcohol.

Concentrated sulphuric acid dissolves the substance, forming a bright-red solution.

A solution of it in hot alcohol is coloured a brownish-red by ferric chloride.

B. *Dianisylidene-Dicoumaranone.*

5. *Tetrabromide of Dianisylidene-diacetoresorcinol-diacetate* (VIII).

$$\begin{array}{c} CH_3 . COO \quad \text{(VIII)} \quad OOC . CH_3 \\ CH_3O . C_6H_4 . CHBr . CHBr . CO \quad\quad CO . CHBr . CHBr . C_6H_4 . OCH_3 \end{array}$$

A mixture of 2 grams of α-dianisylidene-diacetoresorcinol, 2 grams of anhydrous sodium acetate, and 20 c.cs. of acetic anhydride was heated to gentle boiling on a sand-bath, and was then allowed to cool slowly; water was added, and the mixture was let stand for a couple of hours. The aqueous layer was decanted, the residue was shaken with dilute sodium carbonate, and extracted with ether. The ether solution was dried with calcium chloride, filtered, and after evaporation of the ether a yellow, oily residue was obtained.

The oily diacetate was dissolved in a small quantity of chloroform, and the theoretical amount of bromine was added to this solution. After standing for several hours most of the chloroform was evaporated, and alcohol was added to the residue. A colourless amorphous compound was precipitated. As repeated efforts to crystallize it were unsuccessful, we converted it by interaction with alcoholic potash into dianisylidene-dicoumaranone.

6. *Dianisylidene-dicoumaranone* (III).

To an alcoholic solution of the tetrabromide of the diacetate prepared from 3 grams of α-dianisylidene-diacetoresorcinol 84 c.cs. (6 mols.) of semi-normal alcoholic potash were added, and the mixture was heated on the water-bath for five minutes. The solution, which darkened in colour with separation of a brownish-yellow solid, was cooled and filtered. The residue was washed with water and alcohol. A solution of the solid in hot chloroform was washed with water, concentrated and mixed with alcohol. The yellow solid which separated was re-crystallized from chloroform, and dried at 105° C. for analysis :—

0·1475 substance gave 0·3930 CO_2 and 0·0603 H_2O
corresponding to C 72·66 H 4·54
$C_{26}H_{18}O_6$ requires C 73·21 H 4·25.

Dianisylidene-dicoumaranone crystallizes from chloroform in yellow prisms, which after drying at 150° C., melt at 327°–328·5° C.

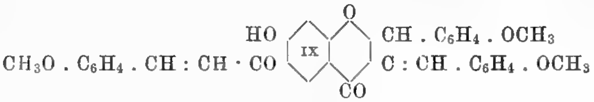
It is almost insoluble in the usual organic solvents.

The crystals dissolve in concentrated sulphuric acid, forming a deep purple-red solution.

In a similar manner, the same dianisylidene-dicoumaranone was obtained from β-dianisylidene-diacetoresorcinol.

C. *Derivatives of Diflavanone.*

7. *Anisylidene-2-p. methoxycinnamoyl-3-hydroxy-4′-methoxyflavanone* (IX).



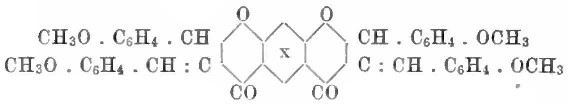
Diacetoresorcinol (5 grams) and anisaldehyde (20 c.cs.) were dissolved in 200 c.cs. of hot alcohol, and dry hydrochloric acid was passed into the solution until the latter was saturated. The mixture was allowed to stand, with occasional heating for several days in a stoppered flask. The dark-red, oily product which was precipitated, was crystallized several times from a mixture of chloroform and alcohol. By this means orange-yellow crystals were obtained, which gave on analysis the following results :—

0·1556 substance gave 0·4246 CO_2 and 0·0704 H_2O
corresponding to C 74·42 H 5·02
$C_{34}H_{27}O_7$ requires C 74·45 H 5·1.

Anisylidene-2-p. methoxycinnamoyl-3-hydroxy-4′-methoxyflavanone crystallizes from a mixture of chloroform and alcohol in orange-yellow leaves, which melt at 243°–245° C., are soluble in chloroform, slightly soluble in benzene, and almost insoluble in alcohol.

The crystals dissolve in concentrated sulphuric acid, forming a deep-blue solution, the colour of which rapidly changes to a purple-red.

8. *Dianisylidene- 4′ . 4′ -dimethoxy-diflavanone* (X).



A mixture of 5 grams of diacetoresorcinol, 20 c.cs. of anisaldehyde, and 200 c.cs. of alcohol was saturated with hydrochloric acid gas, and allowed to stand for five days. The dark red, oily product was washed with cold alcohol, and after several crystallizations from boiling xylene it was obtained in the form of yellow crystals which melted at 249°–251° C., and gave on analysis the following results :—

0·1703 substance gave 0·4704 CO_2 and 0·0790 H_2O
corresponding to C 75·33, H 5·15
$C_{43}H_{34}O_8$ requires C 75·67, H 5·14.

Dianisylidene-4′ . 4′-dimethoxy-diflavanone crystallizes from boiling xylene in yellow prisms, which are soluble in chloroform, moderately soluble in hot benzene or hot xylene, and nearly insoluble in alcohol.

Like anisylidene- 2-p . methoxycinnamoyl-3-hydroxy-4′ methoxy-flavanone the deep blue of its solution in concentrated sulphuric acid rapidly changes to purple-red.

X.

STUDIES IN THE DIFLAVONE GROUP.

IV.—ON DIVERATRYLIDENE-DICOUMARANONE.

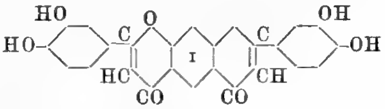
BY HUGH RYAN, D.SC., AND MICHAEL J. WALSH, M.SC.,
University College, Dublin.

Read DECEMBER 13, 1915. Published MARCH 28, 1916.

IT has been shown by Ryan and O'Neill (Proc. Royal Irish Academy, xxxii (1915), B, p. 48) that dibenzylidene-diacetoresorcinol interacts with acetic anhydride and sodium acetate to form a diacetate, which readily adds on bromine; and that when the tetrabromide of the dihydroxydichalkone diacetate is heated with alcoholic potash it is converted into diflavone.

As diflavone contains no hydroxyl radicals, it cannot act as a mordant dye. It seemed, therefore, of interest to attempt the preparation of hydroxyl-derivatives of diflavone, with a view to elucidating the effect of the double chromophore on the tinctorial properties of the group.

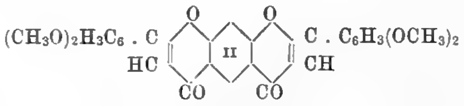
From the marked auxochromic character of two hydroxyl radicals in the ortho position, as in quercetin, alizarin, and several other dyes, it was to be expected that one of the most important dyes derived from diflavone would be a tetrahydroxy-diflavone (I) of the formula:—

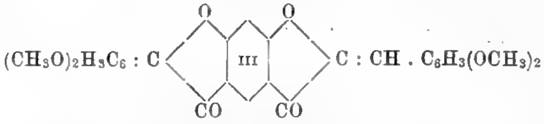


A synthesis of this tetrahydroxy-diflavone was attempted, but as the course of the reaction proceeded in a different manner from that observed by Ryan and O'Neill in the case of diflavone, the final product which we obtained was a derivative not of diflavone, but of the unknown dicoumaranone.

Diacetoresorcinol, prepared by the method of Eijkman, Bergema, and Henrard (Chemisch Weekblad, i. p. 453), from resorcinol diacetate and zinc chloride, interacted with veratric aldehyde in the presence of alcoholic sodium hydroxide to form diveratrylidene-diacetoresorcinol, and from the latter compound by acetylation a diacetate was obtained.

The yellow crystalline solid, which is formed when the tetrabromide of diveratrylidene-diacetoresorcinol diacetate is warmed with alcoholic potash, may be either tetramethoxydiflavone (II) or diveratrylidene-dicoumaranone (III).





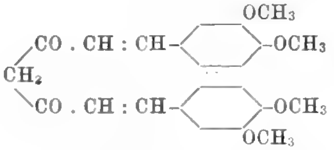
It is only from analogy with the corresponding reactions in the monoflavone group and from the behaviour of the compound that it can be determined whether the new compound is a derivative of diflavone or of dicoumaranone.

Flavones dissolve in concentrated sulphuric acid, giving colourless or yellow solutions, with or without fluorescence; while coumaranones, on the other hand, with sulphuric acid, give orange or red solutions.

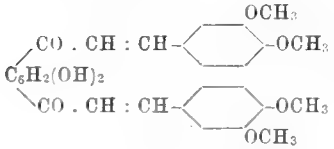
A solution of diflavone in concentrated sulphuric acid has a light yellow colour and a characteristic blue fluorescence. Since the diveratrylidene-derivative, which we prepared, forms a deep violet-coloured solution in concentrated sulphuric acid, its behaviour is similar to that of coumaranones, and very unlike that of flavones or of diflavone.

Moreover, in the monoflavone group, the chalkones derived from resacetophenone and benzaldehyde can be converted into flavones, whereas those derived from other aldehydes, such as anisaldehyde, form coumaranone derivatives.

There is a similarity between the structure of diveratrylidene-diacetoresorcinol and that usually assigned to curcumin-dimethyl ether, which makes a determination of the tinctorial character of the diveratrylidene compound of interest.

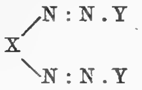


Curcumin-dimethylether.



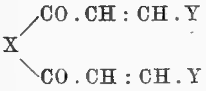
Diveratrylidene-diacetoresorcinol.

From analogy based on the structure of direct dyes in the nitrogen group which contain two chromophore radicals symmetrically placed in the molecule:—



$$X\begin{matrix}\diagup N:N.Y\\ \diagdown N:N.Y\end{matrix}$$

it has been concluded by von Kostanecki, Lampe, and Milobedzcka [Ber. 43 (1910), p. 2163], that curcumin also contains two chromophores symmetrically placed in the molecule:—



$$X\begin{matrix}\diagup CO.CH:CH.Y\\ \diagdown CO.CH:CH.Y\end{matrix}$$

Curcumin, inasmuch as it is a β-diketone, is also a mordant dye (Werner. Ber. 41 (1908), p. 1057).

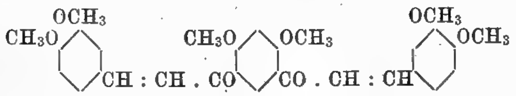
It is generally held (c.f. von Kostanecki, Lampe, and Milobedzcka (*loc. cit.*)) that the auxochromic character of the hydroxyl radical in the "vanillin rest" is not very marked, and if this is true, the dimethylether of curcumin should not, as a dye, differ very markedly from curcumin, nor should the tinctorial character of diveratrylidene-diacetoresorcinol differ very much from that of curcumin, if the former substance is a mordant dye.

Experiments showed, however, that diveratrylidene-diacetoresorcinol is not a direct dye, and its tinctorial effects on samples of wool mordanted with alumina, tin salt, iron salt, and chrome salt respectively are so slightly marked that the substance can scarcely be regarded as a mordant dye.

Experimental.

Diacetoresorcinol, which was obtained by the action of zinc chloride on resorcinol-diacetate, was converted by means of dimethyl sulphate and potash into diacetoresorcinol-dimethyleter, following the method already described by Ryan and O'Neill (Proc. Royal Irish Acad., 1915, B, p. 48). It condensed readily with veratric aldehyde in the presence of alcoholic sodium hydroxide to form diveratrylidene-diacetoresorcinol-dimethylether.

(1) *Diveratrylidene-Diacetoresorcinol-Dimethylether.*



1 c.c. of 50 per cent. sodium hydrate was added to a hot solution of 2 grams of diacetoresorcinol dimethylether and 2 grams of veratric aldehyde in 20 c.cs. of alcohol. On warming the mixture for a short time on the

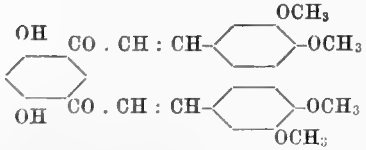
water-bath, a yellow crystalline solid separated. The solid was filtered washed with water and alcohol, dried, and recrystallized from chloroform and alcohol. When dried at 105° C., it softened at 212° C., melted at 216–217° C., and gave on analysis the following results:—

0·1299 substance gave 0·3294 CO_2 and 0·0692 H_2O,
corresponding to C 69·17, H 5·92,
$C_{30}H_{30}O_8$ requires C 69·46, H 5·84.

Diveratrylidene-diacetoresorcinol-dimethylether crytallizes from chloroform and alcohol in light yellow prisms which are insoluble in water, dilute potash, petroleum ether, or ligroin, scarcely soluble in alcohol, ether, or toluene, soluble in benzene, and readily soluble in chloroform.

A solution of the substance in concentrated sulphuric acid has a deep red colour. An alcoholic solution of the substance gives no coloration with ferric chloride.

(2) *Diveratrylidene-Diacetoresorcinol.*



A solution of 2 grams of diacetoresorcinol and 3·5 grams of veratric aldehyde in 50 c.cs. of absolute alcohol was heated to gentle boiling on a sand-bath, and to it 5 c.cs. of 50 per cent. sodium hydrate were added gradually. After a short time the sodium derivative of diacetoresorcinol separated, which, on further heating, redissolved. By continuing the heating for half an hour the orange-coloured sodium derivative of diveratrylidene-diacetoresorcinol separated. On addition of alcohol a further precipitate was obtained. The solid was filtered, washed with alcohol, dissolved in water, and precipitated by addition of dilute hydrochloric acid. When recrystallized several times from chloroform and alcohol it softened at 193° C., melted at 194–196° C., and gave on analysis the following results:—

0·1230 substance gave 0·3080 CO_2 and 0·0588 H_2O,
corresponding to C 68·3, H 5·3.
$C_{28}H_{26}O_8$ requires C 68·5, H 5·3.

Diveratrylidene-diacctoresorcinol crystallizes from chloroform and alcohol in light orange-yellow acicular prisms. It dissolves easily in chloroform, slightly in benzene, and with difficulty in alcohol or ether. It is insoluble in water, and dissolves readily in dilute aqueous alkali.

An alcoholic solution of the substance gives a red coloration with ferric chloride.

A solution of the substance in concentrated sulphuric acid has a deep red colour.

The constitution of the substance being very similar to that generally assumed for dimethyl-curcumin, it was considered desirable to examine its behaviour towards unmordanted and mordanted fabrics. The substance gave no tinctorial effect with unmordanted wool. With wool mordanted with aluminium chloride and stannous chloride, the following results were obtained:—

Mordant.	Alum.	Tin Salt.
Tint.	Pale lemon.	Pale canary.

The tints for curcumin are:—

Orange Yellow.	Orange Red.

It is thus seen that the tinctorial effects of diveratrylidene-diacetoresorcinol on mordanted wool are very slight in comparison with those obtained with curcumin.

(3) *Diveratrylidene-Diacetoresorcinol Diacetate.*

A mixture of 1 gram of diveratrylidene-diacetoresorcinol, 1 gram of anhydrous sodium acetate, and 10 c.cs. of acetic anhydride was heated to vigorous boiling on a sand-bath, and then allowed to cool. Cold water was added, and the mixture was left, with occasional shaking, for a short time. The aqueous layer was decanted, the residual oil was well shaken with a solution of sodium bicarbonate, and then extracted with chloroform, and finally mixed with absolute alcohol. After several recrystallizations from chloroform and alcohol, the diacetate melted at 155–157° C., and gave on analysis the following results:—

0·1080 substance gave 0·2644 CO_2 and 0·0496 H_2O,
corresponding to C 66·76, H 5·1,
$C_{32}H_{30}O_{10}$ requires C 66·87, H 5·26.

It crystallizes from chloroform and alcohol in slender yellow prisms, which are slightly soluble in carbon disulphide, alcohol, or ether, soluble in benzene, and readily soluble in chloroform.

Its alcoholic solution gives no coloration with ferric chloride. A solution of the substance in concentrated sulphuric acid has a deep red colour.

(4) *Diveratrylidene-Diacetoresorcinol Diacetate Tetabromide.*

After addition of a chloroform solution of 0·6 gram of bromine to a solution of 1 gram of diveratrylidene-diacetoresorcinol diacetate in the least possible quantity of dry chloroform, the colour of the bromine disappeared rapidly. The solution, after standing over-night in a stoppered flask, was concentrated, and mixed with alcohol. As the light-yellow amorphous solid thus got showed no tendency to become crystalline, it was converted by treatment with alcoholic potash into diveratrylidene-dicoumaranone.

(5) *Diveratrylidene-Dicoumaranone.*

The tetrabromide (1·5 gram) dissolved in 20 c.cs. of semi-normal alcoholic potash, forming a reddish solution, which, when heated for a few minutes on a water-bath, gave a copious separation of a solid. The solid was filtered, washed with water, alcohol, and chloroform, and then recrystallized a couple of times from glacial acetic acid. When dried at 105° C., it softened at 279° C., and melted at 285–286° C. As the substance was very sparingly soluble in organic solvents, it was difficult to free it from the small quantity of mineral matter which was present even in the sample analysed:—

0·1163 substance gave 0·2915 CO_2 and 0·0467 H_2O,
corresponding to C 68·36, H 4·47,
$C_{28}H_{22}O_8$ requires C 69·11, H 4·56.

(The ash left in the boat weighed 0·0014 gram, and if a correction for this is made, the percentages of carbon and hydrogen become 69·19 and 4·52 respectively.)

Diveratrylidene-dicoumaranone crystallizes from glacial acetic acid in thin, yellow, apparently hexagonal plates, which are nearly insoluble in alcohol or toluene, and slightly soluble in chloroform or boiling xylene.

The crystals dissolve in concentrated sulphuric acid, forming a deep violet solution, the colour of which changes to a light brown after standing for a few hours.

XI.

ON UNSATURATED β-DIKETONES.—III.

By HUGH RYAN and GERALDINE PLUNKETT,
University College, Dublin.

Read December 13, 1915. Published March 28, 1916.

By the action of methyl cinnamate on acetone in the presence of sodium wire, Ryan and Dunlea (Proc. Royal Irish Acad. xxxii (1913), B, p. 1) obtained an unsaturated β-diketone, cinnamoyl-acetyl-methane. Similarly from cinnamic ester and acetophenone, methyl-ethyl-ketone and methyl-isopropyl-ketone they obtained cinnamoyl-benzoyl-methane, cinnamoyl-propionyl-methane, and cinnamoyl-isobutyryl-methane respectively.

Attempts to synthesise dicinnamoyl-methane—the parent substance of curcumin—by this method were unsuccessful, and indeed it was found that although the unsaturated compound, cinnamic ester, condenses with saturated ketones, it does not interact in the same manner with unsaturated ketones.

It was shown later by Ryan and Algar (Proc. Royal Irish Acad. xxxii (1913), B, p. 9) that unsaturated ketones such as benzylidene-acetone and anisylidene-acetone condense readily with dimethyl oxalate, in the presence of sodium, to form unsaturated β-diketones, such as methyl cinnamoyl-pyruvate and methyl p. methoxycinnamoyl-pyruvate, and that these diketones, as well as the diketone-acids formed by their gentle hydrolysis, have well-marked tinctogenic properties.

In the present communication we deal with the conversion of veratrylidene-acetone into the unsaturated β-diketone, methyl 3.4-dimethoxycinnamoyl-pyruvate. The latter compound formed the benzeneazo-derivative, and the isoxazol characteristic of β-diketones. It was also converted into 3.4-dimethoxycinnamoyl-pyruvic acid.

Similarly from piperonylidene-acetone we obtained methyl methylene-3.4-dioxycinnamoyl-pyruvate, and the corresponding acid.

A comparison of the shades obtained with mordanted wool, and some of the synthetical, unsaturated diketone-dyes recently prepared by us, may be of some interest, and for this purpose we have compiled the following table, which gives a summary of the shades given by these dyes, and by curcumin :—

—	Colour given to Wool Mordanted with—			
Dye	Chrome	Alum	Tin	Iron
Cinnamoyl-acetyl-methane[1],	Dark yellow	Light yellow	—	Bright red
Cinnamoyl-benzoyl-methane[1],	Dark yellow	Light yellow	—	Reddish-brown
Methyl Cinnamoyl-pyruvate[2],	Russet-brown	Orange-yellow	Light Orange-yellow	Reddish-brown
Cinnamoyl-pyruvic acid[2],	Brown	Orange	Orange	Deep Reddish-brown
Methyl p. Methoxycinnamoyl-pyruvate[2],	Saffron	Orange-yellow	Orange	Olive-brown
p. Methoxycinnamoyl-pyruvic acid[2],	Chocolate-brown	Bright orange	Bright orange	Reddish-brown
Methyl 3·4 Dimethoxycinnamoyl-pyruvate,	Chocolate-brown	Deep yellow	Bright orange	Dark Olive-brown
Methyl Methylene-3·4-dioxycinnamoyl-pyruvate,	Light brown	Yellow	Orange-yellow	Brownish-black
3·4-Dimethoxycinnamoyl-pyruvic acid,	Chocolate-red	Orange-red	Orange-brown	Dark chocolate-brown
Curcumin,	Brown	Orange-yellow	Orange-red	Brownish-black

It will be seen from the above table that the shades imparted to mordanted wool by 3·4-dimethoxycinnamoyl-pyruvic acid and its methyl ester are very similar to those obtained with curcumin—the dye of turmeric—and this similarity in the shades may indeed be advanced as an argument in support of the formula which has been assigned to curcumin. If we compare the formulae of the three substances, curcumin (I), methyl

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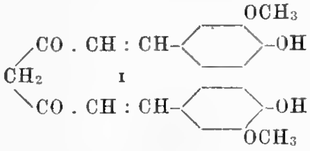
[1] Ryan and Dunlea (*loc. cit.*).

[2] Ryan and Algar (*loc. cit.*).

3.4-dimethoxy-cinnamoyl-pyruvate (II), and 3.4-dimethoxycinnamoyl-pyruvic acid (III):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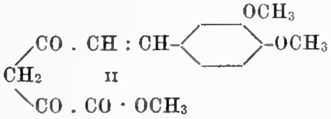
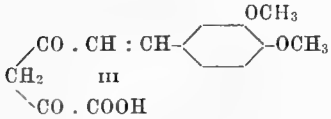

II


III

and bear in mind that since the auxochromic effect of the hydroxyls in the vanillin residues of curcumin can only be very slight, the curcumin shades should not differ materially from those of its dimethyl ether, it is evident that the three compounds should give similar shades to mordanted wool. The same double chromophore, -CO : CH : CH-, is present in all the compounds, and also the auxochrome is the acidic methylene radical. In the curcumin molecule the double chromophore occurs twice, but this is to some extent balanced by the fact that the methylene radical in $X . CO . CH_2 . CO . COOR$ is a much stronger auxochrome than the same radical in the group $X . CO . CH_2 . CO . X$. Still more is this so in the case of the pyruvic acid, the shades of which are even more intense than those of curcumin.

It will be seen also that the tints got with cinnamoyl-acetylmethane are slightly less intense than those got with cinnamoylbenzoyl-methane, and this is probably due rather to the greater intensification of the auxochromic methylene radical by the more acidic benzoyl radical than to the slight chromophoric character of the phenyl group. This view gains support from the intensification of the shades obtained by replacing phenyl by the still more acidic carboxyl radical.

The effect of methoxyl in increasing the depth of the colour is shown by a comparison of the tints got with cinnamoyl-pyruvic acid, p. methoxy-cinnamoyl-pyruvic acid, and 3·4-dimethoxycinnamoyl-pyruvic acid, the last compound dyeing mordanted wool deeper shades than any other member of the group.

EXPERIMENTAL PART.

1. *Veratrylidene-Acetone.*

Veratric aldehyde was prepared by adding 37·5 grams of hot 50 per cent. aqueous potash to a solution of 25 grams of vanillin and 41·5 grams of dimethyl sulphate in a little alcohol (von Kostanecki and J. Tambor Ber. xxxix (1906), p. 4022). When the energetic reaction had subsided, water was added, the mixture was made slightly alkaline and the veratric aldehyde was extracted with ether. After evaporation of the ether, colourless crystals of veratric aldehyde were obtained.

The yield was nearly quantitative.

To a solution of 25 grams of veratric aldehyde in a mixture of 96 c.cs of acetone and 34 c.cs of water 3·4 c.cs of 25 per cent. sodium hydrate were added. The mixture was left for twelve hours in a stoppered flask, and then, after addition of 150 c.cs of water, the solid was extracted with ether. The veratrylidene-acetone, which was obtained after removal of the ether, was recrystallized from hot, dilute alcohol. It melted at 85°–86° C, and gave on analysis the following results:—

0·1006 substance gave 0·2582 CO_2 and 0·0606 H_2O
corresponding to C 69·99, H 6·68
$C_{12}H_{14}O_3$ requires C 69·90, H 6.79.

Veratrylidene-acetone crystallizes from dilute alcohol in almost colourless prisms, which are readily soluble in alcohol, ether, chloroform, or benzene.

Its alcoholic solution gives no coloration with ferric chloride.

The crystals are coloured red on contact with concentrated sulphuric acid in which they dissolve, forming an orange-coloured solution.

Veratrylidene-acetone was also obtained by methylating ferulic-methylketone, the latter substance having been prepared by condensing vanillin with acetone in the presence of dilute alkali.

Ferulic-methylketone (15 grams) and methyl iodide (22 grams) were dissolved in 200 c.cs of alcohol, and 8·74 grams of 50 per cent. aqueous potash were added. The mixture was heated to gentle boiling under a reflux condenser for two and a half hours. The alcohol was distilled, water was added, and the ketone was extracted with ether from the alkaline solution. When the oily residue, which remained after evaporation of the ether, was covered with a layer of alcohol, it became crystalline. After recrystallization from dilute alcohol it melted at 85°–86° C.

L. Francesconi and G. Cusmano (Gazz. chim. ital. xxxviii (1908), II, p. 70) by a similar method obtained yellow acicular crystals, which melted at 168° C, and which apparently constitute an isomeric form of the compound described above.

3. *Methyl-3·4-dimethoxycinnamoyl-pyruvate.*

$$(CH_3O)_2C_6H_3CH : CH . CO . CH_2 . CO . COOCH_3$$

A mixture of 20 grams of veratrylidene-acetone and 30 grams of dimethyl oxalate was heated in a small dry flask until it had melted; five grams of sodium wire were added, and the mixture was warmed until an energetic reaction commenced. When the reaction had subsided, about 50 c.cs of anhydrous ether were added, and the flask, protected from atmospheric moisture, was let stand for twenty-four hours. The excess of sodium was removed by addition of moist ether. The sodium derivative of the diketone was dissolved in 100 c.cs of water; the alkaline aqueous layer was separated and acidified with dilute hydrochloric acid. The diketone was extracted with chloroform. The chloroform solution was shaken with dilute sodium bicarbonate, separated, and passed through a dry filter paper. On addition of alcohol to the concentrated chloroform solution, the diketone separated in orange-yellow crystals, which, when dried, melted at 121°–122°C., and gave on analysis the following result:—

0·2172 substance gave 0·4888 CO_2 and 0·1122 H_2O
corresponding to C 61·37, H 5·7
$C_{15}H_{16}O_6$ requires C 61·64, H 5·5.

Methyl 3·4-dimethoxycinnamoyl-pyruvate crystallizes from alcohol in orange-yellow plates, which are sparingly soluble in cold alcohol, soluble in ether or benzene, and readily soluble in chloroform. Its solution in ether or chloroform has a strong green fluorescence.

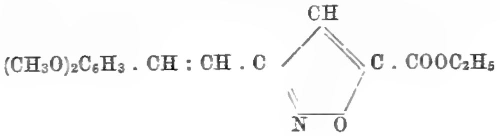
A solution of the substance in boiling alcohol gives a dark-brown coloration with ferric chloride.

The crystals are coloured dark violet on contact with concentrated sulphuric acid, in which they dissolve, forming a violet-coloured solution.

When mordanted wool is boiled with a solution of the substance in diluted alcohol, the following shades are obtained:—

Mordant	*Colour*
Aluminium Sulphate, . .	Deep yellow
Potassium Dichromate, .	Chocolate-brown
Stannous Chloride, . .	Bright orange
Ferric Sulphate, . . .	Dark olive-brown

3. *Ethyl 3·4-Dimethoxy-γ-Cinnamenyl-Isoxazol-α-Carboxylate.*



A solution of 3 grams of methyl-3·4-dimethoxycinnamoyl-pyruvate and 6 grams of hydroxylamine hydrochloride in 100 c.cs. of alcohol was heated to gentle boiling under a reflux condenser for five hours. The mixture was boiled with animal charcoal and filtered. Half of the alcohol was removed by distillation, and boiling water was added to the residue until a precipitate began to form in the hot liquid, which was then cooled in iced water for a couple of hours and filtered, The isoxazol crystallized from dilute alcohol in colourless prisms, which melted in 135°–137°C, and gave on analysis the following results:—

0·1100 substance gave 0·2532 CO_2 and 0·0600 H_2O.
corresponding to C 62·77, H 6·06
$C_{16}H_{17}O_5N$ requires C 63·3, H 5·61.

As in the case of the action of hydroxylamine hydrochloride on methyl cinnamoyl-pyruvate, previously described by Ryan and Algar (Proc. Royal Irish Acad. xxxii (1913) B, p. 12), the methyl ester of the pyruvic acid was converted by the hydroxylamine hydrochloride in the ethyl alcoholic solution into the ethyl ester of the isoxazol-carboxylic acid.

The isoxazol is insoluble in dilute aqueous potash, sparingly soluble in cold, readily in hot alcohol, and readily soluble in chloroform.

An alcoholic solution of the substance gives no coloration with ferric chloride.

4. *Benzeneazo-3·4-Dimethoxycinnamoyl-pyruvic Methyl Ester.*

$$(CH_3O)_2C_6H_3\,.\,CH:CH\,.\,CO\,.\,\underset{\displaystyle N:N\,.\,C_6H_5.}{\underset{|}{CH}}\,.\,CO\,.\,COOCH_3$$

A solution of 3·4-dimethoxycinnamoyl-pyruvic methyl ester in alcohol was cooled in iced water, and to it was added a cold, dilute, aqueous solution of phenyldiazonium chloride. On addition of a cold, saturated solution of sodium acetate, the mixture became turbid, and after standing in iced water for four hours the solid which separated was filtered, recrystallized from dilute alcohol, and dried in a vacuum desiccator. It consisted of orange needles, which melted at 105–107°C, and gave on analysis the following results:—

0·2000 substance gave 12 c.cs of nitrogen at 766·3 m.m.p. and 10° C.
corresponding to N 7·14
$C_{21}H_{20}N_2O_6$ requires N 7·07.

Benzeneazo-3·4-dimethoxycinnamoyl-pyruvic methyl ester is soluble in cold alcohol, readily soluble in hot alcohol or benzene, and very readily soluble in chloroform. It dissolves also in dilute aqueous potash.

5. 3·4-*Dimethoxycinnamoyl-Pyruvic Acid.*

$(CH_3O)_2C_6H_3 . CH : CH . CO . CH_2 . CO . COOH.$

Dimethoxycinnamoyl-pyruvic methyl ester (2·92 grams) was shaken with 40 c.cs. of semi-normal, alcoholic potash in a stoppered flask until solution had taken place, and was then let stand for twenty-four hours. About 100 c.cs. of water were added, and the alkaline solution was extracted with ether. From its solution in the latter solvent the acid was extracted by means of dilute sodium carbonate; the aqueous layer was again acidified, and once more extracted with ether. The ether was distilled, and the residue was recrystallized from dilute alcohol. When dried at 105° C., it melted at 185° C., and gave on analysis the following results:—

0·1422 substance gave 0·3152 CO_2 and 0·0656 H_2O
corresponding to C 60·45, H 5·13
$C_{14}H_{14}O_6$ requires C 60·43, H 5·0.

Dimethoxycinnamoyl-pyruvic acid consists of orange-red prisms which are sparingly soluble in hot alcohol or cold benzene, and readily soluble in chloroform. Its solutions have a green fluorescence.

Concentrated sulphuric acid colours the crystals reddish-violet, and dissolves them, forming a reddish-violet solution.

A solution of the substance in alcohol gives a dark-brown coloration with ferric chloride.

When mordanted wool is boiled with a solution of the substance in diluted alcohol, the following shades are obtained :—

Mordant.	*Colour.*
Aluminium Sulphate, . .	Orange-red.
Potassium Dichromate, . .	Chocolate-red.
Stannous Chloride, . .	Orange-brown.
Ferric Sulphate, . . .	Dark chocolate-brown.

6. *Piperonylidene-Acetone.*

To a solution of 20 grams of piperonal in a mixture of 85 c.cs. of acetone and 30 c.cs. of water, about 3 c.cs. of 25 per cent. sodium hydrate were added, and the mixture, after vigorous shaking, was let stand for an hour in a warm place. After addition of 100 c.cs. of water, the piperonylidene-acetone was filtered, and recrystallized from alcohol. It melted at 107°–108° C.

7. *Methylene*-3·4-*Dioxycinnamoyl-Pyruvic Methyl Ester.*

$CH_2O_2C_6H_3 . CH : CH . CO . CH_2 . CO . COOCH_3.$

A mixture of 9 grams of piperonylidene-acetone and 15 grams of dimethyl oxalate was heated in a dry flask until it melted. On addition of 2·5 grams of sodium wire there ensued an energetic reaction, which was attended by the separation of a brown solid. As soon as the reaction had subsided and the flask had become cool, 30 c.cs. of anhydrous ether were added, and the mixture was set aside at the laboratory temperature for twelve hours. The ether was decanted from the solid; the latter was then well shaken with dilute hydrochloric acid, filtered, and recrystallized from acetone. When dried at 105° C., it melted at 174° C., and gave on analysis the following results:—

0·1766 substance gave 0·3959 CO_2 and 0·0740 H_2O
corresponding to C 61·13, H 4·65
$C_{14}H_{12}O_6$ requires C 60·84, H 4·38.

Methylene-3·4-*dioxycinnamoyl-pyruvic methyl ester* crystallizes from acetone in deep yellow plates, which are insoluble in cold alcohol or petroleum ether, and soluble in chloroform, hot alcohol, or acetone.

The crystals are coloured deep red by concentrated sulphuric acid, in which they dissolve, forming a dark-red solution.

A solution of the substance in boiling alcohol gives a brown coloration with ferric chloride.

When mordanted wool is boiled with a solution of the compound in diluted alcohol, the following shades are obtained:—

Mordant.	*Colour.*
Aluminium Sulphate, . .	Yellow.
Potassium Dichromate, . .	Light brown.
Stannous Chloride, . .	Orange-yellow.
Ferric Sulphate, . . .	Brownish black.

Its *isoxazol* was obtained by heating it for several hours with an alcoholic solution of hydroxylamine hydrochloride. The solution was concentrated, mixed with hot water, boiled with animal charcoal, and filtered while hot. It was recrystallized from boiling alcohol. It consists of colourless prisms, which melt at 114°–116° C., are insoluble in dilute potash, sparingly soluble in cold alcohol or ether, soluble in warm alcohol, and readily soluble in chloroform.

8. *Methylene*-3·4-*Dioxycinnamoyl-Pyruvic Acid.*

$CH_2O_2C_6H_3CH : CH . CO . CH_2 . CO . COOH.$

By shaking 1·38 grams of methyl methylene-3·4-dioxycinnamoyl-pyruvate with 20 c.cs. of semi-normal potash for several hours, the ester was hydrolysed to the corresponding acid. The alkaline solution, which was coloured brown, was freed from neutral substances by diluting with water and shaking with ether. The solid, which separated from the solution on acidification, was recrystallized from glacial acetic acid. To separate it from a small amount of ester with which it was still mixed, it was dissolved in warm, dilute sodium carbonate, saturated with carbon dioxide, filtered and reprecipitated by addition of acid. When dried at 105° C., it melted with decomposition about 185° C., and gave on analysis the following results :—

0·2000 substance gave 0·4346 CO_2 and 0·0612 H_2O
corresponding to C 59·26, H 3·4
$C_{13}H_{10}O_6$ requires C 59·54, H 3·8.

Methylene-3·4-dioxycinnamoyl-pyruvic acid crystallizes from glacial acetic acid in orange-red needles, which are scarcely soluble in alcohol, sparingly soluble in chloroform, and readily soluble in hot glacial acetic acid. Its solution in chloroform has an orange-yellow colour, with a green fluorescence.

The crystals dissolve in concentrated sulphuric acid, forming a dark violet solution.

XII.

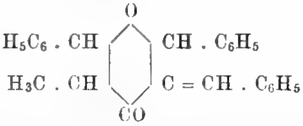
ON THE CONDENSATION OF ALDEHYDES WITH KETONES.

II.—ALDEHYDES WITH METHYLETHYLKETONE.

BY HUGH RYAN, D.SC., AND ANNIE DEVINE, B.A., M.SC.,
University College, Dublin.

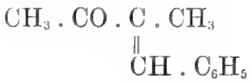
Read DECEMBER 13, 1915. Published MARCH 28, 1916.

BY condensing benzaldehyde with dimethylacetylacetone Ryan and Dunlea (Proc. Royal Irish Acad., xxxii, B, p. 57) obtained a colourless crystalline compound which melted at 168–9° C., and which seemed to be the benzylidene derivative of diphenylmethyltetrahydropyrone, the reactions of the compound being best represented by the formula:—



With a view to confirming the structure assigned to this compound by Ryan and Dunlea we attempted the preparation, from benzaldehyde and methylethylketone, of a compound which had been previously obtained by C. Harries and G. H. Müller [Ber. xxxv (1902), p. 968], and which the latter chemists regarded as a pyrone derivative.

According to E. Levinstein (Inaugural Dissertation, Berlin, Jan. 29th, 1902) benzaldehyde and methylethylketone interact in the presence of dilute alkali to form γ-benzylidene-methylethylketone,



$$CH_3 . CO . \underset{\overset{\|}{CH . C_6H_5}}{C} . CH_3$$

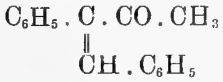
whereas from analogy with the condensation of benzaldehyde and phenylacetone in the presence of alkali—a condensation which has been studied by G. Goldschmidt and K. Krczmar [Monatsh. xxii (1901), p. 659]—we should have expected that the compound obtained by Levinstein was α-benzylidene-methylethylketone,

$$C_6H_5 . CH : CH . CO . CH_2 . CH_3$$

In the reactions which they carried out Goldschmidt and Krczmar obtained cinnamenylbenzylketone

$$C_6H_5 . CH_2 . CO . CH : CH . C_6H_5$$

in the presence of dilute alkali, and the isomeric γ-derivative



$$\begin{array}{l} C_6H_5 . C . CO . CH_3 \\ \qquad\quad \| \\ \qquad\quad CH . C_6H_5 \end{array}$$

in the presence of hydrochloric acid.

With dilute alkali as condensing agent, Harries and Müller obtained from methylethylketone and benzaldehyde a ketone, melting at 38°–39° C., previously described by Levinstein as γ-benzylidene-methylethylketone, but which Harries and Müller regarded as α-benzylidene-methylethylketone. On reduction, the ketone was converted into α-benzyl-methylethylketone, and their view of the constitution of the substance was found correct when the latter substance was also got by the dry distillation of a mixture of the calcium salts of dihydrocinnamic and propionic acids:—

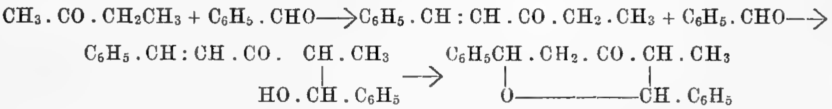
$$(C_6H_5CH_2 . CH_2 . CO . O)_2Ca + (CH_3 . CH_2 . CO . O)_2Ca =$$
$$2C_6H_5 . CH_2 . CH_2 . CO . CH_2 CH_3 + 2 CaCO_3$$

By condensing benzaldehyde with methylethylketone in the presence of hydrochloric acid, Harries and Müller prepared the isomeric ketone, γ-benzylidene-methylethylketone, which also melted at 38°–39° C.

As the result of their experiments, Harries and Müller concluded that benzaldehyde and methylethylketone in the presence of hydrochloric acid form a γ-derivative, and in the presence of dilute alkali an α-derivative.

By the further action of benzaldehyde on α-benzylidene-methylethylketone Harries and Müller prepared a colourless crystalline compound melting at 68·5° C., for which they found the empirical formula $C_{18}H_{18}0_2$, and which they regarded as a pyrone derivative.

If we assume with Harries and Müller that the compound $C_{18}H_{18}O_2$ is a pyrone derivative, its formation from benzaldehyde and methylethylketone will be represented as follows:—



$$CH_3 . CO . CH_2CH_3 + C_6H_5 . CHO \longrightarrow C_6H_5 . CH : CH . CO . CH_2 . CH_3 + C_6H_5 . CHO \longrightarrow$$

$$\begin{array}{ll} C_6H_5 . CH : CH . CO . & CH . CH_3 \\ & | \\ HO . & CH . C_6H_5 \end{array} \longrightarrow \begin{array}{l} C_6H_5CH . CH_2 . CO . CH . CH_3 \\ | \qquad\qquad\qquad\quad | \\ O \text{———————} CH . C_6H_5 \end{array}$$

II. III.

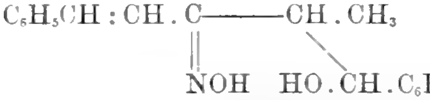
the unsaturated hydroxy-ketone (II) changing into the isomeric diphenyl-methyl-tetrahydropyrone (III) in the course of the reaction.

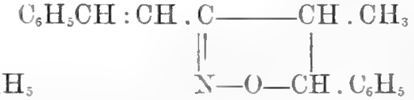
It seemed likely that the last compound (III) would interact with benzaldehyde to give benzylidene-diphenyl-methyltetrahydropyrone (I).

On repeating the experiments of Harries and Müller, we were unable to obtain the compound melting at 68·5° C., and obtained instead a substance with the same empirical formula, $C_{18}H_{18}O_2$, but which melted at 81°–83° C.

The compound $C_{18}H_{18}O_2$ may exist in the two structurally isomeric forms II and III. It is possible that the compound prepared by Harries and Müller may have the formula III, and that isolated by us the formula II, but since the oximes of the two substances have the same melting-point, 195°–196° C., it is also possible that our substance was a purer preparation of the substance previously described by Harries and Müller.

We should expect that the oxime of a compound which has the formula II would readily change into an isoxazol





but the analysis of the hydroxylamine derivative of the compound melting at 81°–83° C. showed that it was not an isoxazol, and for this reason we were at first inclined to regard the substance as a tetrahydropyrone derivative.

However, as the compound gives an orange colour with concentrated sulphuric acid, it seems more likely to be an unsaturated ketone than a tetrahydropyrone, and this view is to some extent confirmed by the behaviour of the substance on further condensation with benzaldehyde.

The compound $C_{18}H_{18}O_2$, melting at 81°–83° C., condensed readily with benzaldehyde in the presence of alcoholic hydrochloric acid to form not benzylidene-diphenyl-methyl-tetrahydropyrone, $C_{25}H_{22}O_2$, which was expected, but another well crystallized compound melting at 156° C., which has the empirical formula $C_{25}H_{20}O$.

The latter compound was also obtained by condensing benzaldehyde with *a*-benzylidene-methylethylketone in the presence of alcoholic hydrochloric acid.

Using the same condensing agent *a*-benzylidene-methylethylketone interacted with anisaldehyde and with piperonal to form analogously constituted compounds having the formulae $C_{27}H_{24}O_3$ and $C_{27}H_{20}O_5$ respectively.

If the statement of Harries and Müller, that *a*-benzylidene-methylethylketone is formed from benzaldehyde and methylethylketone in the presence of alkali, and is not formed from the same components in the presence of acids, were rigidly true, we should expect that the compound $C_{25}H_{20}O$ could not be formed directly from methylethylketone and benzaldehyde in the presence of alcoholic hydrochloric acid.

Direct experiment, however, showed that the contrary is true—the ketone and aldehyde interacting slowly at the ordinary temperature, when dissolved in alcoholic hydrochloric acid, to form the compound $C_{25}H_{20}O$.

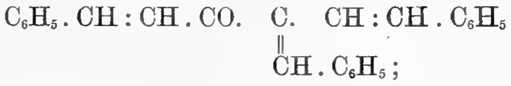
Piperonal and methylethylketone interacted under similar conditions to form an analogously constituted piperonal derivative of methylethylketone.

The preparation of the compound $C_{25}H_{20}O$ from methylethylketone, *a*-benzylidene-methylethylketone and the compound $C_{18}H_{18}O_2$ may be represented by the equations:—

$$CH_3 . CO . CH_2 . CH_3 + 3C_6H_5 . CHO = C_{25}H_{20}O + 3H_2O$$
$$C_6H_5 . CH : CH . CO . CH_2 . CH_3 + 2C_6H_5 . CHO = C_{25}H_{20}O + 2H_2O$$
$$C_{18}H_{18}O_2 + C_5H_6 . CHO = C_{25}H_{20}O + 2H_2O$$

The unsaturated nature of the compound $C_{25}H_{20}O$ was shown by the formation of a dibromide $C_{25}H_{20}OBr_2$; but we were unable to establish the presence of a keto radical in the substance, since the latter formed neither an oxime nor a phenyl-hydrazone.

Empirically the substance corresponds to a tribenzylidene derivative of methylethylketone



$$C_6H_5 . CH : CH . CO . \underset{\underset{CH . C_6H_5}{\parallel}}{C} . CH : CH . C_6H_5 ;$$

but as it is difficult to see how such a compound can be formed by normal reactions from benzaldehyde and methylethylketone, we shall postpone the consideration of its structure until further experimental facts have been accumulated.

EXPERIMENTAL PART.

A. *Action of Benzaldehyde on Methylethylketone in the Presence of Alkali.*

1. *Equimolecular Quantities of Benzaldehyde and Methylethylketone.*

A mixture of 130 grams of methylethylketone, and 140 grams of benzaldehyde, with a solution of 50 grams of sodium hydroxide in 1500 c.cs. of water, was shaken on a machine for eight days. The oil which separated was extracted with ether, and after evaporation of the latter the residue was distilled in a current of steam. When the benzaldehyde ceased coming over, the residue in the flask was subjected to further distillation in a current of steam, previously heated in a coil to 180° C., while the flask from which the distillation was being conducted was heated to 180° C. in an oil-bath.

The oil which now distilled solidified after short standing, and the solid, when recrystallized from petroleum ether, melted at 38°–39° C.

Towards the end of the operation the distillate contained a small quantity of another compound which melted at 81°–83° C.

a-Benzylidene-methylethylketone crystallizes from petroleum ether in large plates which are easily soluble in alcohol, ether, benzene, or chloroform, and scarcely soluble in water.

The crystals are coloured reddish-brown on contact with concentrated sulphuric acid, in which they dissolve, forming a reddish-brown solution.

It has been shown by Harries and Müller (*loc. cit.*) that α-benzylidene-methylethylketone forms an oxime, melting at 85°–86° C., a phenylhydrazone, melting at 101° C., and that its solution in glacial acetic acid reacts with bromine, forming a dibromide which melts at 109°–110° C.

2. *Further Action of Benzaldehyde on α-Benzylidene-methylethylketone.*

A mixture of equivalent quantities of benzaldehyde and α-benzylidene-methylethylketone was shaken with a large volume of dilute aqueous alkali for about a fortnight. The oil was extracted with ether, and after evaporation of the latter, most of the unchanged α-benzylidene-methylethylketone was distilled in a current of superheated steam. When the residue, left in the flask, was recrystallized from alcohol, it melted at 81°–83° C.

It was found later that when the reaction was allowed to progress for a much longer time, and the extracted product was then distilled *in vacuo*, a better yield of the compound melting at 81°–83° C. was obtained.

A still better yield of the product was got by allowing a mixture of 8 grams of α-benzylidene-methylethylketone, and 5·3 grams of benzaldehyde with a solution of 1 gram of sodium hydroxide in 100 c.cs. water, and 100 c.cs. alcohol to stand for several days at the temperature of the laboratory.

The oil which separated was dissolved in warm alcohol, and when the solution was cooled the substance separated in colourless crystals which melted at 81°–83° C. After drying in a desiccator it gave on analysis the following results:—

0·2548 substance gave 0·7566 CO_2 and 0·1542 H_2O
corresponding to C 81·0, H 6·7
$C_{18}H_{18}O_2$ requires C 81·2, H 6·7.

The compound crystallizes from alcohol in prisms which are scarcely soluble in cold, and readily in hot, alcohol. It is very soluble in ether, chloroform, or benzene.

The crystals are coloured orange on contact with concentrated sulphuric acid, in which they dissolve to an orange-yellow solution.

By an apparently similar method Harries and Müller (*loc. cit.*) obtained a compound, the formula of which is $C_{18}H_{18}O_2$, but which melts at 68·5° C. From the analysis, and the properties of the compound, they regard it as a pyrone derivative. Its oxime, which they prepared, melted at 195°–196° C. As the compound prepared by us melted about fourteen degrees higher than that got by Harries and Müller, we prepared its oxime, and found that it also melts at 195°–196° C.

An alcoholic solution of 2 grams of the condensation product melting at 81°–83° C., and 2 grams of hydroxylamine hydrochloride, was mixed with a saturated aqueous solution of 1·5 grams of sodium carbonate, and the mixture was heated to gentle boiling for several hours under a reflux condenser. The colourless, crystalline precipitate which formed was filtered, washed with water, dried, and recrystallized from chloroform and alcohol.

When dried at 110° C., it melted at 195°–196° C., and gave on analysis the following results:—

0·1229 substance gave 0·3452 CO_2 and 0·0752 H_20
corresponding to C 76·66, H 6·8
$C_{18}H_{18}ONOH$ requires C 76·87, H 6·76.

The oxime crystallizes in needles which are sparingly soluble in alcohol, and soluble in chloroform, ether, or benzene.

The phenylhydrazone of the compound, which melts at 81°–83° C., was prepared by dissolving 1·5 grams of the condensation-product and 1 gram of phenylhydrazine in 20 c.cs. of absolute alcohol (warm), and letting the mixture stand with occasional warming for a few days. The phenylhydrazone was filtered and washed with alcohol. When dried it melted at 134° C., and gave on analysis the following results:—

0·1362 substance gave 9·4 c.cs. of moist nitrogen at 19° C. and 758 m.m.p.
corresponding to N 7·9
$C_{18}H_{18}O : N \cdot NH . C_6H_5$ requires N 7·9.

It crystallizes in short colourless needles, which slowly acquire a light-brownish colour on exposure to light.

Semi-carbazone of the compound melting at 81°–83° C.

A solution of 1.5 grams of semi-carbazide hydrochloride and an equal weight of anhydrous sodium acetate in a little water was added to an alcoholic solution of 2·6 grams of the compound melting at 81°–83° C. The mixture was allowed to stand for two days in a warm place, then heated to boiling, and filtered. After washing with water and alcohol it crystallized from a mixture of chloroform and hot alcohol in fine needles, which were filtered and washed with ether. When dried at 110° C., it melted at 195°–198° C., and gave on analysis the following results:—

0·1857 substance gave 20·2 c.cs. of moist nitrogen at 15° C. and 757 m.m. p.
0·1392 substance gave 0·3590 CO_2 and 0·0839 H_2O
corresponding to C 70·3, H 6·7, N 12·7
$C_{18}H_{18}O : N . NH . CO . NH_2$ requires C 70·6, H 6·5, N 12·7.

B. *Condensation of Aldehydes with Methylethylketone in the Presence of Acids.*

1. *Action of Benzaldehyde on Methylethylketone in the Presence of Alcoholic Hydrochloric Acid.*

A solution of 5 c.cs. of methylethylketone and 17½ c.cs. of benzaldehyde in 20 c.cs. of alcohol, which had been previously saturated with gaseous hydrochloric acid, was allowed to stand in a stoppered flask for several days. The oil which separated was dissolved in a mixture of chloroform and alcohol. The crystals which were formed were filtered and recrystallized from chloroform and alcohol. When dried at 110° C., the substance melted at 156° C.

The same compound can be obtained by the action of benzaldehyde. in the presence of alcoholic hydrochloric acid on either *a*-benzylidene-methylethylketone or the condensation-product which melts at 81°–83° C.

2. *Action of Benzaldehyde on a-Benzylidene-Methylethylketone in the Presence of Alcoholic Hydrochloric Acid.*

A solution of 2 grams of *a*-benzylidene-methylethylketone and 2·7 grams of benzaldehyde in 20 c.cs. of alcoholic hydrochloric acid rapidly turned a reddish colour, and gradually deposited an oily substance, which in the course of a few days solidified. The parent liquid was decanted, and the residue was recrystallized a couple of times from chloroform and alcohol. When dried the colourless, crystalline solid melted at 156° C.

3. *Action of Benzaldehyde on the Condensation-Product $C_{18}H_{18}O_2$ in the Presence of Alcoholic Hydrochloric Acid.*

Equimolecular quantities of the condensation-product $C_{18}H_{18}O_2$ and benzaldehyde were dissolved in alcoholic hydrochloric acid, and the solution was let stand in a stoppered flask for a few days. From the solution, which turned a reddish colour, a copious separation of crystals occurred. The solid was filtered and recrystallized from chloroform and alcohol.

After drying at 110° C. it melted at 156° C., and gave on analysis the following results:—

0·1876 substance gave 0·6120 CO_2 and 0·1043 H_2O
corresponding to C 89·0 H 6·2
$C_{25}H_{20}O$ requires C 89·2 H 6·0.

The compound crystallizes from chloroform and alcohol in short rectangular prisms, which are sparingly soluble in ether or alcohol, and readily soluble in chloroform.

The crystals are coloured a deep orange on contact with concentrated sulphuric acid, in which they dissolve, forming an orange-coloured solution.

Its alcoholic solution did not react with phenylhydrazine to form a phenylhydrazone.

Similarly attempts to prepare an oxime by the action of either hydroxylamine hydrochloride or hydroxylamine on an alcoholic solution of the compound were unsuccessful.

A chloroform solution of the substance reacted slowly with bromine to form a dibromide which, after recrystallization from ether, melted with decomposition at 145° C., and gave on analysis the following results :—

0·4340 substance treated with sodium and alcohol by Stepanow's method required 17·4 c.cs. $\frac{N}{10}$ $AgNO_3$ for the complete precipitation of the bromide

corresponding to Br. 32·04
$C_{25}H_{20}OBr_2$ requires Br. 32·2.

The *dibromide* crystallizes in rectangular prisms, which are sparingly soluble in alcohol or ether, and readily soluble in chloroform.

4. *Action of Anisaldehyde on α-Benzylidene-Methylethylketone in the Presence of Alcoholic Hydrochloric Acid.*

The crystalline solid, which separated when a solution of 2 grams of α-benzylidene-methylethylketone and 3·6 c.cs. of anisaldehyde in 20 c.cs. of alcoholic hydrochloric acid was allowed to stand a few days, was filtered, and then boiled with pyridine. After removal of the pyridine the residue was recrystallized a couple of times from chloroform and alcohol.

It melted at 173° C., and gave on analysis the following results :—

0·1738 substance gave 0·5194 CO_2 and 0·0974 H_2O,
corresponding to C 81·5, H 6·2,
$C_{27}H_{24}O_3$ requires C 81·77, H 6·1.

The substance forms colourless crystals, which are sparingly soluble in alcohol, benzene, or ether, and readily soluble in chloroform.

A solution of the crystals in concentrated sulphuric acid has a deep orange colour.

5. *Action of Piperonal on α-Benzylidene-Methylethylketone in the Presence of Alcoholic Hydrochloric Acid.*

On standing a few days a solution of 2 grams of α-benzylidene-methylethylketone and 3·8 grams of piperonal in 20 c.cs. of alcoholic hydrochloric acid deposited an oil, which was boiled with pyridine, and then precipitated in a crystalline state by addition of alcohol. After a few recrystallizations from chloroform and alcohol it melted at 191° C., and gave on analysis the following results :—

0·2592 substance gave 0·7220 CO_2 and 0·1144 H_2O,
corresponding to C 75·97, H 4·90,
$C_{27}H_{20}O_5$ requires C 76·38, H 4·75.

It crystallizes from chloroform and alcohol in yellowish, hexagonal plates, which are sparingly soluble in cold or hot alcohol, and readily soluble in chloroform.

The crystals are coloured a dark red on contact with concentrated sulphuric acid, in which they dissolve, forming a cherry-red solution.

6. *Action of Piperonal on Methylethylketone in the Presence of Alcoholic Hydrochloric Acid.*

A solution of 8 c.cs. of methylethylketone and 32 grams of piperonal in 150 c.cs. of alcoholic hydrochloric acid rapidly turned a dark-blue colour, which gradually changed to purple. After standing a few days in a stoppered flask a tarry product separated. From the latter, by treatment with chloroform and alcohol, a bluish solid was obtained.

On mixing with dilute potash the blue colour, which was apparently due to a hydrochloric acid addition compound, or to an oxonium salt, disappeared. The substance was recrystallized several times from chloroform and alcohol. When dried at 110° C., it melted at 212° C., and gave on analysis the following results :—

0·1442 substance gave 0·3802 CO_2 and 0·0596 H_2O,
corresponding to C 71·9, H 4·6,
$C_{27}H_{20}O_7$ requires C 71·8, H 4·3.

The substance crystallizes in long, colourless, rectangular prisms, which are very sparingly soluble in ether, benzene, or alcohol, and soluble in chloroform.

The crystals are coloured dark red on contact with concentrated sulphuric acid, in which they dissolve, forming a deep-red solution.

PROCEEDINGS

OF THE

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THE ACADEMY *desires it to be understood that they are not answerable for any opinion, representation of facts, or train of reasoning that may appear in any of the following Papers. The Authors of the several Essays are alone responsible for their contents.*

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ERRATA.

SECTION C.

p. 92, l. 12, *for* 250 *read* 150.

p. 117, note 1. The words after Plate X belong to note 2.

p. 283, l. 21, *for* 24 *read* 64.

p. 254, l. 10, *for* willow *read* alder.

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY

PAPERS READ BEFORE THE ACADEMY

I.

NOTES ON THE POTTERY MANUFACTURE IN IRELAND.

By M. S. DUDLEY WESTROPP.

Plates I–III.

Read February 10. Published May 15, 1913.

During early times pottery of a coarse kind was made in Ireland, but nothing appears to be known relating to its manufacture. The earliest pottery extant are the food-vessels, cinerary urns, and incense-cups, dating from the Bronze Age. Large quantities of pottery have been found in the Irish crannogs; but dates are rather uncertain, as the crannogs lasted down to Elizabethan times. Encaustic tiles of about the thirteenth century to the fifteenth, which have been found in large quantities in Irish cathedrals and monasteries, may possibly have been made in the country. A reference to their having been manufactured in monasteries occurs early in the thirteenth century.

During mediaeval times wooden vessels, and later on those of pewter, were more generally used than earthenware, and consequently the manufacture of the latter was probably very small.

Coming down to a more recent period the following reference to the manufacture of coarse pottery occurs in the Egmont Manuscripts, vol. ii., page 128:—"Lord Shannon to Sir John Percival, March 13th, 1682–3, Shannonpark. I am importuned by the bearer to give you the trouble, who is a potter that lives near me; he serves all Cork and the country about it, he has made pipes for me to save leaden ones, that holds very well, as also flower pots for gardens."

It is not, however, until towards the close of the seventeenth century that the manufacture of the finer kinds of earthenware appears to have been carried on in Ireland. The various factories will be noted under the towns in which they were situated.

BELFAST.

The earliest mention at present known of a fine pottery manufactory in Ireland refers to one established in Belfast towards the end of the seventeenth century. It is alluded to by Dr. William Sacheverell in "A Voyage to I-Columbkill in the year 1688," published in 1702. In this he states that he left Liverpool on the 23rd of June, 1688, but, owing to a gale, the ship on which he was a passenger had to put into Belfast Lough. While waiting for the weather to moderate, he spent some days visiting the surrounding country, including the town of Belfast.

Speaking of the latter, he says:—"It is the second town in Ireland, well built, full of people, and of great trade. The new pottery is a pretty curiosity set up by Mr. Smith, the present sovereign and his predecessor, Captain Leathes, a man of great ingenuity."

Sacheverell here states that Mr. Smith was sovereign in 1688; but, according to "The Town Book of Belfast," David Smith was sovereign from Michaelmas, 1698, to Michaelmas, 1700, and died in 1705; while Captain Robert Leathes was sovereign from 1686 to 1690, and from 1696 to 1697, and died about 1718, having been first mentioned as burgess in 1669.

This pottery is also referred to by Dr. Thomas Molyneux in a manuscript preserved in Trinity College, Dublin, entitled "A Journey to the North in August, 1708." Under the head of Belfast he says:—"Here we saw a very good manufacture of earthenware, which comes nearest to Delft of any made in Ireland, and really is not much short of it; it is very clean and pretty, and universally used in the North, and, I think, not so much owing to any peculiar happiness in the clay, but rather to the manner of beating and mixing it up."

This statement of Molyneux implies that there were other pottery factories in Ireland at this period, but up to the present their localities have not been ascertained.

How long this Belfast pottery lasted, and exactly what kind of ware was made, are uncertain; however, there was recently on loan in the National Museum, Dublin, a shoe of enamelled or tin-glazed earthenware, decorated in blue, and bearing on the sole, also in blue, the letters "$\text{H}\overset{\text{M}}{\underset{+}{\;}}\text{R}$" and "Belfast

1724." This piece may have been made in Belfast, and, if so, it would appear that the factory was at work at least as late as the date mentioned.

As far as we know at present no further mention of this Belfast pottery has been found.

In the "Dublin Chronicle" for May 15th, 1787, the following notice occurs:—"Some gentlemen near Belfast, where are extensive strata of the finest pottery clay, large quantities of which are exported to England, have united for the very laudable purpose of engaging from England some knowing hands and establishing an Irish factory." This probably refers to the factory set up shortly afterwards in Belfast by Thomas Greg, Samuel Stephenson, and John Ashmore, for the purpose of making fine earthenware in imitation of Queen's ware. In the year 1792 they petitioned the Dublin Society for aid to carry on the manufacture, and for several years received premiums in proportion to the value of the ware produced. Between June, 1792, and June, 1793, the value of the ware made amounted to £1045 4*s.* 3*d.*; from June, 1793, to June, 1794, to £1107 14*s.*; and from June, 1794, to June, 1796, to £1001 6*s.* 11*d.*

On January 29th, 1793, the proprietors of the factory presented a petition to the Irish House of Commons asking for aid, and stating "that the petitioners, taking into consideration the many and great advantages which might arise from the introduction of a manufacture of Queen's ware and other kinds of fine earthenware, such as made in Staffordshire, they conceived that many materials which have been heretofore overlooked and neglected would be thus rendered useful and important; and many workmen and children would thus find employment. With these views and from these motives the petitioners have united themselves into a company, and, by their exertions, have carried this manufacture to greater perfection in the County of Down, near Belfast, than was ever known in this kingdom. That petitioners have been at great expense in searching for and making experiments upon materials for this purpose, the most important of which they have discovered in this country, and which are mostly prohibited from being imported from England. That petitioners have also been at great expense in erecting buildings, in importing machinery, and in bringing workmen from foreign places. That petitioners have found that the expense attending the introduction of this new manufacture, and the difference in the price of coals from what they are in Staffordshire, has greatly exceeded their expectations, and that several additional buildings are necessary to the greater extent and perfection of it."

On February 1st, 1793, it was "resolved that the petitioners deserve the aid of Parliament." In 1795 Thomas Greg claimed the premium offered by the Dublin Society to the first person who should erect a proper mill for grinding flint—an ingredient necessary for the manufacture of earthenware. In the following year Cunningham Greg was awarded the premium, as Thomas Greg had died in the meantime. The following advertisements relating to this factory are to be found in contemporary numbers of the *Belfast News-Letter.* November 7th, 1792:—"Pottery, Ballymacarrett, near Belfast: Greg, Stephenson, and Ashmore, after various disappointments, have brought the manufacture of cream-coloured or Queen's ware to a degree of perfection much superior to what it was. They have now ready for sale a large assortment of blue-painted, and cream-coloured ware." September 27, 1793:—"Greg, Stephenson, and Ashmore have for sale a large assortment of cream and other coloured earthenware of the best qualities. They can assure the dealers they will find it to their interest to encourage the manufacture, as the prices are lower than for goods imported." November 29, 1793:—"Greg, Stephenson, and Ashmore are manufacturing, and have now ready for sale at their warehouse in Ballymacarrett, a great quantity of cream-coloured and painted earthenware. Apothecaries supplied with any quantity of gallipots." As previously stated, Thomas Greg died early in 1796, and probably shortly after this the partnership was dissolved, for in October, 1799, the following advertisement appears:—"The partnership formerly subsisting under the firm of Greg, Stephenson, and Ashmore, has been for some time dissolved. Any demands against the said partnership will be paid by applying to Cunningham Greg, J. M. Stephenson, and John Ashmore."

Specimens of the ware made at the Downshire Pottery, as this factory was called, probably exist at the present day; but as no examples have as yet been found bearing marks by which they can be identified, it is almost impossible to say exactly what was produced.

Through the courtesy of Mr. R. M. Young, of Belfast, I am enabled to make some extracts from an article on this Belfast pottery which he published in the Ulster Journal of Archaeology for April, 1896. In that year a distillery was being erected on the site of the old pottery between Coats' foundry and Dufflin's mill adjoining Glentoran and the Lagan. Mr. Young visited the site in March, 1896, and states that many specimens of a coarse porcelain (?) were found, in the form of broken cups, saucers, bowls, teapots, &c., at the depth of about 4 feet from the surface, and associated with fragments of the seggars. Some pieces of quartz, together with a fine yellow clay, apparently used in the manufacture, were also obtained. Most of the ware was in the biscuit state, but some pieces had been covered with a light buff-coloured glaze. Mr. Young has kindly allowed me to illustrate some of the pieces found, including a teapot-spout with raised ornaments in cream-coloured ware, unglazed, and a teapot-lid and a small cup in a grey stone-ware. Also illustrated is a small jelly-mould made in glazed buff-coloured ware, which, with other similar pieces in Mr. Young's possession, are said to be authentic examples of Belfast pottery. (Plate III.)

Another pottery was set up in Belfast by Victor Coats about the same time as that of Greg, Stephenson, and Ashmore. Coats appears to have sold hair-powder and starch, and also to have been proprietor of a pottery at Ballymacarrett. Probably only coarse earthenware was made; for in May, 1793, he advertises for sale "a good assortment of butter-crocks, and milk-pans of different sizes, garden-pots, ridge, malt-kiln and flooring-tiles of a remarkable good quality, and also chimney-pots made to any shape at the shortest notice." In 1795 he founded a starch manufactory, and probably shortly after this the pottery was closed; for in 1795 and 1796 he advertises butter-crocks and tiles to be sold cheap to close sales. Coats subsequently appears as partner in the firm of M'Clenaghan, Stainton, and Co., of the Lagan Foundry, Short Strand, Ballymacarrett. He carried on the foundry in his own name from 1802 until his death in 1812.

In James Williamson's map of Belfast, made in 1791, both "Coats' Pottery" and "China Manufactory" are marked close to one another on the banks of the river Lagan, to the right of the road running from the Long bridge to Ballymacarrett bridge, but nearer to the latter. The china manufactory was that of Greg, Stephenson, and Ashmore.

In the Statistical Survey of County Down, published in 1802, it is stated that the manufacture of a superior kind of black glazed ware was carried on at the County Down end of the Belfast Bridge.

WEXFORD.

It is said that the manufacture of fine pottery was carried on in County Wexford early in the eighteenth century. In the "Chronicles of the County Wexford," by George Griffith, published in Enniscorthy in 1877, the writer states that "among the new settlers who came into the County of Wexford after the Revolution was a Quaker of the name of Chamberleyne who settled at Great Killiane on Wexford harbour. He was of a Staffordshire family, and had more or less knowledge of the pottery art. Chamberleyne, as a speculation, began making earthenware, at first of the coarse kind, for which he found a ready and remunerative demand. Later he was induced to embark on a more extensive and higher class of business, and imported materials from England, and enlarged his concerns. The trade prospering, Chamberleyne was induced to try his hand at china; his earlier efforts were successful, but, venturing on too large a scale, the result was a total failure."

Griffith also states that he saw on the end-wall of a well-built store, opposite to the ruins of the parish church, the name "JONATHAN CHAMBERLEYNE 1719" in letters eighteen inches long, made of white earthenware. These remained until the wall was pulled down in 1831. The kilns were standing at Killiane until cleared away about the year 1870. Unfortunately in this account no mention is made of what kind of pottery was produced. The making of china or porcelain would appear to have been very improbable.

DUBLIN.

The earliest reference I have found to pottery-making in Dublin belongs to the year 1739. On November the 10th of that year John Chambers petitioned Parliament for aid to carry on the pottery manufacture, and stated that he had brought workmen from abroad, and had erected a kiln to bake and burn earthenware. He also presented a petition to the Dublin Society in February, 1739; but neither of these applications appears to have had any result, nor is any reference made as to what kind of pottery he produced. In *The Dublin Journal* of August 12th, 1751, his death is announced as follows:—"Died John Chambers, formerly proprietor of the Pot House on the Strand." This pottery was perhaps taken over by John Crisp and Co., for in 1747 the Dublin Society awarded "a premium of £10 for the best dishes and plates of earthenware to John Crisp and Co., who carry on their delft ware at the World's End, on the Strand. Their ware seems to be as good as any imported for colour, size and paint; all made of Carrickfergus clay, as those of Liverpool are." Crisp and Co. obtained a premium of £8 in the following year for the best set of earthenware dishes and plates. Whether there were two earthenware factories in Dublin at the period is not quite clear. However, in 1749, David Davis and Co., on the Strand, near the Ship Building, obtained a premium of £8 from the Dublin Society for earthenware dishes and plates, which were said to excel any of the like imported, in the blue and white colour and beauty of the work and cheapness. Davis and Co. also obtained premiums in the years 1750 and 1751 for sets of earthenware, and are described as being at the World's End. Crisp and Co. are also mentioned as being at the World's End, so that perhaps Davis took over the works from Crisp. The World's End was near Mabbot Street. The following advertisement appears in the "Dublin Courant," in the years 1748 and 1749:—"At the Irish delft warehouse on the North Strand, near the Ship Building, Dublin, are made and sold by wholesale and retail a variety of blue and white delft-ware, allowed by the Hon. the Dublin Society to be as good as any imported." Nothing is said as to the exact kind of ware made. The word "delft" probably meant enamelled or tin-glazed earthenware similar to that imported in large quantities from France and Holland. During this period—that is, between the years 1747 and 1751, the Dublin Society awarded premiums for crockery-ware to James Walker, of Mullinahack; Mary Conolly, of Bride Street; Joseph M'Closkey, of New Street; James Johnson, of Rivers Street—all of the City of Dublin; Thomas Shaw and Mortagh Dempsey, probably of Dublin; and to John Conolly, of Arklow. Premiums were also awarded in the years 1765 and 1767 to James Walker, Joseph M'Closkey, and Thomas Hardy for black pottery, in imitation of and equal in goodness to that imported from Liverpool, and to Thomas Ashburner and Andrew or William Meakins for pan, ridge, and flooring-tiles and water-pipes.

As the manufacture of fine pottery in Ireland appears to have declined about the middle of the eighteenth century, the Dublin Society offered premiums for erecting a manufactory of earthenware in imitation of delft, Rouen, and Burgundy wares. As a result a Captain Henry Delamain, in 1752, took over the earthenware manufactory from Davis and Co., enlarged it, and commenced to carry on the business in a more extensive manner, receiving a premium of £20 from the Dublin Society in 1754.

On November 1st, 1753, Delamain presented the following petition to the Irish House of Commons:—

"Petition of Henry Delamain the younger, of the City of Dublin, gentleman. When the Delft manufacture failed in this city, the petitioner convinced that it might be carried on greatly to the advantage of the nation, took said manufactory into his hands, built workhouses and kilns, erected a mill to grind flint and metals, and discharged debts affecting the old manufactory; and also supported the most knowing persons that were employed in the old manufactory whilst his new one was building, to prevent their leaving the kingdom; and purchased the art of printing earthenware with as much beauty, strong impression and despatch as can be done on paper. That the petitioner lived above twenty years abroad, where he acquired a knowledge of the manufacture of Delft and earthenware, and having taken a circuit through this Kingdom found that every province therein is furnished with the proper materials for making thereof. That the petitioner after many repeated experiments has discovered the secret of glazing delft wares with coals, and painting and glazing that ware. That the petitioner employs upwards of forty families in his manufactory, and proposes to take a number of charter-school boys, apprentice, by which means he will be able to supply new manufactories with artists. And the petitioner is willing not only to communicate all the secrets of his business to any person setting them up, but also to assist them in the construction of their kilns, etc. That the petitioner laid specimens of the ware made by him before the Dublin Society, who were of opinion that they were as good and some of them better than any imported into Ireland, and found on experiments made that they stood boiling water without breaking or cracking. And as it can be made near twenty per cent. cheaper than it can be imported, he apprehends a great benefit will arise not only by preventing large sums from going out of the Kingdom for said manufacture, but also by exporting it to foreign markets, and prays for aid to enable him to carry on said manufacture."

On November 8th, 1753, it was resolved that £1,000 be given to Henry Delamain to enable him to carry on the manufacture of delft ware.

In this petition of Delamain's two interesting statements are made, the one referring to the use of coal for heating the kilns, and the other to the art of printing upon earthenware. Coal does not appear to have been generally used for firing purposes until much later. Is is said to have been employed in France about 1784, and in Delamain's petition to the English House of Commons in 1754, he states that wood "has always been and is now" used for firing porcelain and earthenware, so that he was probably the first who introduced coal for this purpose. With reference to the art of printing upon earthenware, there appears to be some doubt as to the exact period of its introduction. About 1750, however, is mentioned as the probable date though whether first used on Battersea enamel or on Liverpool pottery is uncertain. John Sadler, of Liverpool, intended to take out a patent for the invention in 1756; but it was never enrolled, and in it he stated that, together with Guy Green, he had been working at the art for the last seven years. According to the statement in Delamain's petition, he was aware of the process in 1753, having purchased the secret probably in Liverpool.

As a proof of the quality of the Irish delft the following petition to the Irish House of Commons may be quoted:—"November 1st, 1753. The manufacturers of block-tin in Ireland state that, owing to the great importation of Rouen, Burgundy, and Marseilles earthenware, the trade of the pewterers is at a standstill. That the great uses now made of said French delft (which the petitioners apprehend is not better than the delft of our own manufactures) is prejudicial to this Kingdom."

On January 21st, 1754, Delamain presented the following petition to the English House of Commons:—

"A petition of Henry Delamain gent., setting forth that porcelain and earthenware have always been and now are burnt and glazed with wood fires the manufacturers having not been able to make use of coal without discolouring, and consequently greatly depreciating the value of their goods; and that the petitioner has discovered a method of firing kilns of a particular construction (and which may be built for the same expense as the kilns now made use of) which perfectly burn and glaze all kinds of whiteware with coal in less time, and in larger quantities than the method now practised by burning with wood, and at one third part of the expense; and alleging that as coal is much cheaper in this Kingdom than any sort of fuel whatever is in any other country, this discovery if made public would enable our manufacturers to produce the said wares at a much cheaper rate than they could be made abroad, and that thereby their branch of trade, by reason of a more plentiful and cheap supply of fuel, would be always enjoyed by this Kingdom without a rival; and further setting forth that the kilns invented by the petitioner having been proved before the Dublin Society, he was recommended by them to the House of Commons of Ireland, who granted him £1,000, to be given to him for his encouragement, and to enable him more effectually to carry on the said manufacture, and that the petitioner has expended in making experiments and in perfecting his discovery a much larger sum than hath been granted by the Parliament of Ireland, and that as an undertaking of this kind cannot be carried on to so great an extent, and with so much advantage to both Kingdoms, and particularly to this, as if the invention was made public, the petitioner is willing to discover the same, upon such compensation for his expense, trouble and loss of time as shall be thought proper; and as the utility and merit of his discovery, upon experiment and trial, shall appear to deserve, and therefore praying the House to take the premises into consideration."

This petition was ordered to be referred to the consideration of a committee, but nothing appears to have been done in the matter, probably on account of the following letters from Delamain transcribed from Chaffer's "Marks and Monograms on Pottery and Porcelain," by kind permission of Mr. Frederick Litchfield.

These letters were written from Liverpool and London to his wife and to William Stringfellow, who appears to have been Delamain's manager at the factory, or perhaps one of the "knowing persons" in the old factory. The first is dated from Liverpool, December 18th, 1753, and is as follows:—

My dear Poll,

Enclosed I send you a letter to Mr. Stringfellow. The purport of it is to desire him by all means to answer some letter that will be wrote to him this night from Liverpoole to know how our large kiln has turned out; send for him on receipt of this, and right or wrong beg of him to write it was burned twice before I left Ireland and once since, and that it succeeds so well that not a bit of ware was smoked, and that it glazed the ware better than turf or wood and makes it harder and less subject to peel, and that about 2 tons or 2½ tons of coal will burn it off. Give him this letter for fear he should forget writing them all the above particulars; let him write the night he receives mine, for as soon as his letter arrives in Liverpoole, the Mayor, Corporation, and all the potters will join in a petition for me to Parliament, and they will give Mr. Stringfellow a handsome sum of money to build them kilns. I go to London this day and shall call in my way at Worster to see the fine new China Manufactory.

To Mrs. Mary Delamain,
at the India Warehouse, Abbey Street, Dublin.

The next letter is dated December 19th, 1753:—

Dear Sir,—I was obliged to go for England at an hour's warning, therefore had not time to bid you farewell, or settle any of my affairs. In my way to London I called at Liverpoole, where I was advised to petition the Parliament of England for a reward, for having burnt and glazed delft ware with *coals*, and at the same time to get the Magistrates and Corporation of Liverpoole to back my petition and to get the potters here to joyne them, all which I have effected; but some of the potters doubt the success of our large kiln, which I have assured them has answered as well as the small one did, and that it was twice burnt before I left Dublin. As they are in correspondence with you, they say you gave them no such information, therefore they will write to you by this post, to know whether it was twice burnt before I left Dublin, and how it succeeds; therefore I beg you will answer them by return of post, that it was burnt before I left Dublin, with perfect ware, which turn'd out as well as ever it was done with *turf* and *wood*, and that you have burnt it since I left Ireland, and that it answers to all our wishes, and that not a bit of ware was smoaked, but all white, and better glazed than ever you saw it done with *wood* or *turf*.

Suppose it has happened quite the reverse, do you write what I desire you for your own advantage as well as my credit, for I have set them all on fire to burn their ware with *coals*, and have come to this agreement with them, that you are to come over to build their kilns, for which they all promise to pay you handsomely; some offered me money, but I told them if they gave me £500, I would not touch a penny of it, but that it should be all for you; all that I desired of them was to back my petition to Parliament with the Mayor and Corporation, which they have promised to do, provided the great kiln turns out well, which they doubt; therefore by all means answer to them by return of the post all you can say in its favour, and more if necessary, for I know we shall make it do as well as the little one. It's the opinion of most people here the Parliament of England won't do anything for me, it being unusual, and this branch of trade thought nothing of by them; let that be as it will, I have pushed on your affaires here much better than ever you could do it yourself, and hope you will receive a large sum from them.

I shall make what haste I can to Dublin, and be assured I will settle all your affairs to your satisfaction, and beg you will push on my business in the interim. They don't want you here these two months, before which time I hope to be in Dublin. Don't let anyone know in Liverpoole I wrote you on this subject. I beg to hear from you, directed to me, to George Fitzgerald, Esq., London. Let me know how everything goes on since I parted. My respects to Mr. Hornby, Mr. Shee, &c. Pray let me hear from you by return of the post, and let me know what's wanting for the manufactory, and whether the front of the house is finish'd.—I am, &c.,

HENRY DELAMAIN.

To Mr. Wm. Stringfellow, the Delft Manufactory,
in the Strand, Dublin.

The last letter is dated from London, January 9th, 1754:—

Sir,—I am glad you're safe arrived in England, and am surpriz'd you did not receive my 2nd letter before you parted. The gentlemen of Liverpoole will assure you, if they do me justice, that I beg'd nothing from them but to gratifye you for the trouble you may be at to build kilns and to sign a petition for me to Parliament, which can by no means prejudice you or them. I am informed this post they refuse to sign the petition, which I think ungrateful, for this secret would never have been found out only for me, who, contrary to your opinion and all others, I persued the scheme to burn with coal, which several of the workmen of my manufacturie made oath of before I left Ireland, and which is confirmed by the votes of the House of Commons of Ireland. As it has been always my intention to serve you and settle you master of the manufacturie, and that I have freed you from all your troubles, it will be the highest ingratitude of you to do anything to my disadvantage, therefore beg you will not enter into any agreement with the manufacturers at Liverpoole till my affair is decided in the House of Commons of England, which will be done in a few days, for if you do it without my approbation, the consequence may be your ruin, and perhaps won't hurt me, and there's no money they can give you can recompense the loss it may be to me, and I am both able and willing to pay you any sum they will give you, and even more. I now make it my request to you, that you will not inform them any part of the secret, and declare to them you never will, unless they sign my petition; and if the Parliament grants me a sum for this, whatever they have agreed to give you I will immediately pay you down in cash that sum, which I promise by these presents, and also you will be recompensed by one man in London more to build him a kiln than all the people of Liverpoole together will give you. I have great friends here, and a strong interest is making for me, therefore entreat you will not do anything to hurt me. As soon as my affair is decided in Liverpoole you must come to London, where we will settle all our affairs, and as soon as the kilns are built and properly burnt, we must go to France together, on some extraordinary affairs to both our advantage; in the interim I will continue y'r guinea a week to y'r wife till our return to Dublin. Inclosed I send you a draught for five pounds, and beg you will get my petition signed, with an alsolute promise that as soon as my affair is settled in Parliament, that you will build their kilns, and do them all the service in your power, but till then you can't do anything. As soon as the Pet'n is signed, which must be done immediately, come up to me to London the next day, as fast as you can; you will perhaps get a horse at Liverpoole for London, if not, hire one to Warrington, and come up in the Stage Coach to London; you must leave Liverpoole on Sunday next to get to Warrington in the Monday's stage, or you will be too late; if you can hire a good horse, you will be in London sooner than in the stage; if you can't, don't miss the Monday's Warrington Stage Coach, for I want you much here on several accounts, and as soon as my affair in Parliament is over, we can set people to work both here and at Liverpoole not to lose time, for we must go to Paris as soon as possible. Write to me Saturday's post what is done, and don't let any one in Liverpoole know y'r coming to London. As soon as you arrive, get a Porter or a Coach to show you the way to Mr. Chilton's, a periwig maker in Porter Street, near Newport Ally, just by St. Martin's Lane or Newport Market; if I am not at home, there's a Tavern next door to me where you may sup, and I have had a bed for you this fortnight past at my own lodgings. Don't let your wife know anything of our going to Paris for fear she should inform mine, which I don't chuse should know it; be assured while we are absent she shan't want for anything. By all means get the petition signed, and send it to me by Saturday's post. Apply to Mr. John Hardman, who is my friend, about it.

I do assure you the manufacturers of Liverpoole, as I am well informed, have no other intention to serve you, but to get the secret out of you, and then to take you as a journeyman painter; therefore take care what you do, or this affair may be your perdition, but agreeing to what I would have you do, you can't fail of making your advantage of it, let things turn as they will. Since I wrote the above, I have consulted with one of the Members of Parliament of Liverpoole, who thinks it better you should not leave Liverpoole in so great a hurry after the petition is signed, for they are jealous people, and may raise numbers of false conjectures to my prejudice; therefore, don't come up to London till you hear further from me, unless you think your leaving the town will not hurt me, for I want you much, and wish you was here this moment, but would not chuse either of us should do anything to disoblige the manufacturers at Liverpoole, therefore, let us act with prudence, which will turn to both our advantage. I have wrote this post that your wife may receive a guinea every Saturday night till we return, and that all care may be taken of her and the children if wanted. As soon as you receive this, go with the inclosed bill to Mr. Sandford, Mr. Gibson will show you where he lives, and he will pay you five pounds English on sight. I will in a few days send you down a letter of credit, in case you want more money, that you may take it up without writing to me or drawing for it.

Pray observe what I have wrote, and don't do anything with the people of Liverpoole without my consent; I shall write to you constantly how my affairs go on in Parliament; push the manufacturers to sign my petition without delay, write to me every post what occurs. I believe I shall receive my money in Holland, as soon as we get over.—I am, dear Sir, your assured friend, &c.,

HENRY DELAMAIN.

To Mr. Stringfellow.

It appears that Stringfellow handed the letters which Delamain had written to him to the committee appointed to investigate his claim, which probably accounts for the fact that nothing further was done in the matter.

The following advertisements relating to Delamain's delft manufactory appear in *The Dublin Journal.* October 16th, 1753:—"The new Delft Manufactory on the Strand is almost built, the proprietor of which to endeavour to establish the earthenware manufacture in this kingdom has provided the ablest masters for making earthenware, and instructing youth in all branches, and will take 25 Charter Schoolboy apprentices every year, and as they will be masters of the trade in three years, several manufactories can be supplied with workmen; and what it cost him large sums to discover, viz., inventing kilns to glaze delft with coals, grinding flint, glazing it, he will communicate all secrets of the trade to any person who will establish such works, and will supply them with workmen to carry it on, so that large sums of money will be saved that goes out of it for French delft. I am sure no nation has better or cheaper materials for it."

This advertisement was followed by a letter from a friend of Delamain's: "I am surprised to see by an advertisement that Mr. Delamain has become potter, who I knew in Flanders, a captain in the Prince of Saxe Gotha's service, and who distinguished himself the last war against the French. I am pleased that he brought this beneficial branch of trade to such perfection as to be recommended by the Dublin Society to the bounty of Parliament; for I am assured by Mr. Duany and the Surgeons of the Infirmary on the Inns Quay that he was the first that introduced it for the benefit of their hospital. If this trade should miss after so large a sum already expended on it we shall lose a trade that will save large sums that go from us to France for earthenware."

September 17th, 1754:—"The earthenware manufactory on the Strand is now finished, and built to employ two or three hundred people. All Charter-School, parish or distressed tradesmen's children of either sex will be received and taught all the different branches of making all sorts of earthenware by the best masters. Each child during apprenticeship to get two shillings a week for the first year, three shillings for the second, three shillings and sixpence for the third, four shillings for the fourth, and four shillings and sixpence for the last three years.—HENRY DELAMAIN."

June 10th, 1755:—"The great efforts that is made by some people (whose interests it is) to hurt the earthenware manufactory in the Strand, obliges the proprietor thereof to inform the publick that the Hon. the Dublin Society has certified the earthenware made there is as good as any imported here, and is sold 30 per cent. cheaper than the French earthenware, to prevent the importation of which Delamain can prove that he has spent above £5,000 in building and furnishing one of the largest manufactories of the kind in Europe. As some of the clerks have sold some faulty ware that was ordered to be broken, to prevent which for the future, the ware will be sold at the India warehouse in Abbey Street, where all orders will be received and executed with expedition. The ware will be sold wholesale at the manufactory only."

August 30th, 1755: "To the merchants of the Kingdom of Ireland—I have brought my earthenware to such perfection that I have a great demand for it from Germany, Spain, and Portugal, but for want of capital I am not able to export a quantity of it, which makes me have recourse to such gentlemen as trades in these Kingdoms to assist me by sending it abroad. Since I have discovered the method of burning my ware with coal, and found out lately a good body and glaze, I can serve them on such reasonable terms that they can undersell the French in all the foreign markets. All losses on my ware that is sold abroad I will reimburse the exporters of it. The warehouse at the manufactory will be open Wednesdays and Saturdays only for wholesale."

Delamain again petitioned Parliament for aid in November, 1755, and in the following year was granted £1,100 to enable him to carry on the manufacture. In Roque's Map of Dublin, of 1756, Delamain's factory is marked as being in Mabbot Street, between Frenchman's Lane and the Strand, probably about where Rourke's bakery is now situated.

In *The Dublin Journal* of January 11th, 1757, Delamain's death is announced: "January 10th, 1757, died, Captain Henry Delamain, formerly in the Duke of Saxe Gotha's service, master of the Irish Delft Manufactory, who, by the expense of a large fortune and unwearied application, brought that ware to such perfection as to totally prevent the enemies of our country from drawing large sums yearly from this country for Burgundy and Rouen ware. Mary Delamain, his widow, carries on said manufactory."

On November 9th, 1759, Mary Delamain presented the following petition to the Irish House of Commons:—"Petition of Mary Delamain, widow of Henry Delamain, late of the City of Dublin, earthenware manufacturer. That the petitioner's late husband erected a manufactory for making earthenware, and brought it to such perfection as not only to excel anything of the kind ever attempted here before, but to equal the best foreign ware imported, on which he expended his entire fortune to the amount of £6,000 and upwards. That in the Session of 1753 Parliament did grant him a sum of £1,000 as an encouragement for carrying on said manufacture, and the Dublin Society upon inspection and having satisfaction received of his having expended said bounty in the improvement of said manufacture, did in the year 1755 confer on him a further sum of £1,100. That the said Delamain did with the best economy expend this latter sum also in finishing and improving his manufactory in the completest manner, but died the 10th of January, 1757, leaving her destitute of a capital sufficient for carrying on the work extensively, as the sums granted were expended on completing the works, as well as his whole fortune, and some debts contracted which petitioner has since paid. That notwithstanding these difficulties the petitioner has since the death of her husband carried on said manufacture, which is allowed to be greatly improved, but for want of a capital to purchase materials at a prime cost is prevented from lowering the price of the ware, and giving the usual credit to merchants, shopkeepers, and retailers throughout the kingdom. If the petitioner receives assistance once more from Parliament she hopes it will enable her to give credit and lower the price of the ware so considerably to the wholesale dealers that they can afford to retail said wares 25 per cent. under present prices, which there is no doubt would occasion such large demands at home and abroad as to increase the number of men to equal the apparatus which is sufficient to employ above two hundred of the poor natives, foreigners not now being necessary; keep and bring large sums of money into the kingdom, and be a lasting benefit to the Nation in general."

Mrs. Mary Delamain died on March 4th, 1760; and an advertisement in *The Dublin Journal* of March 8th, 1760, states that the earthenware manufacture carried on by Henry Delamain and afterwards by Mrs. Mary

Delamain is to be continued in the most extensive manner as formerly for the advantage of their children.

Henry Delamain's brother, William Delamain, and Samuel Wilkinson were the persons who carried on the business, and, on November 6th, 1761, presented the following petition to Parliament:—"Petition of Samuel Wilkinson and William Delamain, executors of Mary Delamain, late of the city of Dublin, earthenware manufacturer. That the late Henry Delamain erected a manufactory for earthenware, in which he discovered the art of burning with coal instead of wood, and brought it to such perfection as not only to excel anything of the kind ever attempted in this kingdom before, but to equal the best foreign ware imported, in which he expended his entire fortune of £6,000 and upwards. In 1753 Parliament granted him £1,000, and in 1755 the Dublin Society gave a further sum of £1,100. That on the decease of Henry Delamain his late widow Mary Delamain, carried on the business with great success, and declined troubling Parliament in 1757, assured that the manufacture would support itself; but, finding that the export of the ware to foreign markets was prevented by the war, Mary Delamain petitioned Parliament in 1759; but no further money was granted in that year to private petitioners. That the petitioners since the decease of Mary Delamain have carried on the manufacture for the advantage of the orphans of Henry and Mary Delamain in particular and of the nation in general with so much success as to prevent the import of foreign ware which annually carried out of the country above £10,000 to France, and have supplied dealers in every principal seaport of this kingdom. That petitioners, by commencing on a small stock, are prevented from purchasing coals and other materials in the proper season, and lowering the price of the ware, or employing between two and three hundred of the poor natives, and, on a peace, of exporting to foreign markets above £20,000 worth every year, over and above the home consumption."

This petition was referred to a committee for consideration; and the following witnesses were examined:—"William Delamain, being sworn, said that the late Henry Delamain expended £8,000 and upwards in building houses, mills, kilns, and completing an apparatus for an earthenware manufactory sufficient to employ about three hundred people, in making experiments to discover the art of burning with coal instead of wood (which the many who attempted it in this kingdom and elsewhere have failed in), bringing artists from abroad at immense expense, in which he was opposed by the proprietors of different manufactures, and improving the earthenware manufacture. That the manufacture is brought to such perfection as to exclude the importation of Rouen and Burgundy ware these last five years, which annually carried out of the kingdom above £10,000, and is allowed to equal any earthenware in Europe. That this manufactory brought up a great number of apprentices, some of which are esteemed the first workmen in England, who, for want of a capital, the proprietors of this manufactory were obliged to discharge. That the proprietors entering on a small stock are disabled from purchasing coals, block-tin, lead, colours, clay raised in the North of Ireland, and other materials in the proper season, being all ready-money articles, the want of which subjects the manufacture to many losses. That a parliamentary aid would enable the executors to employ the entire apparatus which is sufficient to manufacture £40,000 worth of ware every year, half of which they could export to our islands in the West Indies, where some ware was sent by the late proprietor and was sold to advantage, and many orders have since come, which, for want of a capital, could not be complied with. That said aid would enable the executors to lower the price of the ware 20 per cent. and make it a lasting benefit to the nation without any further assistance from Parliament.

" Peter Shee, being sworn, said he was employed by Henry Delamain in the year 1752, and continued until 1757 as painter and clerk, and that the said Henry Delamain was the first that discovered the art of burning with coal, instead of wood, by which the earthenware can be sold 30 per cent. cheaper; that the manufactory is carried on since March, 1760, by Samuel Wilkinson and William Delamain for the benefit of the children of the late Henry and Mary Delamain; that great quantities of the ware are sold in every principal city of this kingdom; that the late Henry Delamain expended £6,311 14*s.* 2½*d.* of his own family fortune before his first application to Parliament in 1753 in bringing said manufacture to perfection.

Account of money expended by Henry Delamain on earthenware manufacture from his commencement to the time of his first application to Parliament in 1753:—

Paid former proprietor for purchase of manufactory,	£580	0	0
,, for additional buildings and improvements,	1,456	14	2½
,, for building nine kilns of different construction, to discover the method of burning with coal,	630	0	0
,, for building mills at Palmerstown for grinding colours,	287	0	0
,, for sundry utensils,	456	0	0
,, for sundry materials,	312	0	0
,, for bringing several workmen from England and other parts, maintaining and paying wages until works were perfected, several of whom deserted the works, having been bribed from abroad,	730	0	0
,, Expenses in making experiments to discover the art of burning with coal instead of wood in the course of nineteen months,	1,860	0	0
Total,	£6,311	14	2½

On March 22nd, 1762, William Delamain and Samuel Wilkinson presented a petition to the Dublin Society asking for aid, and at the inquiry the following depositions, copied from the original minutes, by kind permission of the Council of the Royal Dublin Society, were made:—"Mr. Delamain, being sworn, deposed that they have an account of every kiln that has been burnt since his brother's death in 1757. They have been very cramped all along, and particularly since his sister's death, by want of money, but have never stopped for one week since the first beginning. There are twenty hands employed in the house, and three hundred might be employed if they had a stock. They get their clay from Carrickfergus. The manufacture was first begun by his brother in 1753, when he got £1,000 from Parliament. He has been concerned as executor to his brother since March, 1760; and his sister carried it on from her husband's death to her own. About thirty men brought up in this manufactory are now employed in the china manufacture in England. If they had £1,000, they could lay in a sufficient stock of coal, clay, and other materials to carry on the work effectually. The clay should be three years old before it is used; there is not a coal in Dublin for their use, and though three different sets of ware are bespoke by Mr. Secretary Hamilton, they can't fire a kiln for that reason. Mrs. Ann Day being sworn, said she can't say what the quantity of goods made yearly is. The last account amounted to £1,000, for between the year and eighteen months, but that was only the cash account; other goods being sold on credit, she thinks she can say with great justice that £50 worth a week, might be made with the hands they have now. They have but twenty hands. They have a good demand, and would have more if the ware could be sold cheaper. They have reason to expect that their ware would meet with great success in the American islands, but the insurance is so high. They have sent some to Jamaica, and it returned in rum; but it is by the retail trade that they support the manufacture. The great consumption of their ware is at home; they have three established customers in Cork who would take a great quantity if they had a stock to supply them. The great demand is from the city of Dublin and the province of Munster. They don't supply the shops with their best ware, but some of the poorer sort of shops buy the second and third ware, and they have made a good deal of goods for Mr. Newton for about two years back. They might go on making the flint ware, but are not acquainted with the method; their's is not of that kind, but near the Burgundy ware, and to imitate china. There is no ware in England of the same kind as theirs; and if they could send it there, they would find a greater call for it than they have here. The duty on their ware to England is three pence half-penny the pound weight, so that a set made for the Lord Lieutenant (Earl of Halifax), and sent by him to England, amounted to £7 duty." As a result of this petition Wilkinson and Delamain were granted £300 to assist them to carry on the manufacture.

In 1763 they presented another petition to Parliament, and in June, 1765, were awarded a premium of £150 by the Dublin Society for delft made since June, 1764, amounting in value to £1,000. For the year ending June, 1766, the value of the ware made was £762 0*s.* 8½*d.*, and for similar periods ending June, 1767, and June, 1768, the value was £567 19*s.* 4*d.* and £300 respectively.

The following advertisement appears in *The Dublin Journal* for August 9th, 1766:—"Delamain's Earthenware Manufactory, Abbey Street:—From the great encouragement given to said manufacture by the Right Hon. and Hon. the Dublin Society, the directors thereof take this public opportunity of returning their most grateful thanks to that most respectable body, and also to the nobility and gentry who have been pleased to countenance and encourage this national undertaking. The executors of the late Henry Delamain beg to acquaint the Society and the public that they have lowered the price of earthenware 15 per cent.; the fine painted landscape plates from nine shillings per dozen to seven shillings English, the second sort from six shillings to four shillings and sixpence; tureens, epergnes, boats, bowls, fruit and salad dishes, and all other articles lowered fifteen per cent. There is now a large assortment of the finest ware ever made, ready for sale, far superior to any imported. All commands to be directed to Mrs. Ann Day, at the warehouse in Abbey Street."

Through the kindness of Mr. S. G. Stopford Sackville, of Drayton House Northamptonshire, I am enabled to illustrate two pieces of Dublin delft. Mr. Sackville possesses six pieces, three bowls and three plates, all of a fine tin-glazed ware, well-painted with landscapes in blue, and each marked underneath with a large harp and crown and the word "Dublin," also in blue. These pieces—probably remains of a set—are stated to have been presented to either the Lord Lieutenant (the Duke of Dorset) or to Lord George Sackville, about 1753; and it is almost certain that they were made at Delamain's factory. (Plates I., II., III.)

Like Liverpool and other English enamelled pottery, no marks appear to have been used on any of the Irish earthenware. This set being an exceptional one probably accounts for the mark.

Wilkinson and Delamain appear to have carried on the delft manufacture until 1769, when the factory was taken over by the workmen employed, as the following advertisements in *The Dublin Journal* prove—February 22nd, 1770 :—" This is to acquaint the nobility, gentry, and the public in general that the workmen of the delft manufactory on the North Strand has rented said concerns from the executors of Mr. Henry Delamain for to carry on said works as usual, but in a far better and more extensive manner ; and as they have been carrying it on these six months past, they have now got a large assortment of ware, such as table-sets of India patterns, ornamental ware, etc., of the newest fashions ; coats of arms, crests, views of gentlemen's country seats, etc., done in the most elegant manner, far superior and cheaper than any of the kind can be imported, and will engage them to stand hot water. As they are new beginners they mean to sell their goods at the lowest profit for ready money only, and will give the greatest encouragement to those who buy to sell again. They likewise make all kinds of pots for apothecaries and perfumers. Country dealers will have their orders executed with punctuality, care, and expedition at the most reasonable rates."

July 14th, 1770—" Whereas the workmen of the delft manufactory on the North Strand, formerly Delamain's, a few months ago rented said concerns from the executors of said Delamain, they take this opportunity of returning thanks to their friends and the public for the great encouragement since commencement in business, and acquaint the nobility, gentry, and public that they have opened a commodious shop in front of said concerns where they intend selling their goods and nowhere else, and have now a considerable assortment of excellent ware, such as plates, dishes, etc., far superior and cheaper than any of the kind imported. They likewise do landscapes, coats of arms, crests, and views of gentlemen's country seats, in the most elegant manner, and as they now have had the honour of receiving a bounty from the Dublin Society, they intend going on in a very extensive manner. They also make pots for grocers, apothecaries, and perfumers."

James Roche appears to have been the manager of the factory ; and on April 12th, 1770, he and his partners obtained a premium of £50 from the Dublin Society for excellent earthenware of the same sort as delft made between August, 1769, and the above date, and valued at £340 6*s.* 6*d.*

In 1770 James Roche & Co. claimed the premium offered by the Dublin Society for making earthenware in imitation of flint or Paris ware ; but it appearing that the ware, although good of its kind, was not the sort for which the premium was offered, it was refused.

The latest reference to Roche's delft manufactory occurs in 1771, when a petition was presented to the Dublin Society asking for aid to carry on the manufacture.

In 1770 the Dublin Society offered a premium for pottery made in imitation of Staffordshire ware or that commonly known as yellow stoneware.

A factory appears to have been set up as on December 12th, 1771, Edward Ackers and James Shelly, stone- and earthen-ware manufacturers, from Staffordshire, petitioned for aid to carry on the manufacture.

In 1773 "£200 was awarded to Edward Stacey, Edward Ackers, and Thomas Shelly, stone- and earthen-ware manufacturers from Staffordshire, but now of the City of Dublin, for flint ware, commonly called Queen's ware, manufactured by them in Ireland, and chiefly of Irish materials, between March, 1772, and March, 1773, to the value of £1,334 4*s.* 3*d.*"

They also received a premium of £80 for Queen's ware valued at £800, made between March, 1773, and March, 1774. Edward Stacey appears as one of the proprietors of "the delft manufactory of the World's End Lane" in 1765, and probably joined with Ackers and Shelly when that factory ceased working.

This delft manufactory of the World's End Lane may have belonged to Ambrose Henley, who, in June, 1765, received a premium of £45 from the Dublin Society for second-quality delft manufactured by him since June, 1764, and valued at £300. He also received £70 for delft-ware manufactured between June, 1765, and June, 1766, to the value of £573. It appears, however, that Henley deceived the Dublin Society regarding the quantity of ware he made; and it was ordered that he was to get no further premiums. In October, 1766, James Roach was awarded £12 for "discovering a fraud by which the Society were imposed upon in June last to give a premium of £70 to Ambrose Henley, manufacturer of earthenware."

In 1775, Richard Williams, a glass-maker, advertises Queen's or Paris ware, but whether he made it, or even that it was made in Dublin, is uncertain.

After about this date no mention of any pottery-manufacture in Dublin occurs; but in 1791 the following advertisement appears in *The Dublin Journal*:—"The pottery business was formerly carried on with some degree of success in this city, but only in the common lines of workmanship; now there are only two persons who carry on the manufacture. About fourteen years ago a person undertook to carry on the Queen's ware in imitation of that of Chinese in the vicinity of this city; but the undertaker, who brought over men from Staffordshire, suddenly died, and no one has since attempted the like undertaking. The common ware is still made, but of a very inferior sort."

In John Angel's "General History of Ireland," published in Dublin in 1781, the following references to earthenware manufacture in Ireland occur:—"The great quantities of pipe-clay found in Clonmel and other parts of Ireland have induced many of the manufacturers of Staffordshire to set up in Dublin the manufacture of earthenware, which, no doubt, will meet with every encouragement from the inhabitants of Ireland."

"Pipe-clay has been found in many parts of Ireland, which has been exported to England and France for the purpose of making that beautiful yellow ware called Paris ware. But in Dublin they make at present this ware, which is much esteemed." Under the head of Carrickfergus it is stated that "there used to be considerable quantities of a bluish-white clay exported from this town to England for the purpose of making delft ware, which, after being there manufactured, was again imported into Ireland. This business has greatly decreased of late owing to the universal use of yellow Paris ware.

Josiah Wedgwood gave evidence before the committee appointed to inquire into the commercial relations between England and Ireland, and stated in 1785 that large quantities of flint and pipe-clay from Ireland were imported into Staffordshire for making fine pottery, and that he himself used them, and also that flint was found near Dublin, which was used when a manufacture of Queen's ware was set up there in 1784. He also stated that no fine pottery was made in Ireland at this date, the factory set up in 1784 having ceased work the following year.

In an article in *The Dublin Chronicle* of September 6th, 1787, it is stated that it is a well-known fact that Wedgwood obtained clay from Ireland for the most beautiful of his works. A notice in the same paper for September 8th, 1787, says that "a very fine bed of clay has been discovered at Miltown, and is now being manufactured by the ingenious Mr. Heaviside into crucibles and garden-pots."

In John Lord Sheffield's "Observations on the Manufactures, Trade, and Present State of Ireland," published in Dublin in 1785, it is stated that "at present Ireland has no very considerable pottery-works, except coarse kinds."

Thomas Wallace, in his "Essay on the Manufactures of Ireland," published in Dublin in 1798, speaking of pottery, says —"If there exist any manufacture of this kind beyond a few coarse tiles and still coarser earthenware, it is so trivial as to deserve no notice."

After about the end of the century no pottery, except the coarser kinds, appears to have been made in Dublin until about 1872. In that year Mr. Herbert Cooper, who had been apprenticed to the pottery business with Copeland at Stoke-upon-Trent, began making fine pottery on a small scale at the Queen's Institute, Molesworth Street, Dublin. He obtained some clay from Knockcroghery, Co. Roscommon, and from this a small number of objects were made. Frederick Vodrey, a china and glass merchant in Moore Street, Dublin, became a kind of partner with Cooper for about twelve months, during 1873 and 1874, but after that he worked on his own account in Moore Street, and turned out ornamental ware with coloured glazes, figures, &c. Vodrey used chiefly English clay from Shelton in Staffordshire, for his ware, and continued the manufacture for a few years. He was not a potter himself, and did not actually make any of the pieces, but employed English potters to do the work. Mr. Herbert Cooper continued making pottery, both of Irish and English clay at Molesworth Street until about 1875. In the Cork Exhibition of 1883 Vodrey exhibited "Dublin-manufactured pottery from Irish clays,'' and in the Irish Artisans' Exhibition of 1885 "artistic and domestic pottery." Mr. Herbert Cooper, however, states that Vodrey never used Irish clay. Pieces of pottery with various coloured glazes are to be found stamped "VODREY DUBLIN POTTERY."

Large quantities of earthenware were imported into Ireland during the eighteenth century, including Rouen, Burgundy, and Marseilles ware, Dutch pottery and tiles, and English ware. A good deal of this was enamelled or tin-glazed pottery. In 1755 the French ware was sold in Dublin at four guineas a set, painted in yellow and purple, £3 10*s.* in blue and white; plates painted in yellow and purple 9*s.* 6*d.* a dozen, and blue and white plates 7*s.* 6*d.* a dozen.

For three years ending March, 1747, the average value of earthenware imported annually into Ireland was £3,367, and between 1753 and 1759 it varied from £10,318 to £6,677. Between 1750 and 1756 the value of the ware imported annually from France alone varied from £1,201 to £131. For three years ending March, 1773, the value of imported wares amounted to £12,085 annually, and for a similar period ending March, 1783, to £17,401.

Towards the end of the eighteenth century, and early in the nineteenth, when the manufacture of fine earthenware had ceased in Ireland, the value of imported pottery amounted in 1799 to £26,612, in 1807 to £56,441, and in 1808 to £90,423.

Pottery, probably of the coarser kinds, appears to have been made in Ireland after about the year 1820, for in the Custom House Books, preserved in the National Library, Dublin, entries are to be found of the exportation of earthenware of native manufacture. The exports were chiefly from Cork and Dublin, and the annual amounts for the years 1820 to 1823 varied in value from about £500 to £100.

ROSTREVOR.

An earthenware manufactory appears to have been set up at Rostrevor, Co. Down, probably in the second quarter of the eighteenth century. The following advertisements relating to the factory appear in *The Dublin*

Journal. April 10th, 1742:—" William Bright of Charles Street, and Alexander Owens, of Hammond Lane, Dublin, proprietors of the Rostrevor Pot House in the County of Down, make and sell all sorts of the best blue and white earthenware. Such gentlemen as are pleased to bespeak sets of dishes and plates may have their coats of arms or any other pattern they please done on them in the best manner. As the whole work is performed by natives of this kingdom only, they humbly hope to meet with proper encouragement, and propose to sell at the most reasonable rates. N.B.—The said proprietors obtained the premium of £10 from the Dublin Society for exhibiting the best set of earthenware consisting of nine dishes and three dozen plates, which were immediately bought by his Excellency the Lord Chancellor (Robert Jocelyn, afterwards Baron Newport and Viscount Jocelyn) to encourage paid work."

March 29th, 1743: " Whereas the partnership between Alexander Owens, at the Cheshire Cheese in Hammond Lane, Dublin, and William Bright of Charles Street, of the Pot House of Rostrevor near Newry Co. Down is dissolved, now said Owens carries on said Pot House and will furnish any gentleman with any sorts of blue and white earthenware, such as dishes and plates of any pattern, or their coats of arms done on them. Said Owens makes all sizes of punch bowls, tea cups and saucers, basins of all sizes, chamber pots and several other sorts of blue and white earthenware. Also apothecaries may be fitted out with any sort or kind of their pots. Likewise said Owens has imported all sorts of English earthenware. Country shopkeepers and dealers may be furnished at the Pot House of Rostrevor with all sorts of the blue and white ware made there, or English earthenware, where a warehouse will be kept."

In the Proceedings of the Dublin Society, dated April 1st, 1742, it is recorded that: " William Bright produced two complete sets of earthenware for the premium and Mr. William Lake one; Mr. Lake's was allowed to have the advantage of colour, but Mr. Bright's being thought the better set on the whole the premium was adjudged to him."

Where William Lake had his factory is not known, as no other reference to him occurs.

A notice of the Rostrevor Pottery occurs in " The Ancient and Present State of the County of Down," published in 1744. Under the head Rostrevor it is stated that: " At the lower end of the village is a small quay for ships, and here is also a salt house and a pottery for white earthenware made of the fine clay found near Carrickfergus, and frequently exported to foreign parts." Almost identical references to this pottery are to be found in John Angel's " A General History of Ireland," published in 1781, and in Wilson's

"Postchaise Companion," published in 1786, both apparently copied from the previously mentioned work. In Angel's and in Wilson's accounts the present tense is used: "here *is* a pottery," &c., but as no other reference to this pottery has been found, it is unlikely that it was continued as late as 1786.

LIMERICK.

Apparently a delft manufactory was erected in Limerick about the year 1762, for in that year the Dublin Society awarded a premium of £30 to John Stritch and Christopher Bridson, of the City of Limerick, for erecting a manufactory of earthenware in imitation of delft or white ware. Specimens of the ware were produced and approved of by the Dublin Society. This is the only reference to this manufactory I have found, so that at present it is not known how long it lasted. Christopher Bridson died in 1768, and perhaps it was closed shortly afterwards.

Early in the nineteenth century coarse pottery was made in Limerick, as proved by the following advertisement in *The Limerick General Advertiser* for May, 1818:—"John Hanks & Co. inform the public that they have commenced the pottery and tile manufacture in the concerns lately occupied by Joseph Sargent Esq., Newgate Lane, near the new Gaol, Limerick, and will sell flooring, kiln, ridge, and pan tiles, garden pots, crockeryware suitable for domestic purposes, and chimney tops, all of which will be of the best manufacture, having gone to considerable expense to procure good workmen. Earthenware articles made to any pattern, size or fashion."

YOUGHAL.

It has often been said that enamelled or tin-glazed earthenware was formerly made in Youghal, but up to the present I have found no reference to confirm this statement, and no mention occurs of any fine earthenware ever having been made in Youghal in former times. Probably only coarse ware, such as milk-pans, tiles, flower-pots, &c., was made.

The names of the following potters in Youghal occur:—Thomas Green, 1652, Patrick Carthy, 1779, Matthew Shaw, 1781, Joseph Hanks, 1787, and Thomas Pollock, 1795. In 1776 Hugh Pollock, of Youghal, brown earthenware manufacturer, petitioned the Dublin Society for aid, but no further reference to the matter occurs. Pollock's name appears in a Cork directory of 1787 as a manufacturer of all sorts of pottery, bricks, and tiles. In a directory for 1820 the names of John Joseph Fisher, William Restrick, and Kyrle Sidley, earthenware manufacturers, appear; and it is also stated that the manufacture of coarse or brown earthenware is in a flourishing state, there being no less than three potteries of this kind established. Possibly the manufacture of coarse earthenware was continued, as in the Cork Exhibition of 1852 Jasper Drury, of Youghal, exhibited floor-tiles, and in the Cork Exhibition of 1883 John Fleming, of the Tourig Pottery, near Youghal, exhibited ornamental vases, flower-pots, &c.; milk and wash-pans, cream- and bread-crocks, roof- and floor-tiles, and building-bricks; and Jasper Drury & Sons, garden-pots and vases, seed-pans, hyacinth-pots, milk-pans, building-bricks, floor- and roof-tiles, chimney-tops, miniature ware and vases, plates for painting, and rustic baskets.

CORK.

Besides the previous mention of coarse pottery having been made in Cork in 1683, the following advertisements appear in *The Cork Constitution.* August 25th, 1835:—"Stoneware Pottery, Cork. W. Stanton informs the public that recent improvements made in his manufactory at considerable expense enables him to ensure a constant supply of all kinds of ware of the best description. A large stock of jars, bottles, pots, jugs, &c. St. John Street, Cork." March 21st, 1837: "Garrett Russell has concluded arrangements for the manufacture of stoneware and will be supplied with every size of pickle-, butter-, and sugar-pots, water-filters, foot-warmers, and crucibles, also porter, cider, and gingerbeer bottles glazed inside with glass. North Abbey, near North Bridge."

WATERFORD.

The following advertisement appears in *The Dublin Journal* of May 6th, 1755:—"Waterford, May 5th, 1755. This day was exhibited here some white transparent china ware made by a gentleman of this place who has introduced and brought to maturity several other branches and manufactures never attempted before in this kingdom, and who has also greatly at heart to introduce and establish here a manufactory of all kinds of hardware."

No other mention occurs of any pottery or porcelain having been made in Waterford, but in the year 1791 the name of John Williamson, potter, is recorded.

NEWRY, ETC.

Coarse pottery appears to have been made in various parts of the North of Ireland late in the eighteenth century and early in the nineteenth.

In the years 1793 and 1794 Michael Dunbar & Co., of Newry, advertise that they are making at their manufactory on the Merchants' Quay "every sort of black ware and sugar moulds equal to any imported, also floor and kiln tiles, garden pots, fire bricks, and chimney pots."

In 1767 Thomas Hardin, of Portadown, presented a petition to the Dublin Society stating that he was the only person in Ireland who carried on the manufacture of black crockery-ware by means of turf fuel only, and manufactured said ware to the value of £200 yearly, and asked for aid to erect buildings and lay in materials.

In 1793 Thomas Clougher of the Derrycaw Pottery, near Charlemont, Co. Antrim, states that he makes "all kinds of black ware glazed with English glaze, and equal to any imported; also sugar moulds and drips, flooring and kiln tiles, bricks and chimney tops."

In 1803 William Robb & Co. advertise that they "have commenced the crock manufacture at Derrybroughy near Portadown, and make all descriptions of black crocks, bricks, tiles and garden pots."

Coarse pottery was also made at Agivey and near Castledawson, Co. Londonderry, and at Ballycastle, Co. Antrim, early in the nineteenth century.

In the "Statistical Survey of Co. Down," published in 1802, it is stated that a pottery was carried on at Lambeg, near Belfast, by a firm of English potters for over a century, but that only coarse ware was made there.

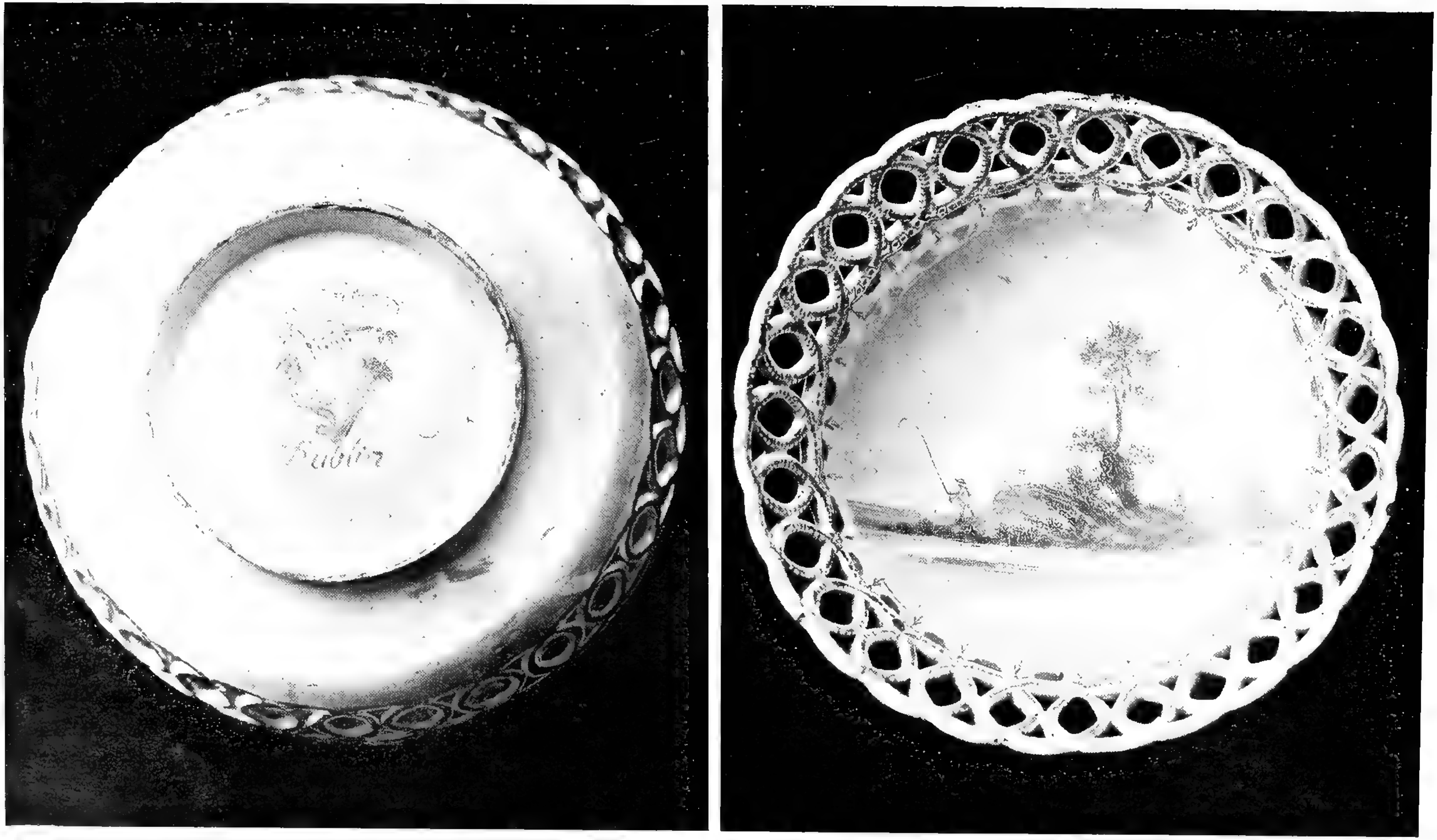
Pottery works were set up at Larne about the middle of the nineteenth century. The works were built by James Agnew and carried on under the management of his agent, Mr. J. Walker, from 1850 to 1855, and afterwards for two or three years by the Greenock Pottery Co. White and printed earthenware, cane ware, brown pans, crocks, and kitchen utensils were made, some of the pottery being made from local clays.

In the Dublin Exhibition of 1853 Walker exhibited fire- and common bricks, crucibles, common and black ware, jars, Rockingham teapots, cane ware, baking-dishes, breakfast- and tea- services, bowls, wine-coolers, and porous water-jugs; and in the Cork Exhibition of 1852, among other things, flooring-tiles.

In the Cork Exhihition of 1883 Robert Burns of Ballynakelly Pottery, Coalisland, Co. Tyrone, exhibited black and yellow glazed tall crocks, wash- and milk-pans, flower-pots, and terra-cotta, some hand-painted, exhibited to show the manufacture rather than the painting. Coarse pottery had been made at Coalisland from early in the nineteenth century.

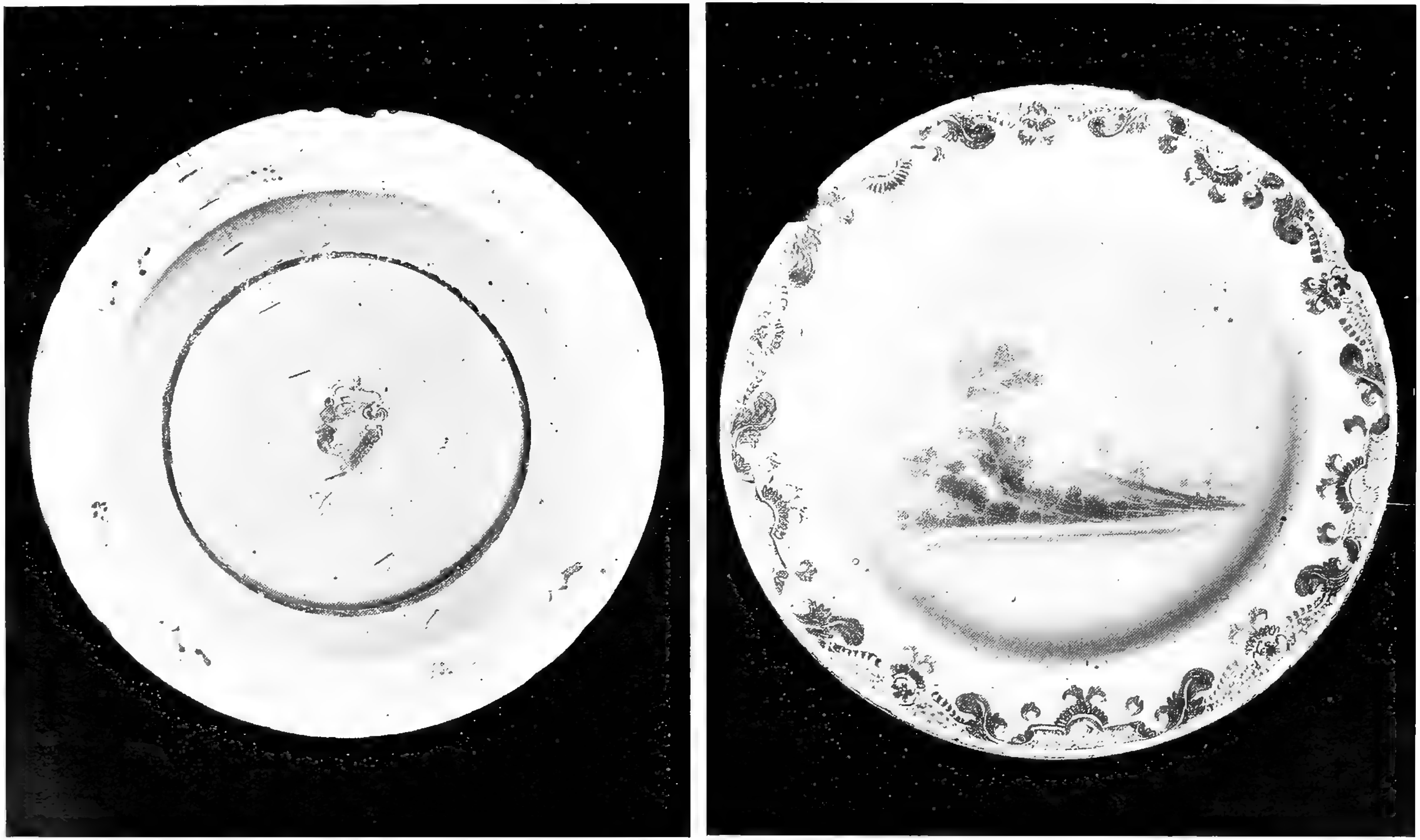
During the second half of the nineteenth century a Mr. Samuel Murland established brick and tile works at Castle Espie, near Comber, Co. Down. About 1870 or 1880 common brown glazed pottery was made, consisting of dairy vessels, tea-pots, flower-vases, etc.

The chief and almost only manufacture of fine earthenware in Ireland in



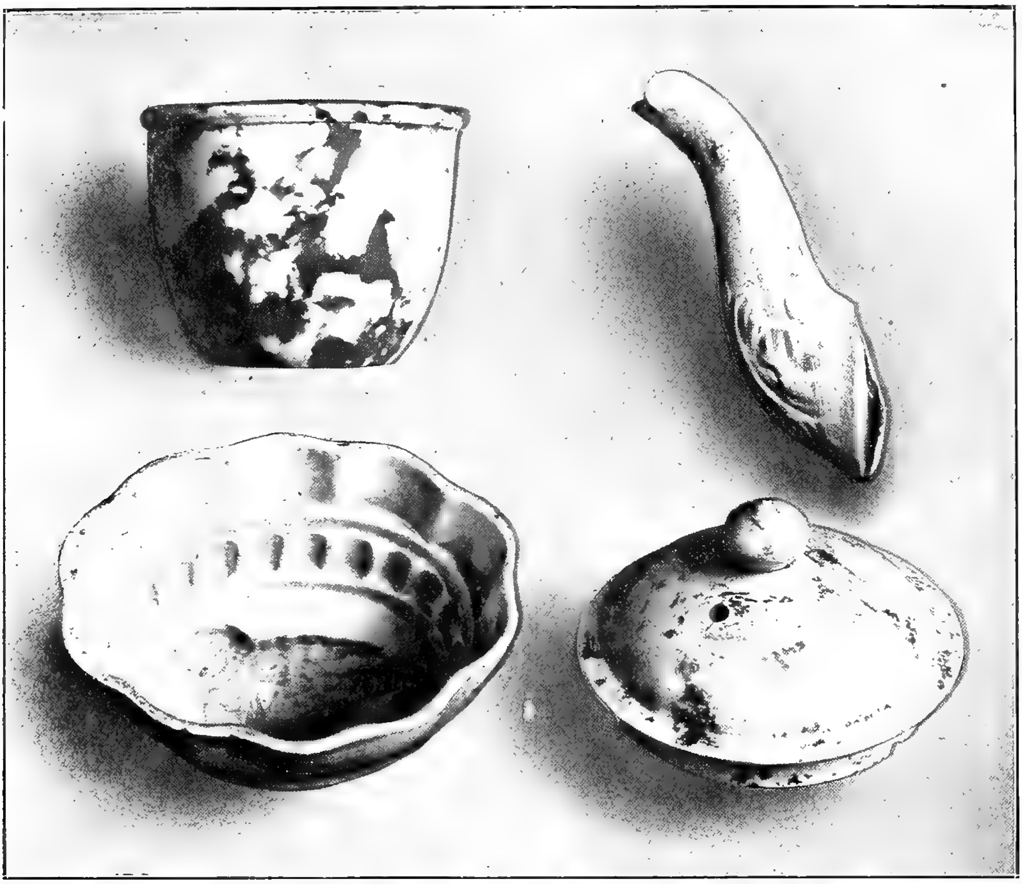
Westropp.—Irish Pottery.

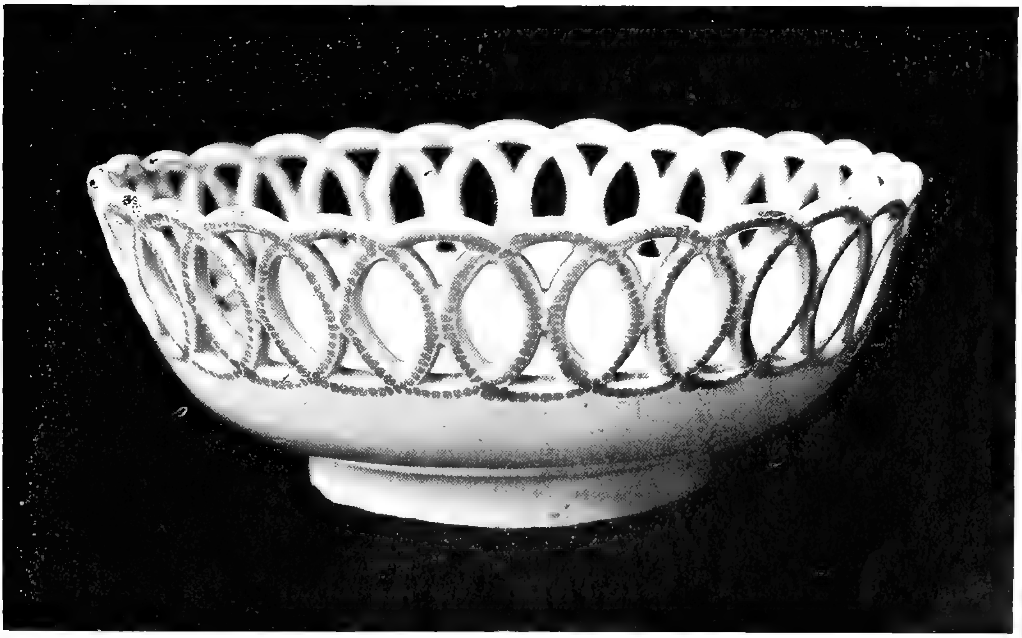
Base and interior of Enamelled Earthenware Bowl, $8\frac{1}{4}$ inches in diameter and $3\frac{1}{4}$ inches high, made in Dublin about 1753. The property of S. G. Stopford Sackville.



Westropp.—Irish Pottery.

Back and front of Enamelled Earthenware Plate, 12 inches in diameter, made in Dublin about 1753. The property of S. G. Stopford Sackville.





WESTROPP.—IRISH POTTERY.

Small Bowl and Teapot-lid of fine stoneware, and Teapot-spout of cream ware found on the site of the Downshire Pottery, Belfast. Jelly-mould of cream ware said to have been made at the Downshire Pottery. The Property of R. M. Young.

Side-view of Bowl. Plate I.

the nineteenth century was carried on at Belleek, Co. Fermanagh, and is still in existence. This factory was started about 1857 owing to the discovery of kaolin and felspar on the property of Mr. J. C. Caldwell of Castle Caldwell.

Mr. R. W. Armstrong and Mr. D. M'Birney of Dublin were the proprietors, and about 1860 were producing ordinary household and toilet ware. About 1863 the manufacture of porcelain insulators for electric telegraphs was commenced. Both fine pottery and porcelain were made at Belleek, including figures, shell-, coral-, rock-work, etc., in biscuit-porcelain, and also objects in an ivory porcelain covered with an iridescent glaze.

In the Exhibition in Dublin in 1865 M'Birney and Armstrong exhibited table- and toilet-ware and stone china; stoneware; mortars, etc., for chemical purposes; Parian china figures and statuettes and earthenware; in the Exhibition of 1872 statuary; dessert sets; table ornaments; dinner ware; tea and breakfast ware; toilet ware; milk pans, bowls, jugs, mugs, etc.; and in the Cork Exhibition of 1883 statuary porcelain, dessert centres and pieces, dessert service of ivory china painted and gilt, and also fancy china articles.

The factory ceased working for a time, but at the present day is producing large quantities of ware, especially the ivory porcelain with the iridescent glaze, almost all made of imported materials.

II.

A CHARTER OF CRISTIN, BISHOP OF LOUTH.

By REV. H. J. LAWLOR, D.D., LITT.D.

Read APRIL 28. Published JUNE 16, 1913.

SOME months ago the Archbishop of Armagh was so good as to call my attention to an early Charter in the possession of the Marquis of Ormonde. On examination it proved to be of such interest that it seems desirable to print the entire text. It runs as follows:—

CRISTINUS dei gr*ati*a lugdunencis ep*iscopu*s *et* Thom*as* dictus prior s*anct*e marie de lugdoñ. *et* totus eiusdem loci conuentus vniuersis s*anct*e m*at*ris eccl*esi*e filiis ad quos presentes litere p*er*uenerin*t* sal*utem* i*n* Chr*ist*o. Nou[eritis] uniuersitas u*est*ra nos assensu *et* co*m*muni co*n*cilio tocius capituli n*ost*ri concessisse *et* quietam clamauisse petro pippa*r*d *et* heredib*us* suis presentac*i*ones eccl*esi*e de Clunken *et* eccl*esi*e de Druncar. cu*m* om*ni* exacc*i*one que ad eccl*esi*am n*ost*ram de lugduñ e*ss*e p*er*tine*n*tes uindicauim*us* excepta tercia p*ar*te decimar*um* garbar*um* q*ue* ad prefatas eccl*esi*as p*er*tine*n*t. q*u*am preno*m*inatus petr*us* pipp*ard* canonicis s*anct*e marie de lugduñ p*er*petue *et* quiete ab om*ni* exacc*i*one remisit. Saluo ep*iscop*ali *et* eccl*esi*astico iure q*uo*d cl*er*icus qui p*re*fatas eccl*esi*as possidebit p*er*soluet. Et ut ista concessio rata *et* i*n*convvlsa i*n* poster*um* remaneat sig*il*li n*ost*ri ap*positi*one co*n*firmauim*us*. Hiis testib*us* Rad*ulf*o p*ar*uo Archideacono midie. R[em]igio[1] p*r*iore de Duuelec. petro cap*ell*ano

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[1] There is a hole in the vellum, in consequence of which part of this word is lost. But that the initial is *R* is all but certain, and the letters *igio* are quite clear. Before these are strokes which must be read either as *n* or as part of *m*.

simo*ne* cap*e*ll*an*o canonicor*um* d*e*[1] Launton̄ Rob*ert*o cl*er*ico Adam cap*e*ll*an*o de hestređ martino de [. . . .]uilƚ[2] Galfr*id*o Esturm̄. Simone Baudewiñ. d*e*[3] kerme matheo d*e* fulsaue Ric*ar*do hedesore Regin*aldo* cl*er*ico Thom*a* cl*er*ico qui cartam sc*r*ipsit *et* sufficientib*us* aliis.

This deed is endorsed: 'Grant (?) of the presentations of Clonken and Drunkar from (?) the Bishoppe (?) of lugd and the prior there[of] (?) [to] piers pippard.' The seal which was once attached to it has disappeared.

I must now essay the task of dating the Charter; and I believe that I shall be able to do so within narrow limits.

Louth[4] was the see of the diocese of Uriel—which was approximately coextensive with what we now know as the diocese of Clogher—for some sixty years. Under the year 1138 the *Annals of the Four Masters* record the death of Gillacrist, Bishop of Clogher. He was a brother of Malachy O'Morghair, Archbishop of Armagh, and was probably the immediate successor of Cinaeth O'Boyle, Bishop of the same see, who died 1135.[5] But though the Irish annalists call him Bishop of Clogher, in the Annals of St. Mary's Abbey he is styled Bishop of Louth. In them, under the year 1139, we find this entry:

"Eodem anno obiit Christianus, episcopus de Liueth, frater Sancti Malachie, vir bonus, plenus gracie et virtutis, secundus illi in celebri opinione."[6]

This fact, that Gillacrist or Christianus was known to the Irish annalists as Bishop of Clogher, and to the Anglo-Norman chroniclers as Bishop of

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[1] See note 3.

[2] The hole mentioned, p. 28, note 1, extends to this word; of its earlier letters only the lower portions remain.

[3] The symbol which I read as *de* seems to be a somewhat flattened *D* of a form found about the date of the Charter. Elsewhere (e.g. *Christ Church Deeds*, 4, 10) we have đ for *de*. But whether the symbol is actually the letter *d* or no, Launton̄, Kerme, and Fulsaue being all apparently place-names, it can hardly represent any word but *de*. See below, p. 39.

[4] Here called Lugdunen., Lugdoñ. In other documents we find the forms Lubgud, Lug., Lugwden., Liueth, Loued, Loueth, &c. In the chronicles ascribed to Benedict of Peterborough (Rolls ed. i, 26) we find Lughbdunen. (one MS. Lughdunen.), which is very nearly the form of our Charter. Colgan (*AA. SS. Hib.*, i, 736) says that Lugdunen. is the form used in the Papal Registers. The Irish name is Luᵹḃaḋ.

[5] *Annals of Tigernagh* (*cont.*). Ware does not mention this bishop; and Harris dates the beginning of Christian's (i.e., Gillacrist's) episcopate in 1126. (*Ware's Works*, 1764, vol. i, p. 179.) On what authority, if any, he relies for this date I do not know. Harris often gives purely conjectural (and incorrect) dates to bishops.

[6] Gilbert, *Chartularies of St. Mary's Abbey, Dublin*, 1884 (Rolls Series), vol. ii, p. 258.

Louth, is explained if we suppose that during his episcopate the see was transferred from the former to the latter place.[1] It is at any rate certain that his successors up to the last decade of the century had their see at Louth, and ruled over the diocese of Uriel, a district which contained the greater part of the diocese of Clogher, in its present extent, together with the County of Louth.[2] Thus we have St. Bernard's authority for the statement that on the death of Gillacrist one Edan, whom the Irish writers call Aedh Ua Caellaidhe, was appointed to fill his place;[3] and Edan is described in more than one charter as Bishop of Louth,[4] and in the record of his death as Bishop of Uriel.[5] He died in 1182. In 1184 another Bishop of Louth[6] is in possession—Mael Isu Ua Cerbhaill. In recording his death in 1187 the annalists style him Bishop of Uriel.[7] His successor was Gillacrist Ua Muccaran, Bishop of Louth and of Uriel, who died in 1193.[8] After him comes a bishop of whom we know nothing more than that his surname was Ua Mael Ciarain, and that he died Bishop of Uriel in 1197.[9]

It appears that about the year 1200 the see was once more transferred: for after the twelfth century we hear of no more Bishops of Louth; and the title Bishop of Uriel almost disappears from the Annals.[10] The successor of Ua Mael Ciarain seems to have been Gilla Tighernaigh Mac Gilla Ronain, whom the annalists call Bishop of Clogher, and who died in 1218.[11] Two or three years before his death, Eugenius, Archbishop of Armagh, held a synod at Drogheda,[12] which proves that by that time the County of Louth had

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[1] In the extract from the Clogher Register quoted below, p. 35, it is implied that, like his successors, he was Bishop of Uriel.

[2] See Hogan, *Onomasticon Goidelicum*, s.v. Airgialla.

[3] *Vita S. Malachiae*, 34.

[4] Namely, in the charter granted to him by Dermot Mac Murrough, King of Leinster; in the charter of Henry II to the Priory of All Hallows, Dublin (1171 or 1172), in *Registrum Prioratus Omnium Sanctorum*, ed. R. Butler (Irish Archaeological Society), 1845, pp. 20, 50; and in the charter of St. Laurence O'Toole to Christ Church, Dublin (14th May, 1178?), in the *Liber Albus* of Christ Church, f. 40v, Cal. (*Proc. R. I. A.* vol. xxvii, Sec. C, No. 1), no. 42. Cp. *Annals of Four Masters*, s. a. 1148; "Benedict of Peterborough," ed. Stubbs (Rolls Series), i, 26.

[5] *Annals of Loch Cé*, s. a. 1182.

[6] See the renunciation of the Priory of All Hallows by "M. Dei gratia Lug' ecclesie episcopus" to John Comyn, Archbishop of Dublin, in Gilbert's edition of *Crede Mihi*, p. 70.

[7] *Annals of Ulster.*

[8] *Register of St. Thomas's Abbey*, ed. Gilbert, p. 267; *Annals of Loch Cé.*

[9] *Annals of Loch Cé.* It is possible that this is a duplicate entry, and that the "Bishop Ua Mael Ciarain" was identical with Gillacrist Ua Muccaran.

The Annals of Ulster speak of bishops of Uriel in 1356 and 1369; but clearly this title did not correspond with the facts.

[11] *Annals of Ulster*; *Cal. of Pat. Rolls*, 1216, pp. 148, 173.

[12] *Chart. St. Mary's Abbey*, i, 155. Eugenius died 1216 (*Annals of Ulster*), and Robert, afterwards Bishop of Ardagh, was Abbot of St. Mary's when the Synod was held. Since

reverted *de facto*, if not *de jure*, to the diocese of Armagh, of which in earlier times it had formed a part.[1]

Now there can be little doubt that the list of Bishops of Louth which I have given is complete. And among them there are two, and only two, whose names might have been represented by Cristinus in a Latin document. One of these is Gillacrist, the brother of Malachy, whom both St. Bernard and the Annals of St. Mary's Abbey call Christianus, and who died *circa* 1139. The other is the second Gillacrist, who died in 1193. In the only Latin instrument in which I have hitherto found mention of him, his initial is given as C.[2]

From which of these two the document before us emanated there can be no doubt, for one of the witnesses is Radulfus Parvus, or le Petit, Archdeacon of Meath. This person held the archdeaconry in 1206,[3] became Bishop of Meath in 1227, and died in 1230.[4] It is therefore impossible that he can have been archdeacon in the lifetime of the earlier Gillacrist. Consequently the Cristinus of our instrument must be Gillacrist II, and its date must lie between 1187—in which year his predecessor, Mael Isu, died—and 1193.

The name of another witness—the Prior of Duleek—enables us to define the date more exactly. That priory was held in the last decade of the twelfth century, and the first decade of the thirteenth, by one Gilbert, whose name or initial appears in many extant documents. He was appointed as early as the episcopate of Eugenius, Bishop of Clonard, who died in 1191[5]: for, along with Eugenius, he witnessed an instrument of our Cristin, Bishop of Louth;[6] and he appears also as a witness in a confirmation granted by Eugenius to the Abbot and Convent of St. Mary's Abbey, Dublin.[7] And he was still Prior on 14th February, 1206—many years after the death of Cristin, Bishop of Louth—when a letter was issued in his name and that of Simon Rochfort, Bishop of Meath.[8] Thus from 1191, at the latest, to the end of the episcopate of Cristin, the Prior of Duleek was Gilbert.

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he was appointed Abbot in 1215 (*Chart. of St. Mary's Abbey*, ii, 40), the Synod must have been held in 1215 or 1216.

[1] The Synod of Rathbraesal made Sliabh Breagh—the range of hills which runs east and west from Clogher Head to Collon—the southern boundary of the Parochia of Armagh. Keating, *History of Ireland*, ed. Comyn and Dinneen (Irish Texts Society), 1902–1908, vol. iii, p. 303. Cp. Theiner, *Monumenta*, p. 40.

[2] *Reg. of St. Thomas's Abbey*, p. 267. I leave out of account the Bishop Ua Mael Ciarain, whose Christian name is unknown; because it will presently appear that a date between 1193 and 1197 for our Charter is impossible. See also above, p. 30, note 9.

[3] *Reg. of St. Thomas's Abbey*, p. 348.

[4] *Cal. of Pat. Rolls*, 1225, p. 115; *Annals of Loch Cé.*

[5] *Annals of Loch Cé.*

[6] *Reg. of St. Thomas's Abbey*, p. 268.

[7] *Chart. of St. Mary's Abbey*, vol. i, p. 157.

[8] *Reg. of St. Thomas's Abbey*, p. 348.

Now the name of the prior who is the second witness to our Charter is not absolutely certain, though I have no hesitation in reading it 'Remigio.' But it is at any rate impossible that it can be 'Gilberto.' It follows that this prior was a predecessor of Gilbert, and that the Charter is not later than 1191.

But the beginning of Gilbert's priorate, and consequently the date of the Charter can be pushed further back. In the grant of Bishop Eugenius just mentioned, among the witnesses, in addition to Gilbert, Prior of Duleek, are Bertram de Verdun and Gilbert Pipard. Now about both of these men we know a good deal. Both of them went to Ireland with Prince John in 1185.[1] Verdun remained there till at least Easter in the following year, acting as the host of Giraldus Cambrensis.[2] But in June, 1188, or earlier, he crossed over to England; for on 14th June we find him at Geddington in the court of Henry II.[3] In 1189 he was taken into the service of Richard I; and he witnessed charters at Canterbury on 1st December,[4] and at Westminster in January, 1190.[5] He accompanied Richard on his crusade, and was in Sicily in November, 1190, and January, 1191.[6] Five months later he reached Palestine (June, 1191).[7] On 21st August, 1191, he was put in charge of Acre,[8] and died at Joppa in 1192.[9] Thus it may be regarded as almost certain that he was not in Ireland after November, 1189, and as probable that he finally left that country before June, 1188, though it is possible that he visited it late in 1188 or in 1189. About Pipard's movements we have less information. But since he was sheriff of Lincoln in the first year of Richard I,[10] he had probably settled in England before September, 1189. Like Verdun, he died after taking some part in Richard I's expedition to Palestine. His death took place in 1192 at Brindisi,[11] where he may be supposed to have been left behind—probably on account of illness—for Richard had reached Palestine in September, 1191.[12] At what time Pipard joined the crusading army is not clear. He may have sailed from England about the same time as the king (11th December, 1189),[13] or he may have started later. It seems pretty certain, however, that he was in Richard's

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[1] *Calendar of Documents relating to Ireland*, vol. i, no. 81.

[2] Giraldus: *De rebus a se gestis*, ii, 13 (*Works*, R. S., i, 65).

[3] R. W. Eyton: *Court, Household, and Itinerary of King Henry II*, 1878, p. 287—a reference for which I have to thank Mr. Goddard H. Orpen.

[4] Gervase of Canterbury (R. S.), i, 503.

[5] *Historians of York* (R. S.), iii, 87.

[6] Roger of Hoveden (R. S.), iii, 62; J. H. Round, *Ancient Charters* (Pipe Roll Society), pt. i., p. 98.

[7] *Itinerarium* in *Memorials of Richard I* (R. S.), i, 217.

[8] "Benedict of Peterborough," R.S., ii, 190.

[9] *Ibid.*, 150. [10] *Ibid.* [11] *Ibid.* [12] *Ibid.*, 227. [13] *Ibid.*, 101.

force about June, 1190, when the fleet set sail,[1] or at latest in July, when the king came to Marseilles, and found a multitude of pilgrims who had been waiting for him so long that they had spent all their money.[2] It is improbable that he was in Ireland after the first half of 1189.

As a result of these considerations I take it to be certain that Verdun had left Ireland for the last time not later than November, 1189, and that he was in England in the summer of 1188; while Pipard was in England for the latter part of 1189. There is little likelihood that both of them were in Ireland after the early months of 1188. Thus we get a terminus *ante quem* for the date of the instrument of which they and Gilbert, Prior of Duleek, were witnesses. And we may affirm with confidence that the last-named was Prior as early as the autumn of 1188, with high probability that he was already in office in the preceding spring. Somewhat earlier must be placed the end of the rule of his predecessor Remigius. The date of our Charter therefore lies between 1187 and 1189, and probably not after the beginning of 1188.

It would be strange if a deed belonging to so early a period, and capable of being dated within a couple of years, did not yield some results of value. For the period from 1185 to 1200, an accomplished historian tells us, " is one for which contemporary authorities are almost altogether lacking."[3] I proceed to indicate some points on which it seems to throw welcome light.

In the first place, we glean some information about the grantor, Bishop Gillacrist. Hitherto the exact form of the name which he assumed in official documents has been a matter of conjecture. We have only known, as already remarked, that it began with the letter *C*. It now appears that it was Cristinus, and not Christianus, as has often been taken for granted.[4] Our document also supplies us with the name of a Prior of Duleek, earlier than any heretofore known. Archdall records only one before 1283—the Prior Gilbert mentioned above—and he is not fully informed about his date.[5] We now know that Gilbert's predecessor was Remigius. We learn also that the name of the Prior of St. Mary's, Louth, in 1188 was Thomas. Archdall records no Prior of that house earlier than 1276.[6]

But those are matters of minor detail. It is more important to observe that some information is supplied concerning the constitution of the bishopric

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[1] "Benedict of Peterborough," R.S., ii, 111.

[2] *Ibid.*, 112.

[3] G. H. Orpen in the *Journal of the Royal Society of Antiquaries of Ireland*, vol. xxxviii, p. 241 f.

[4] E.g. by Ware, *Works*, vol. i, p. 181.

[5] *Monasticon Hibernicum*, p. 537.

[6] *Ibid.*, p. 471 f.

of Uriel. In a paper published more than three years ago on the early history of the Diocese of Clogher[1] I ventured on the conjecture that the Bishops of Louth had a chapter of regular canons. In support of this hypothesis I quoted the statement of the *Annals of Loch Cé* that Bishop Edan was a "head of canons," and the report of the Archbishop of Armagh to the Pope in 1227 that a regular canon had taken part in the election of a Bishop of Clogher. This evidence is indeed very far from conclusive. But our Charter gives it strong support. The grant is made by the Bishop and the Prior and Canons of St. Mary's, Louth, and is attested by their seal. In other words, the relation of Cristin to the canons of St. Mary's appears to have been exactly that which always subsisted between a Bishop and his Cathedral Chapter when it was composed of Augustinian canons.[2] In such cases the Bishop was the Abbot of the community, though its immediate head was the Prior. So it was, for example, at the Cathedral of the Holy Trinity, Dublin.[3] At Carlisle, likewise, where was the only Augustinian Cathedral in England, the connexion of the Bishop with the chapter was of the closest kind.[4] In the words of Dr. James Wilson:—"There was no separate endowment for the maintenance of the episcopate, except a canonry of York . . . For the first century after the creation of the bishopric, all the benefactions were made, not to the priory or to the bishopric, but to the Church of Carlisle, which included both. The endowments of the bishopric and priory were one, and indivisible . . . The Church of Carlisle was an ecclesiastical corporation, and the Bishop had no real property distinct from his cathedral church."[5] Dr. Wilson goes on to remark that the endowments "were, for the most part, of a spiritual nature. The first gift to which we can attach an approximate date was made by King Henry in the form of a reversion of four churches."[6] This is most interesting when considered in relation to our Charter. It is a

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[1] *Irish Church Quarterly*, vol. ii (1909), p. 241.

[2] Since there has been much confusion between the canons of St. Mary's and those of the neighbouring house of St. Peter and St. Paul at Knock, it may be well to give proof that the former belonged to the Order of St. Augustine. It will be found in the Register of Archbishop Fleming, f. 17^{v} (Calendar, no. 82).

[3] See J. L. Robinson in the *Irish Church Quarterly*, vol. vi (1913), p. 38.

[4] Here no prior intervened between the bishop and the canons.

[5] "An Augustinian Cathedral—Carlisle," in *Transactions of the Scottish Ecclesiological Society*, vol. iii, p. 267.

[6] *Ibid.*, p. 268. In this respect the Church of Carlisle was in striking contrast to the Priory of the Holy Trinity, Dublin, which from the first possessed much landed property. See the donation of St. Laurence O'Toole in the *Liber Albus* of Christ Church, f. 40^{v}, Cal. (in *Proc. R.I.A.*, vol. xvii, Sec. C, No. 1), no. 42. But it must be remembered that up to the time of St. Laurence the Chapter of Holy Trinity was not Augustinian. His charter was probably only a confirmation to the Augustinian Canons of property already belonging to the Church. Compare *Christ Church Deed*, 364c.

grant of property common to the Bishop and canons; it is attested by a single seal; and the property is of the character which Dr. Wilson describes as spiritual, the advowsons of two churches.

At this point reference may be made to the curious form of the deed. The Bishop, Prior, and Convent release the presentations to Peter Pipard, with the assent and counsel of the chapter. This seems strange when we consider that the 'convent' and the 'chapter' were one and the same body. Possibly the formula was in part borrowed from the ordinary episcopal grants in which the relation between the bishop and the chapter was not so close as at Louth. The grant of a bishop usually ran in his name, the chapter merely consenting. In the instrument before us the customary form may have been adapted to the circumstances of the Bishop of Louth by the insertion of the words "et Thomas dictus prior," &c., without the corresponding deletion of the assent clause below.

Here we may notice also the reservation to the community of the third part of the greater tithes of the churches—"excepta tertia parte decimarum garbarum quae ad praefatas ecclesias pertinent." This "third part" was, I suppose, the "quarter episcopal," to which it would very nearly correspond in amount.[1] We learn from a Register of Clogher, quoted by Ware, that in the time of Bishop Gillacrist I, "his brother Malachy obtained from Pope Innocent II that the fourth part of the tithes, or the episcopal part through all Ergall (Uriel), should be allotted to the Bishops of Clogher."[2] This appears to be good evidence that in the period with which we are concerned the system of quarters episcopal was in force in the diocese of Uriel. But as long as the Bishop was the head of an Augustinian chapter, and without separate property, they would naturally be paid, not to him, but to the community of which he was a member. Moreover, they would, of course, be exacted only from churches the patronage of which did not belong to the community. The churches of the chapter would be served by the canons placed in charge of them, the entire revenues being paid into the common fund. But when a church belonging to the chapter was alienated to a lay patron, they would be reserved in the grant. Thus we can under-

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[1] In later times the rectorial tithes were commonly counted as double the vicarial. One-third of the former would therefore be two-ninths, or about a quarter of the whole.

[2] Ware, *Works*, vol. i, p. 180. The antiquity of Ware's Clogher Register is not so great as the common description of it as 'ancient,' or the statement of Harris that it was "the best authority" (*ibid.*, p. 179) for the early bishops, might lead us to suspect; for it was compiled by Archdeacon Rory O'Cassidy as late as the year 1525 (*ibid.*, p. 187). It seems to have reckoned all the Bishops of Louth as Bishops of Clogher. Accordingly we may surmise that it was to the Bishops of Louth that Innocent II granted the quarters episcopal of Uriel.

stand why the reservation of the third part of the greater tithes was made in the grant of Cristin to Peter Pipard, and also why he was bound to pay it to the canons rather than to the Bishop. When the churches made over to him passed from the jurisdiction of the Bishops of Uriel to that of the Archbishop of Armagh, the reservation, as we shall see, was continued.[1] The third part was not, however, as we might have expected, made a portion of the revenue of the Archbishop, but remained in the hands of the canons of Louth. The reason, no doubt, was that the Archbishops of Armagh were never entitled to demand quarters episcopal from the churches of their diocese.[2] But this is to anticipate.[3]

I must own that it has been a surprise to me to find that the convent of St. Mary's was the Chapter of the Bishops of Louth. Aedh (Edan) Ua Caellaidhe, the successor of Gillacrist I, was the organizer of the newly formed diocese of Uriel; and during his episcopate the Abbey of St. Peter and St. Paul, Knock, near Louth, was founded and endowed. Its consecration by Malachy of Armagh is recorded by the Four Masters under the year 1148.[4] And in a eulogy of Donnchadh Ua Cearbhaill, leader of the men of Uriel at that period, which has been printed by Dr. Whitley Stokes,[5] while much is said of his benefactions to Knock, and mention is made of some of

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[1] See below, p. 38.

[2] Reeves, *Colton's Visitation*, p. 115.

[3] Valuable confirmation of the conclusion which I have reached as to the constitution of the bishopric comes from the Fiants of Elizabeth. In these there are three different lists of possessions of the Priory of Louth (nos. 1312, 5416, 5877). We cannot affirm that they are exhaustive; but they contain no less than sixty denominations. Over thirty of these are in the first list, which is headed, 'Rectories and Spiritualities of Lovid.' The other lists enumerate places of which the *tithes* belonged to the monastery. There is no mention whatever of property in land. That is to say, so far as we can judge from these lists, the endowments of St. Mary's were wholly 'of a spiritual nature': just as, according to Dr. Wilson, were the early endowments of the Augustinian Chapter at Carlisle. Further, with two exceptions, all the places mentioned seem to have been in the County of Louth. The canons of St. Mary's must have held far the greater number of the churches of that district. The exceptions are worth naming. They are Magheross (Carrickmacross) and Ferney, both in the County Monaghan, and thus in the diocese of Uriel. The Louth canons had no possessions, it would appear, outside the diocese of which, as I hold, they were once the Cathedral Chapter. And finally from another fiant (no. 6034) we learn that they received a third part of the tithes of Dromin. This church is not included in the lists of their possessions; and accordingly, from it, as from Clonkeen and Drumcar before 1244, they received simply the 'tertia pars' or quarter episcopal.

[4] Archdall (p. 471) puts in this year the founding, or re-founding, of St. Mary's. But this is certainly incorrect. The Annals report that 'the church of Cnoc na Sengan was finished by the Bishop Ua Caellaidhe and Donnchadh Ua Cearbhaill' in that year, and say nothing about St. Mary's.

[5] *Martyrology of Gorman*, p. xx, from the Antiphonary of Armagh Cathedral (T.C.D. MS. B. 1. 1).

his other monastic foundations in the same district, there is no reference to the Priory of St. Mary. *A priori* one might have expected that it would rather have been at Knock than at Louth that Bishop Edan would have placed his seat. The date of the introduction of Augustinian canons to St. Mary's appears to be unknown. It is quite possible that the chapter was fixed at that house prior to the foundation of the priory at Knock.

But the interest of our Charter is not wholly ecclesiastical. Mr. Orpen has investigated, with his usual care, the history of the Anglo-Norman settlement in Louth.[1] He believes that on the occasion of Prince John's visit to Ireland in 1185, or soon afterwards, a considerable part of the modern County of Louth was distributed among his retainers. Now, one of those who came over from England with him was Gilbert Pipard, the future crusader, to whom reference has already been made. It is known that he was an itinerant justice in England in 1176 and 1179,[2] and that he was in the entourage of John in Ireland in 1185. We have found reason to think that he was still in Ireland when Cristin's charter was written. To him, according to Mr. Orpen, or to his brother Roger, John gave the barony of Ardee. Now let us turn to the Charter. It is a grant of the presentation of the churches of Clonkeen and Drumcar to Peter Pipard. Peter Pipard seems to have been a man of some distinction, though we do not meet with his name very often in our scanty collection of documents belonging to this period. He is supposed to have been a brother of Gilbert and Roger. With Theobald Walter, and others, he witnessed a grant by John of the bishopric of Glendalough to John Comyn, Archbishop of Dublin, on 27th December, 1192.[3] He was afterwards justiciary, apparently in 1194. But, while in possession of that office, he seems to have fallen into disfavour,[4] and we do not hear of him afterwards. We have no difficulty in explaining why the Bishop and Convent of Louth presented the advowsons of two of their churches in the barony of Ardee to a member of the Pipard family. It was obviously their interest to be on friendly terms with the man into whose possession had lately come so large a territory in the diocese of Uriel. But, however this may be, our Charter confirms Mr. Orpen's conclusion, for it proves that as early as the year 1188, within three years of John's departure from Ireland, the Pipards had some interest in the district in which the churches were situated. But the question arises, why was Peter selected in preference to Gilbert or

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[1] *Journal of the Royal Society of Antiquaries of Ireland*, vol. xxxviii, p. 241 ff; *Ireland under the Normans*, vol. ii, p. 118 ff.

[2] "Benedict of Peterborough," vol. i, pp. 108, 239.

[3] Register of Archbishop Alan, pt. ii, f. 25^{v}. This grant is printed in Gilbert's *Crede Mihi*, p. 44, without the names of the witnesses.

[4] Orpen, op. cit., p. 112.

Roger, as the grantee of the churches? I venture to suggest that the answer to this question is to be found in the hypothesis that it was neither to Gilbert nor to Roger that Ardee was granted by John, but to Peter Pipard himself.[1] Gilbert left Ireland soon after our Charter was issued, and died in 1192; Peter was disgraced in 1194, and probably died soon afterwards. It is therefore not to be wondered at that Roger alone of the three brothers appears as lord of Ardee in such documents as we possess.

We can now trace the history of the churches of Drumcar and Clonkeen further back than has hitherto been possible. We learn that in 1188, and probably many years earlier, they belonged to the Bishop of Louth and his chapter. Some thirty years after their surrender to Peter Pipard, the lord of Drumcar was Ralph de Repentini, a feudatory of Roger Pipard. By him the Church of St. Fintan of Drumcar was granted to St. Mary's Abbey, Dublin, Roger being one of the witnesses to the instrument.[2] It is worthy of note that confirmation was sought, not from the Bishop of Louth or of Clogher, but from the Archbishop of Armagh, which proves that the boundary between the two dioceses had already been altered. The confirmation was given by Archbishop Eugenius in his Synod at Drogheda in 1215 or 1216.[3] Another confirmation was granted by Archbishop Donat about 1229.[4] The history of the church of St. Edan, Clonkeen, was similar. It was granted by Richard de Stormi, doubtless another feudatory of the Pipards, to St. Mary's Abbey, Dublin. We learn this fact from the confirmation of Archbishop Donat already cited. In what year the grant was made we have no means of ascertaining. It is interesting to observe that confirmation of both grants was also given by Nehemiah, Bishop of Clogher (1227?–1237), in terms which clearly prove that he still claimed Louth as part of his diocese.[5] In these documents there is a reservation of the third part of the greater tithes for the canons of Louth. But a few years later a controversy arose between the Dublin monks and the Louth canons with reference to the "third part," which the former had evidently declined to pay. On what ground their liability to this due was disputed we are unfortunately not told. If, as has been suggested, the third part was really the quarter episcopal, it was possibly contended that the Priory of Louth, being no longer associated with the Bishop of Uriel, had no claim to it. A settlement was made in 1244, by which Clonkeen was restored to the Priory, and Drumcar remained with the Abbey,

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[1] It is to be remembered that Drumcar and Clonkeen are not adjacent parishes which might have been included in the holding of a single tenant. They are at opposite ends of the barony of Ardee.

[2] *Chart. of St. Mary's Abbey*, i. 39.

[3] *Ibid.*, 40, 150. For the date, see p. 155, and above, p. 30, note 12.

[4] *Ibid.*, 153.

[5] *Ibid.*, 160.

the claim to the third part being surrendered by the former.[1] This arrangement held good until the Reformation.[2]

Something must now be said about one or two of the witnesses to the charter who have not hitherto been mentioned.

Richard Hedesore bears a surname which is well known in the history of the County Louth, usually in the form Haddesor. It may be noted, however, that a certain Richard de Heddeshoure witnessed a grant of Ralph de Vernon, lord of Balisconan, who was a feudatory of the Pipards.[3] This instrument is not dated, but it is referred to in a mandate of Eugenius, Archbishop of Armagh (1206–1216), in which Ralph de Vernon is described as *late* lord of Balisconan.[4] Hence it is probable that Richard de Heddeshoure is the Richard Hedesore of our Charter. The probability is increased when we observe that the name which follows his is Geoffrey Sturmin. I have no hesitation in identifying this person with Geoffrey Esturm̄ of our Charter. It is impossible not to connect the name Sturmin with the townland of Stormanstown, in the barony of Ardee. But Stormanstown is in the parish of Clonkeen. And so we reach the further conclusion that Geoffrey was a relative of the Richard de Stormi who gave St. Edan's Church, Clonkeen, to the Abbey of St. Mary, Dublin.

There is a third witness common to Ralph de Vernon's grant and our Charter, for it cannot be doubted that Matthew de Fulsiage, whose name appears in the former, and Matthew de Fulsaue are the same person. Another member of the same family may be Robert de Fulsay, who witnessed an instrument of Peter de Repentini.[5] There is a township named Fulshaw in the parish of Winslow, Cheshire.

Baudewin de Kerme seems also to be a person known independently of our Charter. For one Baldewin de Caermarthen (Kaermurthin, Caermerthin, Carmarthin, Carmertin) is several times named in documents of the period with which we are concerned;[6] and Caermarthen is often written Kermerthin, Kermerdin, or Kermerdyn.[7] It is highly probable that "Kerme" is an abbreviation of one of the latter forms.

Launtoñ, of the canons of which Simon is described as chaplain, I take to be Llanthony.[8] The Priory of Llanthony, near Gloucester, had many churches

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[1] *Chart. of St. Mary's Abbey*, i, 336.

[2] For Clonkeen see *Fiants of Elizabeth*, no. 1312, and for Drumcar, Archdall, op. cit., p. 145.

[3] *Chart. of St. Mary's Abbey*, i, 55.

[4] *Ibid.*, 149 f.

[5] *Ibid.*, p. 43.

[6] *Register of St. Thomas's Abbey*, pp. 8, 12, 80, 124, 269.

[7] *Ibid.*, 9, 14, 30, 121; *Chart. of St. Mary's Abbey*, i, 347, 352; ii, 361.

[8] One is tempted to identify it with Launton in Oxfordshire. But I am not aware that there was a house of canons at that place.

in Meath, at any rate in the fourteenth century. Among the rest was St. Kenan's, Duleek. And at Duleek there was also, in 1409, a house "commonly called a priory," at which, from time immemorial, one of the canons had resided.[1] The same priory had also several churches in the deanery of Drogheda, Co. Louth, including St. Peter's, Drogheda.[2]

Hestred, as Mr. M. J. McEnery suggests to me, should probably be identified with Heytesbury, in Wiltshire. That place appears in mediæval documents as Hichtredeberia.[3] Other forms are Hehtredebiri,[4] Hectidesburi, Heiteisburi.

In conclusion, I must offer my best thanks to the Marquis of Ormonde for permitting me to examine and to publish the Charter; to the Lady Constance Butler for sending me a tracing of it; and to the Lord Bishop of Ossory for much help in the preparation of this paper.

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[1] *Cal. of Register of Archbishop Fleming*, no. 121 (*Proc. R.I.A.*, vol. xxx, Sec. C, No. 5).

[2] *Cal. of Register of Archbishop Sweteman*, no. 62 (*Proc. R.I.A.*, vol. xxix, Sec. C, No. 8).

[3] C. T. Martin, *The Record Interpreter*, 1910, p. 380.

[4] *Christ Church Deed*, 472; *Chart. of St. Mary's Abbey*, i. 207; ii. 159.

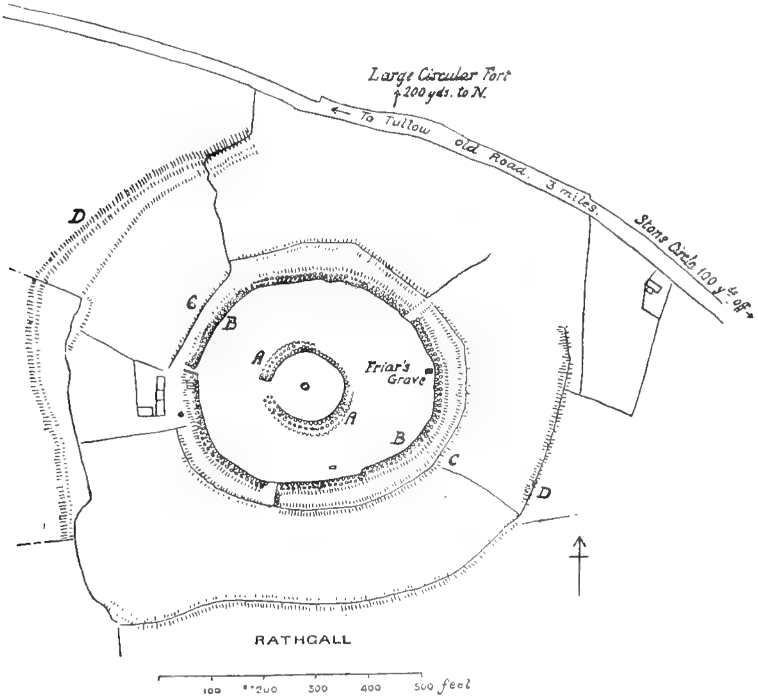
III.

RATHGALL, COUNTY WICKLOW: DÚN GALION AND THE "DUNUM" OF PTOLEMY.

By GODDARD H. ORPEN.

Read February 24. Published June 30, 1913.

I have recently described the remarkable fort known as Rathgall, situated in the County Wicklow, about three miles due east of Tullow, and have made some suggestions concerning its possible history.[1] I need not now repeat my description in any detail. Suffice it to say that the fort is on a low, rounded hill commanding an extensive outlook in all directions. As may be seen from the accompanying plan, which is based on the 25-inch Ordnance Survey



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[1] Journal R.S.A.I., vol. xli (1911), pp. 138–150.

map, and is here reproduced by permission of the Council of the Royal Society of Antiquaries of Ireland. the fort consists of four roughly concentric ramparts, enclosing altogether about eighteen acres. It is in fact one of the largest forts in Ireland. The innermost rampart is a dry-built wall, composed of rough granite stones of no very large size, at present about 8 feet 6 inches high, and (for three-quarters of the circuit) about 18 feet wide at the bottom, and 14 feet wide at the top. It is nearly circular in plan, with one opening, and the space enclosed has a diameter of about 150 feet. The second rampart, 30 to 50 paces from the first, is also dry-built on the inner side, but faced with large stones set in earth on the outer side, with a filling between the two faces. It is about 14 feet wide on the top and about 11 feet high on the outside, and there appear to have been four gates or openings in it. The third rampart is only about 40 feet from the second with a shallow ditch between. The stones that remain are of large size, but the height seldom exceeds 5 feet, though the width is in places 14 feet. The second and third ramparts, together with the intervening ditch, must have formed the principal defence of the fortress. The fourth rampart is in general about 100 yards from the third. It consists of earth faced with fairly large stones, and is in general about 7 or 8 feet high and 10 feet thick.

Following usage, I call this great structure a fort, but, as will be seen, I regard it rather as a primitive *oppidum munitum*.

About 200 yards to the north are the remains of another large fort embracing 8¼ acres, with evident traces of a second rampart at a little distance outside: and about 200 yards to the east of Rathgall, adjoining the road on the north, is a rude stone circle. This, I was told, was "the place where the king of Leinster was buried."

Since writing the above-mentioned paper, my attention has been called by Mr. Stanley Lane Poole to the name *Dún Galion*, mentioned in the Book of Leinster, as possibly a forerunner of Rathgall. The investigations I have made into this suggestion have led me to think it probable not only that Rathgall is to be identified with *Dún Galion*, but also that both these names refer to the "inland town" marked **Δοῦνον** (Lat. *Dunum*) on Ptolemy's Map of Ireland. The importance of these identifications, if they can be established, is manifest; and I now venture to lay before the Academy the evidence which has led me to these tentative conclusions, and which I think is at least sufficient to warrant further investigation both among our MSS. sources and in the fort itself.

The passage in which the fort is mentioned may be rendered as follows:—"*Galió*[*i*]*n* and *Domnand*, names for Leinstermen, as is told in the *Táin Bó Cúalyne*. There came a band of Gauls with their fosterling, Labraid Loingsech [Labraid 'the Exile'], to Erin, and they sacked Dind Ríg, &c. From them the *Galió*[*i*]*n* are named, as if *Gall-lion* ['Gaulish multitude'] and their posterity continued for a long time in the land, witness *Dún nGalion* among the *Dál Mesi Corb*." [1]

It may be inferred from this passage that at the time when the tract was first written there was in existence in the territory then known as Dal Messi Corb an ancient fortress called Dun Galion, and traditionally associated with a foreign people, usually called *Galióin* (more properly *Galiáin*) or, as we may call them, Galians.[2] Was this the fortress now known as Rathgall?

We must first then inquire where the territory known as Dal Messi Corb lay. From the notes in the Lebor Brecc to the Martyrology of Oengus it seems probable that Inis Báithin, now Ennisboyne in the parish of Dunganstown, County Wicklow, was in it,[3] and also Inber Doeli, now Ennereilly near Arklow.[4] O'Donovan, referring to the former passage, says that the Dal Messi Corb were "seated in the barony of Arklow and some of the adjoining districts in the present county of Wicklow."[5] This statement is, no doubt, correct, as far as it goes; but can we not gain some idea as to the extent of these "adjoining districts"?

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[1] LL. 311 a (20). There is a later and fuller version, *ibid.*, 377 a. I render the words *fianlag do gallaib*, a band of 'Gauls,' as such seems the original meaning of the word *Gaill*, i.e., Galli. The more familiar use as denoting the Northmen, and afterwards the English, or, indeed, any kind of foreigners, was a post-Viking extension of the original meaning. See the remarks of Prof. Kuno Meyer; Revue Celtique, vol. xi, p. 438.

[2] The name appears in various forms pointing to nom. pl. *Galiáin*, *Galióin*, *Galiúin*, *Galeóin*, *Gaileóin*, &c. This last form gave rise to a false etymology from *gai*, 'a spear,' adopted by Keating (I. T. S., vol. i, p. 194), and implied by the equivalent *viri armorum* of the Irish Nennius. This meaning was probably suggested by the old etymology of *Laigin* (Leinster) from *laigne*, 'spears,' but the duplication of this idea, as Sir John Rhys remarks (Celtic Heathendom, p. 600), is "a little too much to pass." M. D'Arbois de Jubainville says that the older gen. pl. was *Galián*, assonating with *giall*, *grian*. The nom. pl. would then be *Galiáin*, representing *Galiāni*. This he regards as a derivative of *Galli-a*. But *Galiáin* never has *ll*, while, as Sir John Rhys has pointed out to me, there are several related names with the single *l*, e.g. Γαλάται, (Galatians), Galam or Golam, the Celtic name of Míl (Lat. Miles), and *Galedin* for *Galat-in-i*, a Welsh name, to be referred to by-and-by, for the Belgae of the south coast of Britain. Moreover, Windisch treats Galiáin as inflected like *fírian*, pl. *fireoin*, gen. *fírian*, reduced to *fírén* (Táin B. C., p. 50; and see Wörterbuch, Irische Texte); and Stokes gives the original form of this as *vēriānos*, (Urkeltischer Sprachschatz, p. 272). Moreover, Thurneysen says that *fírián* is borrowed from Kymric (Brythonic) *gwirion* (Handbuch des Alt-Irischen, p. 519), or rather, we should say, from the antecedent to that, namely, *Wiriānos*. From this comparison and analysis the important conclusion seems to follow that we must regard *Galiáin*, borrowed from a Brythonic *Galiāni*, as the name by which a Brythonic people called themselves, that is to say, the name could not have been originated by the Goidels. Perhaps *Lagin*, the 'spear-men,' was the Goidelic name applied to an immigrant people who called themselves, or were called by their congeners, *Galiáin*.

[3] Martyrology of Oengus (Henry Bradshaw Soc.), p. 134.

[4] *Ibid.*, p. 206; and see "Inber daele," Onom. Goed.

[5] Four Masters, 952.

The name Dal Messi Corb does not often occur as a territorial name, having been, as we shall see, superseded at an early period by other names; but I think there are grounds for supposing that it included the greater part, if not the whole, of County Wicklow. Cucorb, father of Messi Corb the eponym of the Dal Messi Corb, is represented as a powerful king of Leinster.[1] The progeny of his four sons, Nia Corb, Messi Corb, Cormac Losc, and Corpre, are called *cethri primslonnti Lagen*, "the four chief family-stocks of Leinster."[2] We might infer that the "population groups" called after them were of large size, and that the four names, when used territorially, would cover a considerable extent of territory—in fact, so much of Leinster as was under the sway of Cucorb. There are some indications, however, which suggest that this available territory was not much more than the present counties of Kildare and Wicklow and the greater part of County Carlow.[3]

These "population groups" are marked by the term *Dál* (meaning a part or division) followed by the genitive of the eponym. They belong to the second order collective names) in Professor Mac Neill's careful analysis of Early Irish Population Groups,[4] and they are all of prehistoric origin. Like other group-names, they are often used to denote the territory occupied by the group in question, and this territorial use sometimes survives a shifting of the population. From the traditional genealogies and accounts of Cucorb's four sons we may therefore acquire some further indication as to the territories associated with their names. I do not indeed rely upon the authenticity of the earlier parts of these genealogies, nor even upon the existence of Cucorb and his four sons; but I think the genealogies were devised to account for observed contemporary groupings of peoples, and probably in this case point to a fourfold subdivision of the (then) kingdom of Leinster.[6]

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[1] See the 'death-song' pronounced by Medb Lethderg, Cucorb's widow, over his grave: LL. 44 *b* (23), and 380 *b* (33), translated in O'Curry's MSS. Mat., p. 480. Cucorb is supposed to have been buried in the cairn on the top of Mount Leinster: O'Curry, *ibid.*, p. 478, note 17, and see Journal R.S.A.I. for 1874–5, p. 385, note. I have visited this cairn; it is not a large one and seems mutilated.

[2] LL. 312 a (1), 380 a (39).

[3] I omit Leix and the Fotharta, as Cucorb is said to have granted the former to Laigsech Cendmor son of Conall Cernach, and the latter to Eochu Find Fuathairt, in return for their expelling the Munster men from Leinster. I also omit the present County Wexford, where the Ui Cennselaigh were afterwards supreme, as, except the barony of Forth (if indeed it was included among the Fotharta, see Ann. Clon., p. 56), we hear nothing about it at this time, and it was probably held adversely by the peoples whom Ptolemy places there.

[4] Proc. R.I.A., vol. xxix (C), pp. 59–114.

[5] LL. 312 *a* et seq., and 380 et seq.

[6] It may have been in origin a four-fold division of the Galians and kindred peoples. Prof. Mac Neill compares *na cethri hAraid* (Lecan 451 a) and the tetrarchates of the Galatians in Asia Minor: Proc. R.I.A., xxix (C), p. 69.

From Nia Corb, the eldest son, is traced the descent of Cathair Mór and most of the succeeding kings of Leinster. In my researches—which, however, I must confess, have been far from exhaustive—I have found no passage where Dal Niad Corb is used in a clearly territorial sense, perhaps because Nia Corb's descendants were regarded as so widely spread among the ruling families of Leinster; but the early kings of North Leinster, who traced their descent through Cathair Mór to Nia Corb, seem to have been mainly associated with Alend (Knockaulin) and Naas and the Curragh of Kildare, where, as I have elsewhere attempted to show, the great provincial festival of the year known as Aenach Carmain was celebrated under the presidency of the kings of North Leinster.[1] We shall probably, then, be not far wrong in regarding this division of the family as primarily associated with the northern part of the present County Kildare, though offshoots afterwards became the ruling families in many other parts of Leinster. The territory known as Dal Cormaic is defined in the Book of Leinster and in the Book of Lecan,[2] and seems to have covered the southern part of the present County Kildare and parts of Queen's County. Probably the ancient burial-place known as Killeen Cormaic still preserves the name.

Dal Corpri was in Ara Cliach; and though there was a district of this name in Munster with which the Dal Corpri were connected, there can be little doubt that this Ara Cliach of Leinster included the present baronies of Idrone and perhaps that of Forth in County Carlow. Certainly there was a territory called Clíu (genitive Clíach) in this district, and several passages mentioning Ara Clíach, or Arada Clíach, must be referred to this Leinster Clíu.[3]

In the accounts given of Messi Corb,[4] son of Cucorb, I find no definition of the limits of Dal Messi Corb. The name as a territorial term was at an early period superseded by names of a different formation. The grandson of Messi Corb is represented as having seven sons and about thirty grandsons, and at this period "the sept-names in *Ui*" begin to appear. They are very numerous, but I can locate with certainty only a few. Some, however, clearly occupied the original territory. Chief among these were the Ui Garrchon, whose eponym was Garrchu, great-grandson of Messi Corb. They are found

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[1] Journ. R.S.A.I., 1906, pp. 11-41, "Aenach Carman, its site:" and, in particular, pp. 18–20.

[2] LL. 312 *c* (15–25), 313 *b* (44). The passage from the Book of Lecan is given in Journal R.S.A.I., 1872–3, p. 353. We can at any rate recognize the names Roeiriu (Mullagh-Reelion near Kilkea), Maistiu (Mullaghmast), Sleibte (Sleaty), and Uissen (Killeshin).

[3] See Onomasticon Goedelicum s. v. Ara Clíach and Clíu.

[4] The name is variously written Mesi-, Messi-, Meisi-, Messin- Mas-, Meas-, and Mos-Corb.

at places along the whole coast from near Bray to Arklow.[1] From another great-grandson were descended the Ui Loppin or the Ui Lapen of Cell Rannairech, now Kilranelagh, to the west of the Wicklow Mountains near Baltinglas.[2] In other cases a later sept, claiming descent from Nia Corb, intruded, as, for instance, the Ui Briuin Cualann near Bray,[3] the Ui Mail, who have left their name in the Glen of Imaile, the Ui Enechlais (*i Fortuathaib Laigen*) in the southern part of the barony of Arklow,[4] and still later, after the expansion of Ui Cennselaigh, the Ui Fedlimid and Sil Elaigh in the district about Rathgall.[5] But the greater part of the territory ruled by the descendants of Messi Corb was from an early time known as the Fortuatha Laigen, and this name, in our present quest, is very significant. It means "the stranger tribes of Leinster."[6] These were unfree tribes seated at both sides of the Wicklow Mountains, including, at any rate, the valleys of Glendalough and Imaile[7]; and as the free septs of Ui Garrchon and Ui Enechlais are stated to have been in the Fortuatha, we must suppose that at one time the Fortuatha included the larger part, if not the whole, of southern Wicklow. Moreover, we have authority for saying that these "Stranger Tribes" included the remnants of the Galians, and that they were ruled in historical times by kings whose descent was traced from Messi Corb. For, in the first place, the Galians appear to have joined in the revolt of the Aithech Tuatha, or vassal peoples, and on its temporary success to have received Leinster as their share. Cairpri "Cat-head," the leader, was perhaps a Galian;

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[1] Onom. Goed. Among the *forslonte hua nGarrchon* were the *hui marggni Gaill*: LL. 313 *a* (35).

[2] LL. 313 *b* (7), 384 *b* (34).

[3] Dergne or Deilgne Moghoroc, i.e. Delgany (Ann. Ulst. and Four Masters, 1021), and Tech Conaill, i.e. Powerscourt (Mart. Oengus, 26th May), were in Ui Briuin Cualann.

[4] Inis Mocholmóc, now Inch, was in Ui Enechlais (Mart. Oeng. November 14), and Ui Enechlais was in the Fortuatha Laigen (*ibid.*, ed. 1880, p. 77).

[5] Rathgall in the thirteenth century was in the deanery of Offelimy, which included not only the parishes of Tullowphelim, Rathvilly, and Clonmore to the north, but also those of Aghowle and Ardoyne to the south (Cal. Docs. Irel., vol. v, p. 251). It is now included in the barony of Shillelagh, and the name Offelimy is preserved only in the parish of Tullowphelim.

[6] So O'Donovan, Book of Rights, p. 207, n. Hennessy, indeed, renders *hi fortuathaib Laigen*, "on the borders of Leinster," Ann. Ulst., 708. But Glendalough and Imaile were not on the borders of Leinster, and there were many other Fortuatha who were not on the borders of any territory, but who always seem to have been unfree tribes, not descended from Milesians; e.g., the Fortuatha near Fermoy descended from Mog Ruith the Druid, Book of Rights, p. 78 n.; the Fortuatha of Ailech, to whom significantly would seem to be ascribed the original erection of the *Grianán Ailigh*, ib. 120 n.; the Fortuatha of Uladh, ib., p. 173 n.; the Fortuatha Connacht in Irrus Domnon, also a Firbolg tribe; and the Fortuatha Breg, or Luagni of Tara, again an unfree tribe.

[7] Onom. Goed.

for, according to one account, he is said to have been descended from the son of the King of Lochlann, who aided Labraid in recovering his kingdom.[1] After the recovery of domination by the free peoples under Tuathal Techtmar, we find the Galians of Leinster described as consisting of three Tuaths, namely, Tuath Fidga, "forest-tuath," in the Fortuatha of Leinster and in Ui Cennselaigh, Tuath Fochmainn in Offaly, &c., and Tuath Aithecda, "vassal tuath," in the east of the Liffey valley as far as the sea.[2] The first and the last of these tuaths, I take it, were in Dal Messi Corb. And secondly, that kings of the Fortuatha were descended from Messi Corb appears in the following cases:—Under the year 826 we read: "Destruction of the camp of the Leinster-men (*Dunadh Laighen*, which may very well be an *alias* for *Dún nGalion*)[3] by the Gentiles, where Conall, son of Cuchongalt, King of the Fortuatha, and others innumerable were slain."[4] This Cuchongalt was son of Cethernach, who appears in the pedigree of another king of the Fortuatha, namely, Donnell son of Fergal, who was slain fighting for the Danes at Clontarf, and whose descent is traced through Garrchu to Messi Corb.[5] He was also probably the Cuchongalt king of Rath-inbir who was slain at the battle of Righe in 780.[6] We seem therefore safe in regarding the Fortuatha Laigen as included in the territory of Dal Messi Corb.

There was, indeed, another (probably a Munster) theory of the origin of the people known as Dal Messi Corb. In the tracts concerning the Corca Laidhe[7] they are traced to Lughaidh, son of Ith, and an eponym is found for them in Lughaidh Corb, one of six brothers, each named Lughaidh, and each the progenitor of an unfree people. This was, I think, merely one of the schemes for linking together the non-Milesian peoples of Ireland, i.e., those

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[1] See the text in Rev. Celt., vol. xx, p. 16, and Keating, vol. ii, p. 239.

[2] See the passage edited by Prof. Mac Neill from the Book of Ballymote and other texts in Duanaire Finn, I.T.S., p. lvii.

[3] *Dunadh Laighen* would seem to mean "the stronghold (*par excellence*) of Leinster or the Leinstermen" and as *Laighin* superseded *Galióin* as the name for Leinster and Leinstermen, so *Dunadh Laighen* may have superseded *Dún nGalion* as the name of the fortress. It was presumably in or near the Fortuatha.

[4] Ann. Ulst., 826.

[5] For the pedigree of Donnell son of Fergal see LL. 337 *c. rí na fortuatha. Cuchongelt ocus Dondgal dá mac Cethernaig* are mentioned in the Garrchu genealogy, LL. 313 *a* (18). From about 1014 the kings of the Fortuatha seem to have taken the surname O'Dungaile.

[6] Ann. Ulst., 780. Rath inbir was in Ui Garrchon, probably at Arklow, *Inber mór*, the Inver *par excellence*: Onom. Goed. It was also the Inver of Eogan Inbir: Four Masters, A.M. 3470. See O'Flaherty's "Ogygia" (1685), p. 181.

[7] See Genealogy of Corca Laidhe, Miscellany, Celtic Society, pp. 8, 30, 70, 76. LL. 210 *a* (45). Here Dal Meascorb or Dal Moscorb, variants of the name, is stated to be in Crich Cualann. But this does not help much, as Cualu was clearly a name given to a large district extending from the Liffey at Dublin to below Arklow. See Onom. Goed.

not of Goidelic descent, and the Dal Messi Corb were included because the territory known by that name was so largely occupied by "the Stranger Tribes of Leinster." Similarly in some versions of the developed legend of the Invasions the appearance of the Fir Gaileon or Galians along with the Fir Bolg and the Fir Domnann before the coming of the Milesians is presumably due to the theory of the systematizer that all the non-Milesian peoples must have been in Ireland before the coming of the sons of Míl.

From this somewhat lengthy topographical investigation it appears that the part or division of Leinster known in early times as Dal Messi Corb was of large extent—being in fact a member of what seems to have been a quadripartite subdivision of North Leinster, and that it probably included at least the whole southern part of the present County Wicklow. Though I cannot quote authority for its precise boundaries, I should say that probably the North Wexford mountains and the river Slaney marked the limits on the south and south-west. At any rate we do not seem to be precluded from supposing that at one time it comprised Rathgall. We have also, as it were incidentally, ascertained the important fact that two of the three Tuaths into which the Galians came to be divided were seated within this region.

We must now return to the story of Labraid Loingsech, and see how it agrees with the association of this district with the Galians. There are two versions of this story, which is known as the *Orgain Dind Rig*, or "Destruction of Dinn-Righ." Both versions have been edited and translated by Whitley Stokes, the one from the Book of Leinster, with variant readings from other MSS.,[1] and the other from a Scholium on the Amra Choluimb Cille.[2]

The pertinent incidents, shortly put, are as follows:—Cobthach Coel, 'the Meagre,' treacherously slew his brother, Loegaire Lorc, King of Erin, and poisoned Loegaire's son, Ailill, King of Leinster, and reigned in their stead. Ailill had a son called Moen, because he was 'dumb.' At first he was spared, presumably as being incapable of ruling; but afterwards, on his suddenly recovering his speech (from which event he was called Labraid, for it was said *Moen Labraid* 'the dumb one speaks'), he was banished by Cobthach out of Erin. Here a divergence occurs in the two versions of the tale. According to the Book of Leinster, &c., "he went to the king of the men of Morca, i.e., the men of Morca that dwelt about Luachair Dedad in the west" (of

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[1] Zeitschrift für Celtische Philologie, Band iii, p. 1, from LL. 269 *a*, with variants from Rawl. B., 502, fac. p. 130, and YBL., fac. pp. 112 *a*–113 *a*. These three copies substantially agree. This account is paraphrased by O'Curry, MSS. Mat., pp. 252–257.

[2] Revue Celtique, vol. xx, pp. 429–433, from YBL., col. 989, fac. p. 75 *b* (31), and Egerton, 1782, fo. 9 *b*; cf. Keating's account, I.T.S., vol. ii, pp. 161–169.

Ireland). According to the Scholium "he went eastward till he reached the island of the Britons and the speckled youths of the land of Armenia."[1]

Both versions represent him as obtaining an armed force from the land of his exile, with which he returned to Leinster, sacked Dind Rig, killed Cobthach, and took the kingdom. From his having been exiled he was called Labraid Loingsech, or 'L. the Exile.' It is clear that in the original story this force was a foreign force, and not the Munster men from Luachair Dedad. Even in the first version, as told in the Rawlinson MS., it is said at the end that his name was 'Labraid the Exile,' "since he went into exile, when he gained a realm as far as the Ictian Sea,[2] and brought the many foreigners with him (to Ireland), to wit, 2,200 foreigners with broad lances (*laighne*) in their hands, from which the *Laigin* (Leinster men) are so called." Moreover, in the quatrains of the Dindshenchas of Lagin the foreign force with their novel broad lances is the essential feature:—

"Labraid, the exile (full his number),
by whom Cobthach was slain at Dindrig,
came with a lance-armed host over the sea-water;
from them Lagin was named.

. . .

"Two-and-twenty hundreds of the Gall
came oversea, having with them broad lances:
from the lances that were carried there—
thence the men of Lagin get their name."[3]

In the prose version this foreign force is called the Black Foreigners (Dubgaill), from the lands of the Gauls, and it is added that "it was the Gaileoin that nourished Labraid during his exile in the lands of the Gauls."[4]

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[1] *Dochuaid soir co rainig Inis Bretan ⁊ in breacmacraid thiri Armenia.*

[2] The reference is apparently to the British Coast of the *Muir nIcht,* and this, as Sir John Rhys suggests to me, recalls the Welsh *Arlechwadd Galedin,* "the slope of Galedin, comprising the South of England from Kent to Dumnonia," mentioned in the Iolo MSS., p. 86. The Galedin would probably be the Belgae of Britain; but there is no other allusion to them under this name. Galedin points to Galat-in-i, and this name in its turn reminds one of Calatin and the sons of Calatin, who figure in the story of Cuchulainn's death. There may have been a legendary connexion between Calatin and the Galians, as the latter were opposed to Cuchulainn in the battle of Ros-na-ríg. It seems not improbable that the Galians came directly from this district in the South of Britain to Leinster, though they may have been reinforced by Menapians from the other side of the Channel.

In the Yellow Book of Lecan, Gailli Dana is written for Calatin Dana. Táin B. C., Windisch, pp. 423, 667.

[3] Translated by Edw. Gwynn, "Metrical Dindshenchas," Pt. ii, p. 53.

[4] Rennes Dindshenchas. Rev. Celtique, vol. xv, p. 300.

There are many reasons, historical, ethnological, and archaeological, for thinking that this story of the introduction of a foreign people into Leinster enshrines a historical fact; but it is apparent that the tradition as to the precise country from which they came has been confused and lost. Ptolemy, writing about the middle of the second century A.D., places the Brigantes in the south-east corner of Ireland, and north of them the Coriondi, and still further north the Manapii. The Brigantes are found at the same period in Northumbria in England, and also about Bregenz in the Vorarlberg. The Menapii were a maritime people in Belgic Gaul, south of the Meuse, where their town was called Castellum,[1] identified with Cassel in the Department of the Nord in France. These peoples would be, I suppose, of Brythonic stock, and would be regarded as foreigners by the Goidels of Ireland. Now in the version of the story contained in the Egerton MS., instead of *rig Armenia,* 'the King of Armenia,' occurs in one place *ri fer Menia,* 'the King of the men of Menia'; and M. D'Arbois de Jubainville conjectures that Menia represents Menapia, pronounced in Irish fashion without either the *p* or the *a* that precedes it. For the Irish, he says, could not pronounce the letter *p*, and the preceding *a* was post-tonic, as in Irish it was the initial letter that was accented. The expression *tir fer Menia,* 'land of the men of Menia,' puzzled the redactors of the story, and, having Biblical lands in their minds, they replaced *fer Menia* by Armenia. In fact, *tir fer Menia* would be pronounced like *Tir Armenia.* Others, he supposes, corrected 'Menia' into 'Morca,' placed it in the south [west] of Ireland, and the term 'exile' then became unmeaning.[2]

Mr. Coffey has already called attention to this conjecture,[3] and has stated that the date assigned by M. D'Arbois (216 B.C., or more vaguely the third century B.C.) for the return of Labraid with the Galians and their broad blue lances agrees with that to which on other grounds he is inclined to assign the general use of iron weapons in Ireland.[4] Indeed, he points to a certain broad

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[1] The name κάστελλον here must, of course, not be translated "castle" in the sense of a private castle. It was a fortified πόλις. It is significant, however, as indicating that the Menapians were remarkable for their fortifications.

[2] Revue Celtique, vol. xxviii (1907), p. 32, et seq. On the point of textual criticism, however, a better case might, I think, be made out for supposing that the country originally named was Armorica, and that this became changed in the one case into *Tir fer Morca,* and in the other into *Tir Armenia.* It is at least a curious coincidence that the compiler of the Anglo-Saxon Chronicle, while taking his opening sentences from Bede, says that the Britons came from "Armenia," whereas Bede's words are *de tractu Armoricano.*

[3] Proc. R.I.A., vol. xxviii (C), p. 99.

[4] M. D'Arbois's date for this foreign influx is 216 B.C. He arrives at this date from a calculation based on the early Irish genealogies and on the supposed synchronism of Ugaine Mór and Ptolemy son of Lagos. Inasmuch, however, as these genealogies seem

iron lance-head in the Museum as being probably an example of the broad blue lances from which Leinster derived its name.

M. D'Arbois's conjecture, if it be accepted, leads to the identification of the Galians of Irish tradition with the Manapians of Ptolemy.[1] Even apart from the restoration of Menia (= Menapia) as the land whence the Galians are said to have come, the inclusion of the Manapians among the Galians is plausible on the general ground that the Manapians were a Gallo-Brythonic people appearing in Leinster before Ptolemy's time, and the Galians were foreigners, presumably of Gaulish extraction, appearing at least as early in the same province. It seems better, however, to regard the Manapians as one of the several similar peoples included under the general term 'Galians.' Ptolemy's Brigantes, for example, were probably another, and a trace of them may perhaps be discerned in the Tuath Fidga, "a British people" dwelling in the barony of Forth, County Wexford,[2] in the very district where Ptolemy places the Brigantes. In the passage in the Book of Ballymote already referred to the Tuath Fidga of Ui Cennselaigh are classed as Gaileoin.

This suggested inclusion of the Manapians among the Galians has led me to a reconsideration of the precise site of Ptolemy's Manapia. It has usually been supposed that Manapia was on the site of the town of Wexford,[3] but this supposition seems to be based on no better ground than that the river Modonnus, near the mouth of which, according to Ptolemy, Manapia was

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to have been constructed to suit more or less arbitrarily fixed synchronisms, the basis of his calculation is artificial and unsound. Prof. MacNeill has shown that one of the earliest of the synchronists places the coming of the Goedil at the beginning of Alexander's World-Empire, or 331 B.C. (Proc. R.I.A., vol. xxviii (C), p. 142). Later writers have not been so moderate in their drafts on antiquity. I can give no date beyond the tentative statements that the foreign influx must have occurred before, but perhaps not very long before, the time of Ptolemy the Geographer, for he seems to place the foreigners on his map ; and after, but perhaps not very long after, the coming of the Goedil, for they seem to have not yet dominated all Ireland.

[1] Ptolemy writes Μανάπιοι in Ireland and Μενάπιοι in Belgic Gaul, but the names are usually treated as identical.

[2] LL. 15 *a* (25): *Tuath fidga i fothartaib .i. tuath de Bretnaib.* See, too, Irish Nennius, p. 123 ; Keating, I.T.S., vol. ii, p. 111.

[3] In his "Studies in Early Irish History," p. 51, Sir John Rhys places Manapia somewhere in the neighbourhood of Arklow. This, he tells me, he did partly because the Avonmore there seems best to suit his analysis of the name Mo-donnos. He treats this as meaning 'My Donn [bull],' perhaps a divine bull, suggested by the rush of the river in times of flood. (See D'Arbois's remarks on this analysis, Rev. Celt. xxi, pp. 254, 255, where he similarly treats Ptolemy's βουουίνδα as Bu-vinda, the white cow). This would be more true of the Avonmore than of the Slaney. The prefix mo-, so common in saints' names, seems to have been similarly used in pagan times. *Modovinias*, however, is perhaps a doubtful reading of the Dunmore Ogam. Professor Macalister says that *Moccaggi*, which he takes for *Mo-Cagi*, is the only example that we meet with in oghamic epigraphy of the use of the honorific prefix mo-. (Irish Epigraphy, Pt. iii, p. 124.)

situated, is the first river-mouth marked by Ptolemy north of the Hieron Akron, or south-eastern point of Ireland (Carnsore Point). But if we compare the relative positions of the places marked on Ptolemy's map between the Hieron Akron, or Carnsore Point, and the Buvinda, or Boyne[1] (identifications which seem certain), with the actual east coast of Ireland, we are forced to the conclusions that Ptolemy has omitted to mark the mouth of the Slaney, that his Modonnus is the Ovoca at Arklow, and that his Oboka is the Vartry at Wicklow.[2] These conclusions are rendered almost certain by the fact that Ptolemy places the Brigantes on the east coast as well as on the south, so that their territory must have included the southern part of the present County Wexford, and above them the Coriondi, and then the Manapii, who, of course, cannot be dissociated from the town of Manapia. But there is clearly not room for two of Ptolemy's peoples south of a people whose centre was at Wexford,[3] whereas, if we place the Manapii at Arklow, there is room enough for the Coriondi and the Brigantes to the south of them.[4]

This last identification, about which I feel tolerably confident, has led me to a further conjecture which I admit is rather hazardous, but it fits in remarkably well with all that has gone before, and even seems to give a historical basis to the whole structure. Among his seven inland 'towns' of Ireland Ptolemy places *Δοῦνον* (Dunum) in the same longitude as the mouth of the river Birgos (to be identified with the Barrow), and very slightly (five minutes) north of the latitude of the mouth of the Modonnus and the town of Manapia. Now this name *Δοῦνον* or Dunum manifestly represents the Irish *dún*, and might be expected to stand for the most important *dún* in the locality indicated. This I suggest was *Dún nGalion*, now Rathgall. For assuming the identity of Arklow and Manapia, Rathgall is almost precisely on the spot indicated by Ptolemy. It lies very slightly north of the latitude of Arklow, and only about nine miles to the east of the longitude of the Barrow estuary. Any closer approximation could only be accidental. Moreover it is, I think, in such works as Rathgall, with its quadruple ramparts enclosing on

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[1] For these relative positions see my "Ptolemy's Ireland" Journal, R.S.A.I., 1894, p. 115. As Ptolemy's names here, with the exception of the Boyne, have not been traced, the relative positions of the river-mouths and south-east promontory as compared with the actual coast afford the best *prima facie* ground for identification.

[2] It is hardly necessary to observe that the modern name Ovoca was taken from Ptolemy's Oboka, and affords no counter-argument.

[3] When I wrote my Paper on Ptolemy's Map of Ireland, I felt this difficulty, and attempted to obviate it by doing unwarrantable violence to my authority and placing the Coriondi more inland. All these peoples came to the eastern coast.

[4] Moreover, of his eight peoples on the eastern coast Ptolemy places only one, the Cauci, between the Manapii and the Eblanii: but it would be strange if only one people occupied the whole coast-line between Wexford and Dublin.

a swelling upland the large space of eighteen acres, and having in its immediate vicinity another strong enclosure of large size, and a pre-Christian burial-place, that we might expect to recognize the remains of Ptolemy's inland πόλεις of Ireland, and that we should not necessarily, or even probably, expect them to have been on the sites of medieval towns, which grew up in very different conditions. So of Ptolemy's other inland towns, the Ῥηγία of the Οὐολούντιοι is in all probability the Emain Macha of the Ulaid, and Ῥηγία ἑτέρα is perhaps represented by the group of stone forts which exist or formerly existed at Mag Tuired Cunga.[1]

The dry-stone walling at Rathgall indeed looks so little ruined that some visitors, I am told, are inclined to doubt its great antiquity. But, as has often been observed, you cannot tell the age of a fort, or indeed of any antiquity, by merely looking at it. You must in some way directly or indirectly bring it, or at least the class to which it appears to belong, into relation with record, before you can make even a plausible guess as to its age. Now the class to which Rathgall appears to belong is the dry-stone cathairs of Ireland, and these have justly been regarded from various indications, such as finds, traditions, early notices, &c., as belonging to a very early age. Indeed, it is noteworthy that many of them are traditionally associated with non-Milesian peoples. I have elsewhere observed that they were in all probability the *castella murata* which Giraldus tells were antiquities in his time, *adhuc integra, vacua tamen et deserta.*[2] I have also noticed that very probably Gerald's observant eye had actually seen Rathgall when he wrote the passage referred to, for Rathgall is only four miles from Castlemore Mote, the castle of Raymond le Gros near Tullow; and Gerald, when in Ireland, can hardly have failed to visit his favourite cousin there.[3]

Of course, such an ancient fortress must have been scores of times breached and destroyed, and again repaired and rebuilt. In the case of Rathgall it is probable that the dry-stone walling has been repaired—perhaps largely

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[1] Indeed I venture to suggest that the actual name given by Ptolemy may be traced to this spot. In the Chronicon Scotorum (p. 5), referring to the plains cleared by Partholan, the first mentioned is *Mag Tuired no nedara la Connachtaibh,* that is to say, *Mag nEdara* is given as an alias for *Mag Tuired.* In the Four Masters, A.M. 2550, the name appears, in the same connexion, as *Magh nEitrighe.* According to Keating (I. T. S., vol. i, p. 173) Eitrighe was the name of one of Partholan's four oxen. Now Ῥηγία ἑτέρα, meaning 'altera Regia,' is impossible as the actual name of a town; but if the Irish name for the district or people in or among which the town was situated resembled the Greek word ἑτέρα, the fact that there was another Ῥηγία in the list of towns would tend to fix the spelling as ἑτέρα, and the meaning as 'altera.' Thus some such name as *Cathir Rigda na hEtara* may have produced Ptolemy's Ῥηγία ἑτέρα—and even possibly Αὐτειροί, the name of the people (according to some MSS.) whose chief town it was.

[2] For different views as to this passage see Journal R. S. A. I., 1907, pp. 148–150.

[3] “ See “Ireland under the Normans,” vol. i, p. 140.

reconstructed—in comparatively recent times for other than military purposes.[1] Hence perhaps the absence of some features usually observed in large dry-stone cathairs. But it is quite certain that the vast number of stones which, in spite of known depredations, still remain in the walls of Rathgall, were never collected there for any modern purpose, and the large stones at the base of the outer circles have all the appearance of primitive fortification. The reputed burial-place of the King of Leinster, with its rude stone circle, must be provisionally regarded as pre-Christian. Scientific excavation might be expected to throw light on the question of date, or, at least, of stage of culture, and to afford more certain inferences of origin and use; and it is to be hoped that some competent person may be encouraged to undertake (with permission) such an investigation. Meantime, as far as my judgment goes, I see nothing in the remains to negative the early period suggested for the origin of the fortress.

The substitution of the name Rathgall for Dun Galion, at a time when the Galians had ceased to be a distinguishable people, is easy to account for. We have seen the derivation of the latter name given in the Book of Leinster, and though the etymology is unscientifically stated, it is perhaps in its main element substantially correct, and at any rate it indicates the tradition of the foreign origin of the people. In his "Studies in Early Irish History" Sir John Rhys has made some interesting remarks on the Galians and the return of Labraid the Exile, whom he compares to Dermot Mac Murrough. He there says:—"The name of the Galeoin seems to be of the same origin as **Γαλάται** and Galli";[2] and in a note he observes:—"*Galli* itself, as a loan-word in Goidelic, probably began at an early date to take the sense of Irish *Gáill*, 'strangers.'" It is therefore readily intelligible that the name Dun Galion, 'the dun of the Galians,' at a time when the Galians were no longer distinguishable, should become Rathgall, 'the rath of the strangers.' Indeed I feel no difficulty in supposing that there was an intermediate period when, as suggested in my former paper, the fort was called Dun Bolg. I am now, however, inclined to interpret this name as the "fort of the Builc" or Fir-bolg; for the name Fir-bolg, as Professor MacNeill has pointed out, "was extended in the Irish history-legend at an early period, so as to denote the whole or main population of Ireland before [or, as I would put it, other than] the Góedil." I suggest, then, that the simplest explanation of the fort-names involving *bolg* is that the forts to which such names were applied were regarded as, in origin, forts of the Fir-bolg—i.e. non-Milesians.

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[1] It is used as a bull-paddock, a purpose for which, to the eye of a cattle-rearer, it is admirably suited.

[2] Proc. Brit. Acad., vol. i, pp. 49, 50. Sir John Rhys derives all three names from a stem *gal*, meaning 'bravery,' 'valour.'

With further reference to the name Rathgall it is not superfluous to notice that at least one other well-known name involving *gâll* survives in the district to which we may suppose the Galians to have at one time extended. Just north of the hills which bound the County Wexford lies Clonegall, which presumably represents *Cluain na nGall*, the 'mead or meadow of the strangers.' Of course it is possible that Rathgall may represent *Rathgeal*,[1] 'the white or bright rath.' I have heard the name pronounced locally both ways, that is with a short, and with a long *a*. But I could find no Irish-speaking person there; and, as I have elsewhere remarked, the fort is usually called 'the Ring of the Rá.' It seems probable, however, that the Ordnance Surveyors took the name to be *Rathgáll.*

It may, I think, be said for these conjectures that they harmonize well together, afford each other a certain amount of support, bear out the broad outlines of the tradition as to Labraid and the Galians, and account for certain archaeological objects and certain topographical names. We can imagine Labraid the Exile, like the historical Dermot, returning to his country with an army of Galls, in Labraid's case, perhaps mainly Manapians. They land at Inver Amergin, otherwise Inver Mor, now Arklow, where they construct a cliff-castle, probably on the site occupied, centuries later, by the Northmen, and still later by Tiebaut le Bottiler. This cliff-castle and the port which it protected was called by the traders who informed Ptolemy, 'Manapia,' meaning the town of the Manapians; but the people themselves became known in Ireland as *Galiáin* or Galians, and their cliff-fort at a later period as Rath Inver. To conquer Leinster they would inevitably pass up the valley between the mountains of Wicklow and Wexford to the open country in the neighbourhood of Rathgall. Here they build their great *dún* or fortified πόλις, called from them Dun Galion. According to the legend they slay their master's rival and plant their master on the throne of Leinster. They become known as "the best fighting-men in Ireland." A *tricha ced*, three thousand of them, are engaged to assist Queen Medb in her Quest of the Donn of Cuailgne, but their martial efficiency excites her jealous fears. She is only prevented from having them treacherously massacred by the chivalry of Fergus Mac Roig, who protects them, and allays the Queen's fears by causing them to be distributed among the battalions of her army.[2] They fight at the battle of Rosnaree against the warriors of Ulster, and Conchobar taunts his men with being less brave than the Galians.[3] They are intimately connected with Finn son of Cumhall and the Fiana. Indeed, according to

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[1] That is what we got from a workman on the day of our visit.

[2] Táin (Windisch), pp. 50-54, and see Proc. R.I.A., xxix (C), p. 103.

[3] Ċath Ruis na Ríg (Hogan), p. 51.

the approved account, Finn himself was sprung from the Ui Tairsigh, a sept of the Galians.[1] As foreigners, however, they are a vassal people under the domination of the Gael, and in course of time they join in the revolt of the *aithech tuatha*, or 'unfree tribes of Ireland.' The leader of the revolt, Cairbre Cat-head, is perhaps one of themselves. Though successful for a time, the new dynasty is soon overthrown; and the remnants of the Galians sink into obscurity. We can trace them, however, into the historical period among the Fortuatha Laigen, or 'Stranger tribes of Leinster,' for, like the O'Tooles and the O'Byrnes, victims of a later conquest, they were cooped up among the Wicklow mountains. There in diminished numbers, and becoming less and less distinguishable, they continue to be governed by kings of the race of Messi Corb down to the coming of the Normans.

In the above dim outline of a suggested history of the Galians I have taken a conservative view of the legend of 'Labraid the Exile' and of other legends, observing, indeed, the sequence of the legends, but not the chronology in which they have been set; for legend has little or nothing to do with chronology, and the only date we have is supplied by Ptolemy's notice of the Manapians about Arklow. But it is possible to take another and perhaps a more historically probable view, and to support it by other legends and traditions, and that is to suppose that the Galians and other distinct peoples were in Leinster before the coming of the people who traced their descent from Míl; or, without entering into the thorny question of when the Milesians came, we may say before that people had attained any wide predominance in Ireland. This does not involve pushing back the date to many centuries before the Christian era. There is no indication on Ptolemy's map of such predominance. The legends, too, point to the predominance of the Galians in Leinster at a comparatively late period; and we may perhaps regard the suppression of the Revolt of the Aithech Tuatha, placed in the generation preceding that of Cucorb, as a genuine tradition of what was the first real subjugation of these peoples in Leinster. In the 'death-song' pronounced over his grave by his widow Medb, Cucorb himself is stated to have "raised a contest to conquer the Galians";[2] and even later, in the will of Cathair Mór—a document none the less valuable, because executed, so to speak, long after the death of the testator—the benediction is given to his son Daire Barrach, eponym of the Ui Bairrchi, "that he might be a powerful champion over the green Galians."[3]

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[1] Duanaire Finn, I.T.S., Introd., pp. liii–lv.

[2] *Cosnam Galian gignis fich*, LL. 44 *b* (40-1), and see the whole 'death-song' translated by O'Curry (MSS. Mat., pp. 480–2), who, however, treats *Galian* as "an ancient name of Leinster." I think it is genitive plural.

[3] *Co madh nia co sobharthain os Gailianchaibh glas*: Book of Rights, p. 195, where there is a v. l. *Gailianaib*.

If the foregoing investigation should be deemed to afford *prima facie* grounds for supposing that in Rathgall we have a still existing memorial of this ancient people, and one too noticed by Ptolemy, a new and abiding interest will attach to the structure. It is, therefore, to be hoped that the problem will not be left where I am obliged to leave it, but that Irish scholars may be induced to scrutinize all the available evidence, and that Irish archaeologists may be encouraged to seek such fresh evidence as the spade scientifically directed alone can disclose.

IV.

TYPES OF THE RING-FORTS REMAINING IN EASTERN CO. CLARE.

Part IV. (*Conclusion*).

(CLONLARA, BROADFORD, CULLAUN, AND CLOONEY.)

By THOMAS JOHNSON WESTROPP, M.A.

Plates IV–VI.

Read June 23; published August 7, 1913.

It now remains to close, rather than to complete, this survey of the more interesting forts in eastern Clare by giving the descriptions of a few remaining on the skirts of the districts we have examined. I do not propose passing the line from Quin to Spancel Hill, as the rest of the barony of Bunratty Upper is rather a portion of Central Clare; and, indeed, there is little from Doora to Crusheen in any way dissimilar from what I have described.[1] That the forts of so large a portion of Tulla Lower are passed over in silence, however, demands some explanation.

The great mass of hills and mountains, some rising to nearly 1750 feet above the sea, and but little less above the plains at their feet, extends from Lough Derg and Bodyke southward to Cratloe and Clonlara, leaving comparatively narrow reaches of level country between it and the Shannon, from Killaloe southward. It was doubtless in primitive times, as till after 1655, a tangle of primeval forests and dense thickets along the flanks and bare undesirable moors on the summits and plateaux. It is therefore not wonderful that, save in a few of the valleys, forts rarely occur. The population, even still, has hardly spread into the uplands. This great mass of hills, with large gaps running into them, was appropriately called Slieve Bernagh ("Sl. Behernagh," about 1590, in the Hardiman map, T.C.D.), "the mountain of the gaps." The great mass of sandstone, overlying the limestone plain, is nearly cut through by the deep valley from Broadford eastward past the old church of Killokennedy. Unfortunately, instead of opening like

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[1] The raised oblong platform on which O'Brien's Castle stands is really a natural knoll, cut and banked up into shape. It has a ramp leading up to the west, and was walled round. The lower apparent platform seems wholly natural.

a gate towards Killaloe, it bends almost at right angles up to Glenomera House; and it is only up long slopes that the two long shallow valleys past Trough are to be reached. They run parallel from the high grounds above Hurdlestone and at Formoyle, nearly to Trough[1]; and then the eastern, joining a cross-depression, turns and meets the western, the streams joining to swell the Blackwater,[2] between Trough and Clonlara.

The ancient tribal divisions in these hills were:—(1) Ui gConghaile, still Ogonnello parish, with a strip to the south along the north-east; (2) O gCineidi, now Killokennedy and its valleys; (3) Ui Thoirdhealbhaigh, the eastern flank, from Killaloe southward; and (4) Ui Aimrid, from about the line of Kilkishen southward. The hills were held by a confederacy of tribes called, from a supposed ancestor Blod (*circa* A.D. 400), the *Ui mbloid*, and were roughly represented (and the name, as so often, preserved) by the rural deanery of Omullod. The chief of this group, the O'Kennedys, claimed descent from Cenedigh, father of King Brian. They took a leading part against the Clan Thoirdhealbhaigh in the civil wars with Clan Briain ruadh, from 1275 to 1318, and, on the collapse of their cause, fled beyond the Shannon, where the last prince of Clan Brian contrived to hold his own as O'Brien Ara. The Ui Thoirdhealbhaigh derived their name from a prince of the then obscure Craglea line, chiefly remembered as father of St. Flannan of Killaloe; from his eldest son Mathgamhan the later rulers derive their descent. The MacNamaras of Clann Cuileann, main prop of the Clan Thoirdhealbhaigh princes, came to be overlords of Ui m bloid from 1318 till the great changes of the sixteenth century. It is interesting to observe that the last of these who ruled under the ancient conditions, John, son of Teigie, the "MacNamara Fynn," in 1586, held as his "proper and special inheritance" lands at some of the chief forts described in this survey. These are, for example, Mowhane mac Gillymoyle (Moghane), Ramollane (Rathfollan),[3] and Cahershagenis (Cahershaughnessy[4]). He got a special rent off Tawnaghe (the site of the place of inauguration at Magh Adhair) and off a fort, described later, Cahairgreddane (probably the cathair north from Clooney), Lyssenrynke (unidentified) and Ballysallagh.

The general history has been as fully treated as my present knowledge of

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[1] Hurdlestone is probably the "Baile na glias" (Baile na gcliath) of the 1390 rental, and is Baile na cliath in the MacNamara rental of 1584, and Ballynaglie in the Book of Distribution, 1655. Trough is "Triuchacaed ombloit, the 'hundred' of Omullod.

[2] The Blackwater is the Dubh Abhann, given as the bound of the sees of Killaloe and Limerick in the acts of the Synod of Rathbreasail, 1110. (Keating's "History of Ireland." Irish Texts Society, vol. ix, p. 305.)

[3] *Supra*, vol. xxvii (C), Moghane, p. 218, and Rathfollan, p. 228.

[4] *Infra*, p. 74.

the subject allows; but two points, raised in the previous sections, may find place here. Mr. R. Twigge found in "the Book of Ui Maine" that Macan, son of Bran "of the boat,"[1] was the first person slain in the "siege" of Magh Adhair by Flann. Macan was apparently unarmed, "having a rod in his hand." The "siege" is probably the historic raid of King Flann Sunagh, about 877, when he insulted the Dal gCais by coming to "the very place of inauguration," and playing chess on its green. Essida of Ui Cassin (the later MacNamaras) and eventually King Lorcan soon drove off the invaders, and forced them to obtain terms for a safe retreat.[2]

Macan was of Lismacain, near Sodhmacain, or "Macan's weir." Now, the narrative implies that Macan lived close to the mound of Magh Adhair, on some stream. The name "Lismacain" is lost, but, in 1287, there was a "Ballymaking" on the northern edge of the English lands, apparently at or near Ballymacloon, and to the east of Quin. It is quite possible (indeed probable) that the important *Liss*, with the flooded souterrain, in Ballymacloon, the earthen fort best meeting the above conditions, may be the spot intended; unless (which we have nothing to show) the actual (as apart from the supposed) Norman territory, lay across the river,[3] when the *liss* may have been in Creevagh. The only Liss name within the river-loop is Ballylassa, in quite the other direction.

Since the publication of my last notes on the de Clare estates I find that the Pipe Rolls of 1295[4] show that Thomas de Clare, at his death in 1287, claimed (the 1287 Inquisition on his death, however, does not name any of these) Letton (Lattoon), Tybyrnefonch, and Magadar. Tybyrnefonch (well of the ash-tree) being next Lattoon, and to north-east of it, is most probably the notable holy well of St. Kieran, in Kilkieran, near Castle-Fergus, at the corner of Dromoland Demesne. Such wells are still often overhung by venerable ash-trees. If so, the notable *Tobar na fhuinseon*, on the edge of De Clare's demesnes, where some important conferences were held,[5] is now identified. "Magadar" is not probably the vague, extensive term *Magh Adhair*

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[1] A phrase very suggestive of Bran, son of Febal, famed for his "voyage," and "Bran the Pilgrim" on an inscribed stone found at Temple Brecan in Aranmore, but far later.

[2] After three days' skirmishing, as his bard Flann mac Lonain reports. See also "Wars of the Gaedhil with the Gaill" (ed. Todd), p. 67. Rev. E. Hogan, *Onomasticon Goedelicum*, p. 493, places Lismacain either near Magh Adhair or Lismacuan near Annaghdown; his first location is certainly right.

[3] The inclusion of "Magadar" in the Pipe Rolls proves nothing, as it is clearly Madara, which, with the church and village of Quin, passed the limits of the Ardsollas river. The latter was to be the bound of the Norman settlers, as laid down in the compact of 1275, made between Brian Ruadh and Sir Thomas de Clare.

[4] First noted by Mr. M. J. M'Enery, who kindly pointed it out to me.

[5] Cathreim Thoirdhealbhaigh.

(even then covering much of Clooney parish), but Madara, at Quin village, adjoining the Norman's northern castle and church, the only point where, as the history shows, de Clare's territory crossed the river Gissagh.

SLIEVE BERNAGH.

The forts round the hills are of no exceptional interest; all, save Lisnagree, are low; they are circular with a shallow fosse. Souterrains occur in two of the Ogonnello forts, but are choked up. The only "square" fort shown on the 1839 map seems to have been really oval. Only some sixty forts, none, save Lisnagree, of any special interest, remain in the hills. Of course none are found on the southern face till past the former limits of the great Cratloe forest. Nearly all near Limerick are levelled; there are traces of two stone forts and the name Caherdavin. One group at Elmhill is described in the next paragraph. Knockadrehid is the only fort in the tract beside the Shannon for eight miles, but there are ten to the south-west of Killaloe. The only fort-names are Doonass and Lislattin, the first the Eas-danainne of the Annals, in 1124, Dun easa danainne, in a deed of about 1590.

AHAREINAGH (Ordnance Survey Map, 6 inches to a mile, No. 53).—A small but conspicuous angle of one of the MacNamara peel-towers stands in a ring-fort on the summit of a high ridge (about 400 feet above the sea) overlooking the Shannon valley from O'Brien's Bridge to Carrigogunnell Castle and on to the distant Galtees and the Silvermine Mountains. The fort-makers cut a semicircular trench, 11 feet wide and 7 feet deep, leaving any large block they met *in situ.*[1] They shaped and levelled up the end into an oval platform, 75 feet north and south by 71 feet across, and 6 feet to 10 feet, and in one place even 12 feet high, revetting the face with a dry-stone wall of large, shapeless blocks from 6 feet to 9 feet thick. The tower was very small, 24 feet north and south by 22 feet wide outside, the wall to the west 5 feet, and to the south, 6 feet 4 inches thick. When I sketched it in 1889, the whole west face remained, showing the under story with a pointed vault, and its end window a plain unglazed slit with a flat splay arch. Hardly half now stands. The fort gateway faced a little to the north of east, and is 6 feet wide To the south was a small cell or porter's lodge. The fosse is only traceable to the west and south.

EARLHILL (53).—Following the old bohereen (which after passing a farmhouse becomes a swampy and often overgrown cutting along the top of the

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[1] This is also the case at Duneeva, near Lehinch, and the Dind Seanchas tells of the removal of such a block from the fosse of Dun Ailinn by the divine fort-builder, the Dagda (*Revue Celtique*, xv, pp. 309–310). For plan see Plate IV.

hill, a "hollow way," probably of remote antiquity) we reach a group of forts, about 430 feet above the sea in Earlhill townland. (1) The first is on a knoll; the fosse is 8 feet wide and 4 feet to 5 feet deep; the circular inner ring, enclosing a space 41 feet across, was faced with small sandstone slabs, and is 6 feet to 8 feet high and 9 feet thick. There is a deep hollow of uncertain age and use in the garth. The gateway faced the east; a large block, perhaps its lintel, lies beside it. (2) A natural mound, artificially shaped, lies to the north of the lane. Eastward, but to the south, are the earth-forts. (3) The western is 93 feet across, with small stone-facing, the ring being 9 feet thick and rarely even 4 feet 6 inches high. The fosse is 6 feet wide and much filled, rarely 2 feet deep. The outer ring had large blocks set in it and is 6 feet thick and 2 feet or 3 feet high. (4) A house-ring lies to the east of the last. It has a steep bank, evidently stone-faced till very recent years, with no fosse. The ring is 10 feet thick and over 6 feet high, the garth, 84 feet across. It has a view of Knockfierna peak in Co. Limerick through a gap in the near hill, and a fine view through the valleys to the great northern range behind Killokennedy. It is 416 feet above the sea. (5) A cattle-bawn, low and irregular, with an unusually broken garth, crossing a low hummock, though the field was level not far away. The ring is 6 feet to 9 feet thick, rarely 5 feet high, and the enclosure 100 feet across. (6 and 7) There are two more featureless ring-forts farther eastward in Cappakea, near the long dolmen of Ardnataggle.

The old laneway was called "Crummil's Road" in 1889. The maps in 1839 call the modern road, low down the ridge, "Cromwell's Road." Tradition says that Oliver Cromwell brought his guns along the old way to take Limerick. Unfortunately for the historic interest, he did not besiege Limerick or come nearer than thirty miles from it at Kilbeheney, on the opposite edge of the county. There is no record to connect either road with the march of any of his forces.

LISNAGREE (44).—In a high lateral valley, under the dolmen-crowned ridge of Formoyle, near the head of the pass from Broadford to Limerick, stands one of the few forts of the "low-mote"[1] type in Co. Clare (like

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[1] I have often found the peasantry in counties Limerick, Clare, and Kerry using the term 'mote' for any low forts, and those sometimes of stone. This is the case in Clare at Ballynahown, and in Limerick at the so-called Carrigalla fort near Loughgur. The latter is a remarkable hill-fortress, with strongly built ring-walls at either end. The northern is oval, 75 feet across north and south, 108 feet east and west, with a wall 12 feet thick, faced with large blocks, 3 feet and 4 feet long, with a batter of 1 foot in five. The southern, 116 feet from the last, is nearly levelled, 84 feet north and south, 112 feet east and west, with similar large facing; several enclosures (probably cattle-pens) and a hut-site lie between. It has hitherto remained undescribed.

Lisnaleagaun, Lugalassa, and Magh Adhair), called Lisnagree (Lios na ngroidh, "of the cattle"). The valley, before the present road was made, was a most secluded spot; the bottom was once a lake, which, as the stream-bed deepened, left marshy fields behind; into these a long drift-ridge ran out. As at Aharinagh, the fort-makers cut a deep crescent fosse through the end of the spur, and shaped up a mound—doubtless very necessary when the valley got flooded at rainy seasons. The occupants on later occasions continued to raise it; the last addition was never finished. Doubtless the fort was at first an islet (as Magh Adhair may well have been, and as The Earl's House certainly was down to the time when the river was deepened); but Lisnaleagaun and Lugalassa always stood on dry fields—the latter on the top of a ridge. The fosse is from 2 feet to 6 feet above the level of the adjacent field, with an outer ring, 3 feet to 5 feet high, running into the ridge at the cutting, and is 10 feet wide. The inner mound is of three periods. The first platform was level with the summit of the ridge; then 4 feet to 6 feet of earth was added, and lastly, a third layer, over 3 feet high, left incomplete for about 9 feet from the southern edge in a straight line. The higher part is 96 feet across in the middle, north and south, or 105 feet in all, and about the same east and west; it is 8 feet to 10 feet above the fosse, and 14 feet to 16 feet above the marsh to the north; large hawthorns to the west and south add deceptively to its height and size.[1] I heard at Formoyle, but from a very doubtful source, that the fort was called from the cattle which King Brian Boru took from the Danes and kept at it. Brian certainly hid in the hills of Ui mBloid; and had my informant been certainly reliable, the legend would be of much interest. Being suspicious, I put other questions, which were certainly answered with intention to please me, but the answers to which were incorrect. The fort is in the territory of the O'Kennedys.

KILLADERRY-O'BRIEN (O. S. 44).—The fort is one of a group of five between the old hill road and Doon Lake on the road between Kilseily church and holy well and Bealkelly Castle, below "old Grania's" dolmen, and exactly 1000 yards west from the church. It measures 160 feet over all; the outer ring has been levelled into the fosse to the north-east; the trench is 15 feet wide and usually about 4 feet deep, being still wet. The inner ring is 6 feet to 8 feet high outside and 3 feet inside; it is 12 feet thick. The garth is from 99 feet to 102 feet across. In the fort is a sandstone block with two late-looking irregular rings scribed on it.

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[1] For plan see Plate IV. The section is sketched.

SIXMILEBRIDGE GROUP.

GORTADROMA (O. S. 43).—It is on the western bank of the Owenogarna (amhann o gcearnaigh) river, in a rich, green "callow," and is now much levelled. It measures about 250 feet over all, and 150 feet across the garth, with a shallow fosse and a defaced inner ring, each 10 feet to 12 feet wide, the latter 3 feet to 5 feet high. It is close to, and, to appearance, even overhung by the dark heathery ridge near Snaty Peak.

ENAGH (O. S. 43).—A large fort on the rising ground north from the old house of Stacpole's Court, once the property of that Bartholomew Stacpole, the Recorder of Limerick, who, in 1651, signed, on behalf of the citizens, the surrender of that city to General Ireton. The earthwork has recently been nearly levelled by an improving farmer, so I preserve a description. The place derived its name, Eanach Ui Floinn, from a "fair" or rather great tribal gathering) held, doubtless, near the chief fort,[1] in the territory of the O'Flynns. The fort consisted of a ring, about 200 feet across over all, with steep, stone-faced earthen banks, 8 feet to 10 feet thick, and, I believe, no fosse; but the only section still in any sort of preservation was next the annexe, and needed no extra defence, and the rest is obliterated. The annexe is to the south-east of the ring, and measures 350 feet over all east and west, and 250 feet south-west and north-east across the garth. Its rampart varies from 9 feet to 12 feet thick to the west, and is stone-faced. All the southern and most of the northern part are levelled to improve the field. In Enagh West, lying beside the castle, and the slight depression of Glennagaurlagh, are three defaced forts, each about 100 feet across. There are seven in Ballymulcashel and Curraghkilleen.

GORTALASSA (O. S. 52).—A large circular entrenchment 250 feet across lies at Gortalassa or Fortfield. There are some eight low rings, usually with shallow fosses, between the Owenogarna and Castlecrine. A large but much repaired fort, 210 feet across, with high banks, is in Castlecrine, on a knoll above the beautiful old orchard, with grey-mossed apple trees and sheets of daffodils in the spring.

ROSSROE (O. S. 43).—There are some very curious and irregular groups of earthworks on the gentle slope east of Rossroe Peel Tower, and the dolmen of Knockalappa, beside Rossroe Lake, but too tangled and levelled to explain, probably representing a series of alterations made in far different periods

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[1] The Eanach names in Co. Clare are the Eanachs of O'Flinn and Magh Adhair, Ballykinvarga, Eanty, near Caherconnell fort, and Creganenagh Hill near Termoncronan, also Enagh near Milltown Malbay.

with one of the ring-wall homesteads, with its surrounding bawns and hut-enclosures, such as we find near Castlefergus, and not unfrequently in the uplands in the north-west of Clare. A gold fibula, exactly like those found near Moghane fort, was found at the dolmen. Rossroe rath is a good example, with an outer ring, deep wet fosse, and high inner ring about 100 feet across the garth. Two stone forts, mere rings of overgrown filling, lie between it and Ballysheen (Baile ui oisin, 1390). Cloonmunnia has a large fort 250 feet across east and west, and about 170 feet north and south. In Castle Lake, adjoining Ballymulcassell, is MacCarthy's Island, an interesting little *crannog* carefully constructed with roughly hewn beams, some with mortices, interlaced with piles driven into a shoal and packed with small stones. On the overgrown platform Mrs. Butler (to whose kindness I owed my opportunity of examining this lake dwelling in the very dry spring of 1903) found a flat stone axe and a layer of bones, including a tusk of a large wild boar. It is hardly possible to do more than enumerate the crowded but featureless forts of this district. I have already discussed the probable site of the lost mote (probably the castle of Huamerith, 1199) at Baile an mhuta, probably near Cappagh and Sixmilebridge.

CLEENAGH.

KNOCKADOON (O. S. 51).—A low, steep hill rises between Cleenagh Castle and the estuary of the Fergus. On the top, or rather round it, is a large and conspicuous earthwork. It has an outer ring from 3 feet to 5 feet high, with stone-facing inside; the fosse is hardly sunk below the outer field at the south-east, but is usually about 4 feet deep. The inner mound is steep and well preserved, rising 12 feet above the bottom of the fosse to the south-west, and usually from 10 feet to 11 feet high; it was 9 feet thick and stone-faced inside (and I think most probably outside) with large blocks. The platform is terraced up and fairly level 265 feet east and west, and 189 feet north and south, 317 feet × 263 feet over all. A gravelike mound lies north and south inside, but may be part of a demolished fence.

To the south lies a defaced house-ring, with no fosse, about 54 feet over all. There is a fine view from the great fort over the estuary and its numerous islands.

CULLAUN TO ARDSOLLAS.

GORTEEN (O. S. 35). In a craggy region, overgrown with hazels, between Cullaunyheeda Lough and Dangan, is a very curious group of small forts. Though the majority are dilapidated, and many have not been marked even on the new maps, I regard them as worthy of note, being probably very late and decadent. Very briefly I enumerate them, and give a map on which their reference-numbers identify them.[1] (A) A house-ring, barely 50 feet across, with a thin wall, 6 feet or 7 feet thick, of coarse crag-stones. (B) A larger ring-wall, with a similar house-ring in its garth. (D) A bawn, D-shaped in plan, with nothing in the site to necessitate this shape. (C) A ring of small blocks to the south-west, 10 feet to 12 feet thick, and now only 3 feet 6 inches high, the garth of very rough crag. Its inner diameter is 90 feet, its outer 114 feet. All these are nearly levelled; the wall of C alone has filling; the rest are of two badly bonded faces.

A long, shallow valley runs eastward to Creevosheedy Bog; north of it the ground is free from thickets, and the remains often better preserved. (E) On the edge of the hollow is a faint ring of small field-stones, evidently a house-ring. It is 55 feet inside; the wall is about 9 feet thick. (F) On the northern edge of the same field (at the first "E" of the townland name on the new maps) is a late ring, 60 feet inside; the wall of large blocks without filling is 3 feet 8 inches to 4 feet 3 inches thick, and 3 feet to 4 feet high. In its garth to the north-west is a circular house-site, 30 feet across, touching the outer wall. Its gateway faced the east, and had two lintels, 4 feet 8 inches by 2 feet 6 inches by 1 foot, and 4 feet 3 inches by 2 feet by 10 inches. (G) Beyond the east wall of this field, 100 yards from the last, is a levelled ring; the wall is only 6 feet thick and the garth 65 feet across. (H) Beyond the second "Cloghlea Rock," to the north-east, is a barely traceable ring, somewhat smaller than the last. (I) Beyond the last, near the stream and the Earl's House, is another levelled ring.

(10) THE EARL'S HOUSE. The curious ruin called "the Earl's House" lies near the bend of the stream at the north-east corner of Gorteen. There is not even a tradition to suggest its origin; the "Earl" may be (if not some Earl of Thomond) a legendary "Red Earl"—perhaps a De Burgo.

The 1390 rental names the "half townland of the Red Earl, in Glen,[2] near Glenomera. In the "History and Genealogy of the family of De Burgo," in Trinity College Library (F. 4. 13), we are told that "the Red Earl's lands extended from Forbach in hIar Connacht to Ballymacscanlon, near Dundalk, and *from* Luchud, in Thomond, to Ballyshannon, on Lough Erne." Even this statement (accepted by MacFirbis) does not include any land in Thomond. Richard, the Red Earl, died in 1326. Elsewhere in Clare we have a division of Coolreagh called Coolreagh Earl, and also Earlhill, near Ahareinagh.

The structure is more like one of the lesser Norman motes than an ordinary Clare fort.[3] A small knoll has been cut off from an angle of the low

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[1] Plate V.
[2] Trans. R. I. A. Acad. (1826), vol. xv, p. 47.
[3] Plate V.

plateau by two trenches at right angles, and levelled and shaped into a flat-topped, oblong platform, 90 feet long, east and west, and 54 feet wide, with a slight fence, 3 feet thick to the west and south, probably once palisaded. On it was a house, 60 feet east and west by 30 feet, the wall only a couple of feet high. The fosse to the south and west is 9 feet to 12 feet wide below, and 18 feet to 20 feet above. It is 6 feet deep. About the middle of the southern fosse was a stone causeway leading to a ring-wall, now greatly levelled. The *cathair* is 98 feet across the garth. The wall is perfect round the craggy platform to the north-east. It is of rather poor, coursed dry-stone masonry, and 4 feet to 5 feet high. I could not find its thickness accurately; but it seems from 6 feet to 10 feet thick. There were late cabins in the garth, which led to its demolition. They are now nearly effaced.

Mr. Hough, of Gorteen, tells me that when he was a boy, before the river was deepened, the Earl's House stood on a shallow lake, and water filled its fosse. The remains of eel-weirs in the marshy field support his statement. Farther west is a hollow called Poulaphuca, from the demon-goat or pony; but no one on the townland who spoke to me seemed to know what the name implies. (J, K, L) There are three more defaced *cathairs*, 110 feet, 150 feet, and 120 feet across, to the west of the Earl's House and parallel to the other row of rings (B, C, D).

North of the stream, in rich grassland, are four earthen forts, each about 100 feet across, with shallow fosses and rings 5 feet to 7 feet high, ringed by old hawthorns, perhaps descendants of the quickset hedges which fenced many forts in the early times, and even the ramparts of the town of Athlone on the Connacht side. The rings are gardens of hyacinths, primroses, and stitchwort. There are eight forts in the townland of Dangan, typical circular earthworks. In the Deerpark is a strange-looking low oval earthwork about 120 feet by 100 feet, set with hawthorns, and called Carrowbane (ceathramadh bán), "white quarter," the adjoining townland being Carrowroe or "Red quarter."

Cragbwee and Cant.—The townlands south of Dangan have several, nearly levelled ring-walls. The best-preserved, near the lakelet of Dooley's Hole, is well-built, with two faces and filling, 12 feet thick and usually 4 feet high; the garth is 116 feet north and south, and 125 feet east and west. The others are rings of filling.

Ardsollas to Clooney.

Castlefergus (O. S. 42).—A group of five cathairs, one with a souterrain, was cut through in making the railway. No "finds" are noted. It is unfortunate that the group was so much injured, as it was a most curious and instructive one which encourages me the more to try and reconstruct it, so far as possible, from the existing remains and the maps of 1839.[1] The site lies in the townland of Castlefergus, the ancient Ballyhanan or "Agnan" or "Agnay." So far as I can judge, the large townland was split into the Castle-quarter, Derreen, and Carrowmeer of Ballyhannan and two other portions called Ballyhannan North and South, which preserve its ancient name. Close to the peel-tower and later house of Castlefergus, an early settlement lay on a craggy ridge. It consisted of two large oval forts with three smaller ring-walls to the south and one to the north. The railway to Ennis was run through these in a deep cutting almost obliterating the two chief forts. Small portions of their foundations, with the facing blocks, lie just within the wall to the south of the railway for which most of their material was removed. Three (if not four) were linked together by massive walls; the two others were probably detached. The northern one, impenetrably overgrown in the wood to the north of the cutting, lay about 300 feet away from the southern forts, while these were crowded into a space hardly 500 feet each way. The south-eastern ring-wall is not shown on the maps, so was probably levelled before 1839. Its wall is rarely 2 feet high, but is 9 feet thick, the garth about 45 feet across, a mere house-ring. The southern ring-wall is 13 feet to 15 feet thick of large, facing blocks and filling, entirely overthrown in great heaps, many of its facing blocks *in situ*, 51 feet across the garth with three inner walls forming a Y in plan; to the south-west the wall forms a confused heap. The chief fort is 33 feet to the north-west, and is joined to the last by a wall 15 feet thick. Close to the west end of this joining wall another wall, still 5 feet high, runs towards the N.N.E. for almost exactly 70 feet to the larger oval fort. These joining lines had faces of large blocks, rows of which remain for reaches of 10 feet to 20 feet. To return to the last-named cathair, the heaped ruin is 4 feet to 6 feet high, the wall about 16 feet thick, and the craggy garth 60 feet across, without foundations; an enclosure 27 feet each way adjoins both it and the long wall. Another joining wall runs up to the railway wall and once evidently joined the oval fort. It is 21 feet thick at present, and widens to 27 feet a little south from the modern wall. At 18 feet from it, and from the south cathair, is the faint foundation of a circular hut, 12 feet over all. The thickness of the wall cannot be fixed. 15 feet farther is the only remnant of the large oval fort, 24 feet deep and 50 feet long, of large, carefully laid blocks. Save this small segment, all the rest and the enclosed souterrain have been removed by the railway-cutting. I saw no traces beyond this; but the shrubs and brambles are thick, and the maps imply that it was wider than the cutting. Of the eastern oval fort,

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[1] Plate V.

a small segment to the south of the railway wall alone has escaped. It, too, had a good though rough facing of blocks. All through the surrounding fields rude foundations exist. One field to the south-west of the group has fences of considerable thickness. Another site with three loops adjoins the railway wall in the next field. A small ring-wall lay beyond this, eastward and to the north of the railway, but is, 1 think, entirely swept away. Lastly, over the bound of Castlefergus and in Ardsollas is a cathair, the walls 4 feet high and 17 feet thick, of irregular stonework; it is oval, 81 feet east and west by 99 feet north and east, with no foundations in the garth. The whole group affords another remarkable example of the curious remains being so rapidly obliterated from the face of the land.

There are several forts of considerable size beside the railway to the south of Ardsollas Station. Ballykilty has the Race Park Fort and Ballylassa; while a large double fort is in Ayleacotty. The first is 219 feet across, but is levelled, and barely rises 3 feet over the park. It probably had no fosse. Ballylassa Fort is a stone-faced platform, 102 feet wide, and was probably a ring-wall.

Ayleacotty is of a more interesting type, being double;[1] the north fort is a ring-mound stone-faced 12 feet thick, and 3 feet above the garth, and 8 to 10 feet over the field outside; the fosse is barely 2 feet deep. There are two enclosures to the north-east of the garth; and the fort runs into an angle to the south-east. Divided from it by a shallow fosse, 9 feet wide, is the southern enclosure of the usual shield shape of such an "annexe." It is 84 feet north and south, of stone-faced earth, with a shallow fosse 10 feet to 12 feet wide, and 3 feet deep, with an outer ring of large stonework. The whole of the mounds are planted with large hawthorns, and an old laneway runs along its eastern face. It has a wide view from Slieve Bernagh to the hills beyond the Fergus, but that river is not visible. The railway runs through a deep cutting close beside its western face.

Moyreisk (O.S. 34).—A large group of forts, which I shall barely note, lies between Quin and Moyreisk. There are three low earthen rings in Keevagh, and a curious little cathair in Drim; the latter rests on a low limestone knoll, and has been much rebuilt. The wall had faces of poor masonry and is 10 feet thick, and 6 feet high. The gateway faced N.N.W. A path leads down from it to a cleared space, 70 feet by 36 feet.

In Moyreisk, across the road, westward from the lodge, a large double-ringed cathair, nearly levelled, lies in a plantation on a thicket-covered crag. It is about 253 feet north and south, by 220 east and west, and consists of heaps of mossy stones of fair size. It has an outer ring 50 feet to 72 feet

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[1] Plate IV.

outside the inner wall; the walls can rarely be measured, but are from 12 feet to 15 feet thick, and 3 to 4 feet high in parts. It is about 390 feet north and south, by 320 feet east and west over all.

There is a small fort on a knoll, near a little lake beside the avenue, a mere high ring of mossy stones overgrown with hawthorns, 69 feet across, 15 feet thick, and 5 to 8 feet high, with a late oblong enclosure in the south part of the garth.

Some fifty-six forts lie westward from the Quin river and Moyreisk, to the Fergus, principally in Doora parish. So far as I have seen any of these, or can learn, all are defaced ring-forts, some with fosses and low outer rings—one near Kilbrecan with stone facing. None are of unusual size or different from those described here. Doora was an old centre of civilization. Here St. Brecan established the first Christian churches in Co. Clare, Kilbrecan (Carntemple), Doora (Durynierekin, 1189), and Clooney, being remembered as St. Rikin, at the last-named; he lived about 460–480.

Ballyhickey, or Hazelwood, adjoins Moyreisk on the east. It has a small perfect dolmen and a large ring 250 feet across, and levelled to 2 feet high. Across the road from Quin to Ennis near Wellpark is a network of low foundations of enclosures clinging to a ring-wall with radiating walls and loops. Like the other webs of enclosures at Castlefergus and Rossroe, it is all levelled. They probably represent the growth of an early homestead generation after generation.

CORBALLY (O.S. 34).—On a low hill within a mile of Magh Adhair mound and of the large double earthwork of Creevagh, already described, is another important fort on Drumbaun ridge. Though thickly planted with elms and oaks, it has a fine view out to Slieve Bernagh, the great hill of Kimalta (the Keeper) in Co. Tipperary, and westward to Mount Callan. The principal fort is on the summit of Drumbaun; it has an outer ring 3 feet high, 15 feet thick at the base, and 3 feet on top, rising 8 feet over the bottom of the fosse. The latter is 9 feet wide below, and 25 feet at the field. The inner ring rises 10 feet over the ditch, and barely 3 feet over the garth; it is slightly oval, 93 feet north and south, by 99 feet east and west; the whole earthwork measures 182 feet to 190 feet over all.

At 27 feet to the south, connected by a straight mound, is a less regular annexe. The outer ring and fosse are each 9 feet wide; the inner ring 9 to 12 feet thick, 4 feet 6 inches high to the south and west, and 8 feet to the north and east down the slope. Its garth is 60 feet north and south, by 87 feet, the whole 117 feet over all.[1] There is a deep dry pond beside it.

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[1] See Plate IV.

These earthworks have no traces of stone revetments. Such probably once existed, but, if so, very long ago. In the field to the south-west, near Wellpark, is a deep natural pit such as is locally called a "thunder-hole" and is supposed to be made by a bolt; it is fenced by large stones.

TOONAGH.—Toonagh, the Tuanamoyree of 1655, containing the mound of Magh Adhair, adjoins Corbally on the east. On the highest ground behind Toonagh House, with its lines of huge horse-chestnuts and lilac bushes, a fine fort lies. No stonework remains; but its removal must be recent; and the hard clay banks remain virtually perpendicular. A faint hollow, 15 feet wide, but hardly a fosse, girds the liss; the ring is 9 feet thick, and high to the south, and 6 feet elsewhere; the garth is 115 feet north and south by 102 feet, or 133 feet and 120 feet over all. The bank is planted with great old beeches. A large block lies in the garth. No fort name is remembered.

SPANCEL HILL GROUP (O.S. 26, 34).

I will finish my survey with the group near Spancel Hill (the ancient Cnoc fuarchoilli or Cnoc Uarchoill, "Cold-wood hill"), for the parishes of Kilraghtis and Inchicronan belong to central Co. Clare. The group contains two interesting works, the "square fort" of Knocksallaghmore and the strong double-ringed cathair of Cahershaughnessy, one of the chief forts of the district.

RYLANE (O.S. 26),—A group of little forts, called from recent tenants of the adjoining farms, lies in this townland; we have already noted its dolmens and a curious primitive burial-place there.

The most northern fort, called MANGAN'S FORT, is a low ring-wall on a steep grassy hill 300 feet above the sea, with the widest outlook of any of these forts, save Moghane. The wall is of coarse, large blocks of conglomerate, with large filling of field-stones; it is 10 feet thick, and rarely over 3 feet high. The garth, a nearly impenetrable thicket of furze, hawthorn, and rowan, is 115 feet across with no visible enclosures.

The foundations of Rylane castle remain, with a large cut jamb-block, on a craggy platform from 12 to 15 feet high, and about 50 feet each way, over a spring called Toberlaghan. It is not marked on the maps.

HEHIR'S FORT to the east of the Fiaghmore road was entirely levelled by Mr. Henry Spaight some forty years ago; the men refused to touch it till he dug the first sods, and all attributed his early death to the act. It is covered by tall furze bushes; hardly a trace remains inside.

NAUGHTON'S FORT lies across the road westward on a bolder ridge. It is a remarkably fine and perfect example, though the stone facing has been nearly all removed. The outer ring is 5 feet high, 6 feet thick on top, and 12 feet at the field. The fosse is wet, 8 feet deep, 9 feet wide below, and 19 feet at the field-level. The inner ring is 10 feet thick and high over the fosse, 3 feet over the garth, which is 72 feet across. The whole is 155 feet over all.

CAUHER.—At the foot of the hill, near the dolmens, and to the north-east of them, is a levelled ring known as "the Cauher"; it is 72 feet across inside (like Naughton's Fort), with a wall, 10 feet to 15 feet thick; foundation-blocks and some heaps of small filling remaining. Inside is a house-enclosure and a row of large set blocks.

KNOCKSALLAGHBEG.—West from Naughton's Fort, towards Ballyvergin, is "MACINERNEY'S FORT." It stands on another low hill (fourteen of such can be seen from Mangan's Fort), and has an outer ring, 8 feet thick and 4 feet high, its southern half levelled. The fosse is 10 feet wide, and is nearly filled in parts. The inner fort is 5 feet to 6 feet high to the north, and 9 feet to the west. The ring is 9 feet thick, and the stone facing usually remains. The garth is 4 feet higher than the field, and is 81 feet to 84 feet across, or 138 feet over all. Inside are two mounds and some large blocks.

KNOCKSALLAGHMORE.—"CLOON'S FORT" lies on a low ridge near the old road to Clooney. It is one of the best examples of the so-called "square" fort in eastern Clare. The outer mound is 12 feet thick, and usually levelled; the fosse is 7 feet to 11 feet wide below, and 4 feet to 7 feet deep. The sides are slightly bowed, and measure inside, the north, 75 feet; south, 60 feet; east, 72 feet; and west, 84 feet; or 102 feet and 111 feet diagonally. The inner face is lined with large stones; some slabs, 3 feet wide and 4 feet high occur chiefly at the corners. The rampart is 5 feet high inside, and 10 to 12 feet outside; it is 12 feet thick.[1] The fort has been often used from oldest memory to the present time for public meetings.

MAGHERA.—"Connor's Fort" lies near Aughnadina Bridge, on a pleasant, low knoll above a stream, shaded by a mountain ash and hawthorn. It is a ring-wall, 5 or 6 feet thick, of large blocks, 75 feet across the garth, and is evidently not very ancient. Near it is a curious limestone platform, 12 feet high, full of little natural arches, caves, and fox-earths, but the walls on it are rebuilt or modern.

CARRAHAN CAHER.—I was told by a very old man, in 1895, that when he was a child the old people said the Caher was "a very famous place, and told all sorts of things about it," which he had forgotten. Much of the stonework was removed in about 1867. The maps of 1655 and 1683 mark "Cahergiridan" about this place. The name occurs from Elizabethan times; but I

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[1] See Plate IV.

cannot certainly identify it with the caher, though this is probable. When I saw it in 1895, much of the west segment stood about 5 feet high and thick, and 4 feet high to the north-west and north. The base was of earth, and stone-faced like Cloon's Fort, with large blocks set on edge, usually 3 feet long and high, and 12 inches to 18 inches thick ; some to the east are 4 feet 6 inches, 5 feet 2 inches, and 6 feet long, and 3 feet 6 inches high ; the longest to the west is 5 feet 8 inches long. The wall is usually 6 feet 6 inches thick eastward, the garth 75 feet north and south by 69 feet east and west. On my first visit I noted a gate as facing the south-east. I found no trace in 1912. In 1895 a curious feature existed in a course of blocks, set like books on a shelf above the large bottom plinth. I have only seen this arrangement in two forts in Burren, one being Caheraclarig, near Lemaneagh. All is now gone ; but I have a sketch taken in 1895.

Eastward, towards the road, is an earthen fort stone-faced for 5 feet up, the top of dry masonry, 4 feet high and 9 feet thick. It is 99 feet across inside ; the south edge of the wall is cut off by a modern ditch and fence. In the centre is a house-foundation, with two circular cells, the western partly gone ; the intervening wall 12 feet thick ; the outer 6 feet ; the eastern cell is 12 feet inside ; it lies 48 feet from the west, and is 24 feet over all.

Three earthen forts lie between it and Clooney—one on Crow Hill or Knockaphreagaun to the east. It and Lissana fort have rings, 4 to 6 feet high. Knocknafeany fort is barely 70 feet across ; the mounds 3 feet to 5 feet high ; neither of the last has a fosse. Reaskreagh Fort was defaced when I examined it twenty years ago ; and it is now nearly quite levelled ; it lies in Sraheen.

The five pillars on " Knocknafearbrioga " Hill are supposed to be the seven robbers of St. Mochulla's Bull, petrified by the curse of the saint ; they have been described in these pages ; they lie about 500 yards from Carrahan Caher. Fomerla has remains of a castle, two small cists, a " killeen " graveyard, with a basin-stone, and an earthen ring-fort, 6 feet high, without a fosse. All these forts are ringed with fine hawthorns, and pink thorns abound in Fomerla.

CURRAGHMOOGHAUN.—Close to Castletown Lake, and not far from Cahershaughnessy, rises a low hill, with dense thickets on its western flank, and commanding a wide outlook to the Shannon and the Fergus, and far up to the Burren mountains, of terraced limestone. On the summit is a most problematical earthwork, a circular fort 90 feet across, which once had a dry-stone rampart ; the fosse is 5 feet to 6 feet deep, the inner fort 9 feet above its bottom. Outside at 10 feet to 15 feet away is an outer ring 5 feet high, lost in a thicket of bramble, ash, and hazel. South from the first fort runs a strange loop, C-shaped in plan, with mounds 5 feet high, and 10 feet to 12 feet thick; a deep modern ditch, 6 feet deep and wide, has been dug outside them. At the upper end is an annexe, curved, 96 feet long and 12 feet wide. The main annexe runs southward for 171 feet, and is 75 feet wide; it then bends eastward, and is 624 feet long in all. Large old trees grow on the mounds; the enclosed plantation was recently felled. The object and age of the curved work are to me enigmatical.[1]

CAHERSHAUGHNESSY.—In 1892 I made a careful plan and notes on this fort for a paper by the late Mr. Arthur Gethin Creagh and Mr. Henry Harris in the Journal of the Royal Society of Antiquaries of Ireland;[2] but a few more notes seem desirable, as it is too important to pass over in any purporting survey of the forts of East Clare.

When Mr. Creagh discovered it in 1860 (for the 1839 map is most inadequate, and does not even show the double ring or give its name), it was one of the finest cathairs in Clare, if not in Ireland. The great walls, with their facing of large blocks, were nearly entire, though the gateway was defaced, and some house-sites remained that are now entirely removed. Of its previous history I know no earlier record than that of 1585, when MacNamara Fynn held Caharshagenis.[3]

The fort lies in low, wet, but craggy ground, almost overhung by one of the green fort-capped drift hills so common in the parish. The inner ring is evidently very ancient, of the best type of construction, splendid regular masonry of large blocks, and large packed filling, still 6 feet to 8 feet high and over 12 feet thick, with a regular batter of 1 in 3 to 1 in 4, and at least three upright joints to the south and south-east; the gateway faced the west. The garth is 148 feet to 166 feet across, and has several hut-rings and oblong enclosures; some of these walls are continued as traverses between the inner and outer ring, but are built up to, not crossed by, the ring-fort, as at Ballykinvarga and elsewhere. The outer ring is thin, and of poor masonry, evidently an afterthought, for herding and keeping separate the cattle of the various persons connected with the fort; it is irregularly circular, and about 570 feet across. Its line is greatly overgrown with bushes.[4]

Much of the outer facing of the inner ring had been removed by a road contractor just before 1892; but at the persuasion of Mr. Creagh, the farmer (I greatly regret to be unable to record his name) most creditably prevented any further demolition since then. Can nothing be done, however, to vest in the Board of Works or County Council such important remains as it, Cahercalla, and Magh Adhair, not to speak of Cahercommaun, Ballykinvarga,

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[1] See Plate VI.

[2] Vol. xxiii (1893), p. 287. See also Proc. R.I.A., vol. vi, ser. iii, p. 438.

[3] Chancery Inquisitions (Ch. Rememb. Office), P. R. O. I.

[4] See Plate VI.

and the great western forts, that in any civilized land should be carefully preserved as national monuments of high value.

To close this series of papers, I will first give a table of the types occurring in East Clare, and the best examples herein described, the sections lettered Part I (*a*), II (*b*), III (*c*), and the present section (*d*).[1]

1. The simple ring of dry stone or earth—(stone), (*a*) Newmarket, Caherforia; (*b*) Ballymarkahan, Creevaghbeg, Cragataska, Caherloghan, Lissoffin, Bodyke; Ballymacloon, Abbeyhill, Lisduff, Ballygastell; (*d*) Carrahan, Moyreisk, Gorteen (several); (earth, with or without fosses), Ahareinagh Rylane group, Toonagh.

2. Same, with more elaborate works; (*a*) Rathfoland, Monafolia, Kilnasoola, Ballymacloon; (*b*) Creevaghbeg, Lackenreagh, Caherhurley; (*c*) Bealboruma; (*d*) Curraghmooghaun.

Stone with two or more rings;[2] (*a*) Moghane, Langough; (*b*) Cahercalla, Tulla church; (*c*) Grianan Lachtna; (*d*) Moyreisk, Cahershaughnessy.

3. With side enclosures or double forts; (*a*) Langough, (*b*) Coolreagh, Creevaghmore, Killulla; (*d*) Drumbaun, Castlefergus, Ayleacotty, Earl's House, Enagh.[3]

4. Flat-topped "mote," with fosse and ring; (*b*) Magh Adhair, Lugalassa; Lisnagree;[4] respectively 20 to 24, 8 to 13, and 8 to 10 feet high.

5. Irregular enclosures, conforming to contour of site; (*b*) Ballydonohan.

6. "Square" forts., i.e., more or less straight-sided and angular; (*b*) Ballymarkahan; (*d*) Knocksallaghmore.

7. Same, with raised platform; (*b*) Bunratty, Culleen.

8. Crescent fort abutting on lake-shore; (*a*) Cahernacalla

9. Terraced-up type on hills—notably (*b*) Knockadoon, Fortanne, Liscockaboe.

No case of a spur-fort is known to me in East Clare.[5]

Magh Adhair was most probably sepulchral and ceremonial in origin; but the deep fosse, outer ring, and trace of walling on top suggest that it was also residential and defensive; and the record of the siege of Magh Adhair seems to

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[1] These appear in the Proceedings, (*a*) vol. xxvii, p. 217, (*b*) *ibid.*, p. 371, (*c*) vol. xxix, p. 186, (*d*) present section.

[2] Many have asserted that such were royal residences. This is not borne out at Tara, Ailinn, Cruachan, Boruma, or Grianan Lachtna.

[3] Also Lisnagry and Roolagh, near Killaloe, but in Co. Tipperary, *supra*, vol. xxix, p. 211.

[4] Also Lisnaeagaun, near Kilkee; it does not exceed 16 feet in height.

[5] Unless there was one, as I suspect, on the Turret Rock of Doonass, Dun easa danainne, in the eleventh century, the Rock of Astanen in the reign of Elizabeth (Fiants), where in later days a peel-tower stood till 1655. All early remains have disappeared into eighteenth-century terraces and walls.

bear this out. Tradition regarded it both as a "fort" and a king's grave in 1891. Professor Macalister's excavations in the Long Stone Fort at Forenaughts[1] seem to show an apparently residential fort as a place of burial, and subsequent observance; the great motes in eastern central Europe fall into a similar category. Ballydonohan, so far as Ireland is concerned, seems to be unique; a somewhat similar example has been recorded in France; but the French antiquaries could only affirm my comparison of it with Ballydonohan. I strongly suspect that the latter was connected with some observance, but the subject of "temple forts" in Ireland is completely *in nubibus.* Moghane is one of the rare examples of a great tribal fort or hill-town; they are very rare in Ireland, though some English antiquaries imply that they, and not the small fort, are the ancient type, and that the "private castle" (i.e., the small ring-fort, residence rather than castle) represents the feudal stage of society. In Clare, at least, tribal conditions, so far as hereditary residences are involved, subsisted till late in the fourteenth century, the period of the great rentals; the peel towers from 1430 onward mark the change. Moghane, from the great gold find being so closely connected with it, may be dated back to perhaps the fifth century or the seventh century before Christ, if not earlier. Forts like the rude rings at Gorteen and elsewhere may well have been built down to the close of the fourteenth century of our era. Sepulchral ring-forts (like those of Creevagh, Cahernabihoonach, and the "mote" near Ballinalacken, in North-West Clare) have not yet been proved to exist in Eastern Clare.

It may be but little use to call attention once more to the wholesale destruction of the forts and dolmens. It is most unfortunate that so little can be done. The powers given to the county councils have been largely lost by local apathy and jealousies. Lawyers and agents cannot be blamed in recent sales for returning "no early remains" for townlands abounding in such, or peasants be condemned for sweeping away every relic of their country's past that stands in the way of a little gain. The county councils of Galway and Westmeath set a good example. There may be slight signs of awakening interest elsewhere. But what of the councils in those treasuries of early remains—Kerry, Clare, Sligo, and Mayo? Even where attempts were made to save some structure, they were usually frustrated by some selfish occupant. Thus, wholesale destruction has commenced, and it must brand our generation to all enlightened countries and periods as given over to greed, ignorance, vandalism, and lack of patriotism in a true sense.

It is nothing new in Irish history to find forts in ruins, for eleven centuries ago Oengus, son of Oengoba, wrote:—"Temar's mighty *brugh* has

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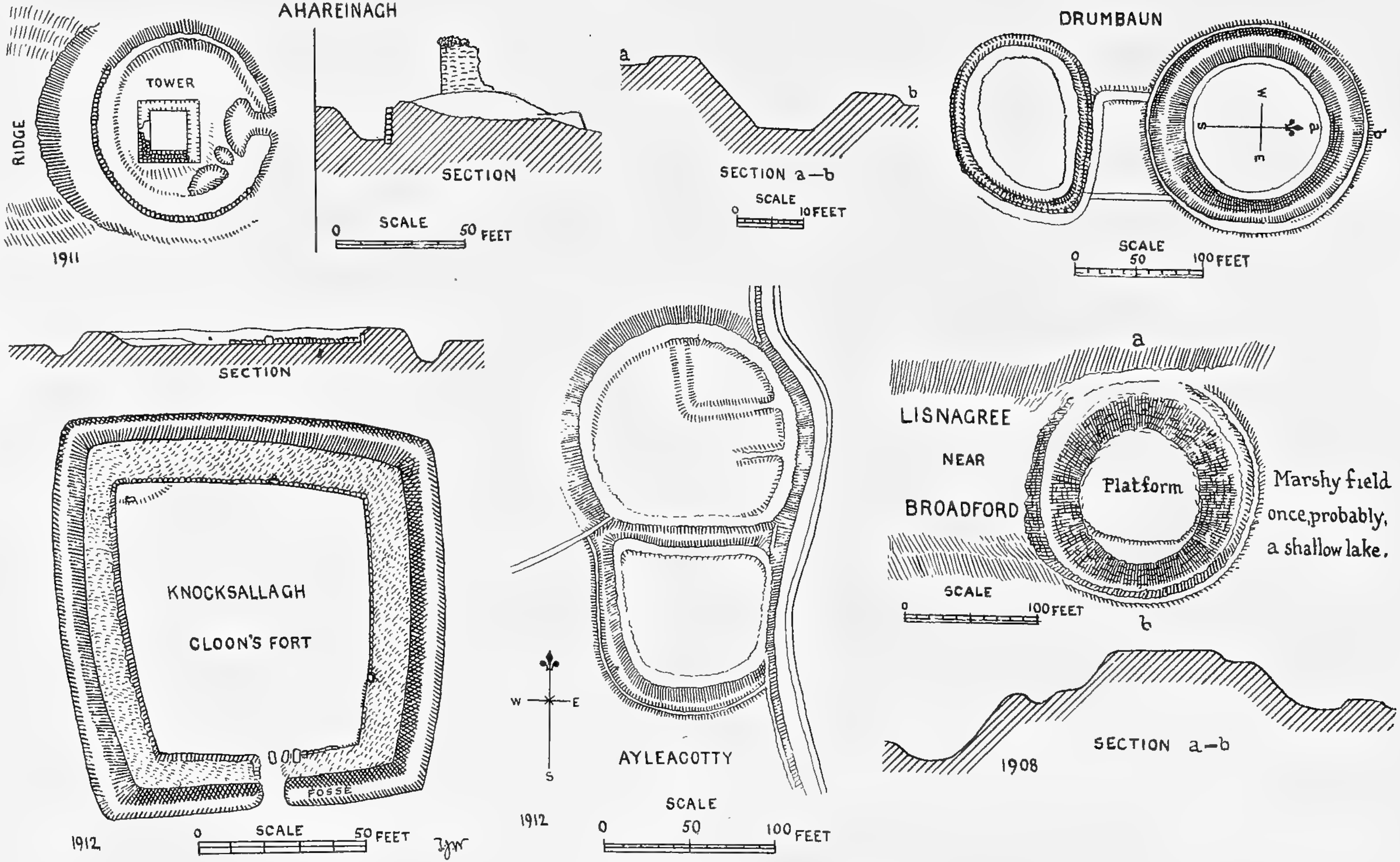
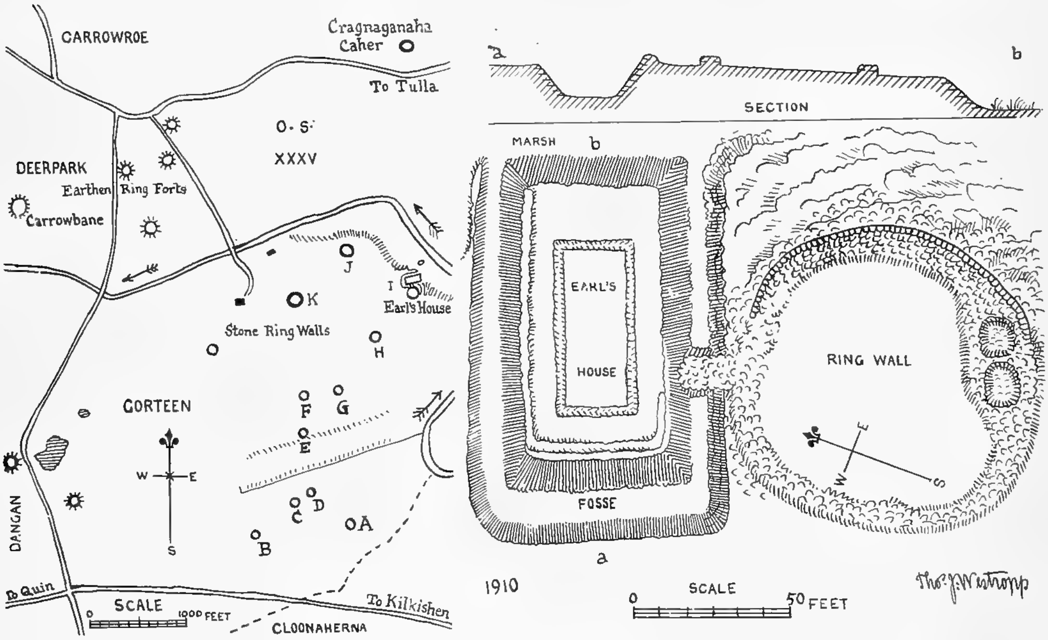
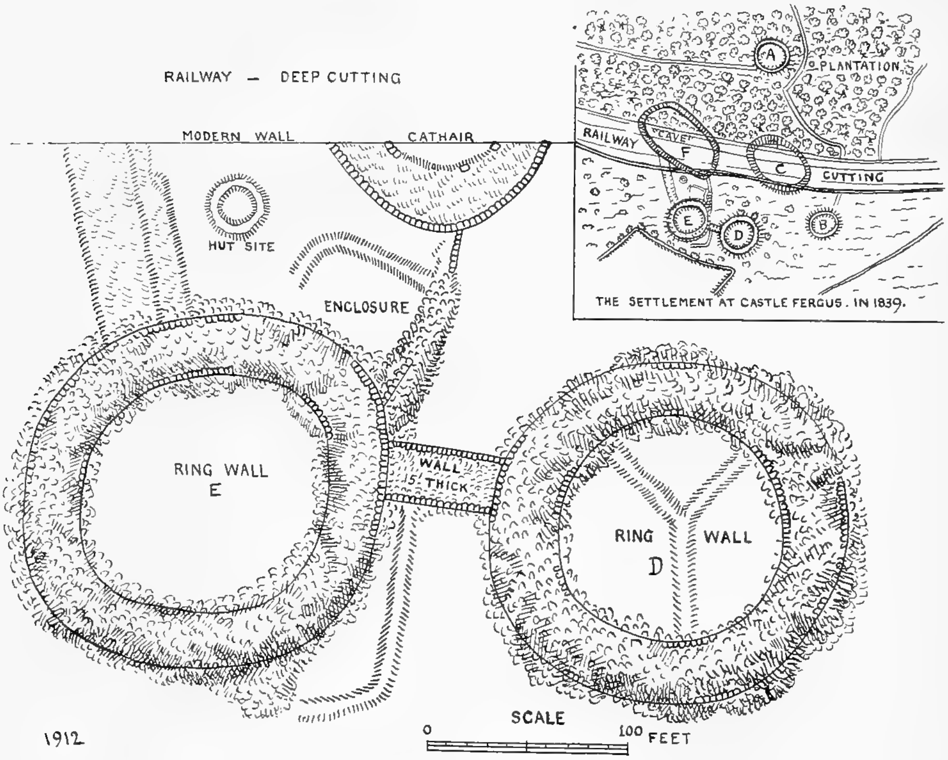
[1] *Supra*, vol. xxx, p. 351; also Borlase's "Dolmens of Ireland," vol. ii, p. 422.



Westropp.—Ring-forts in Eastern Clare.

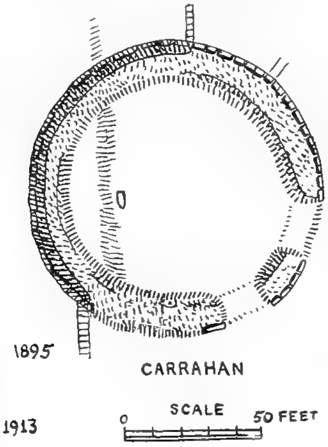


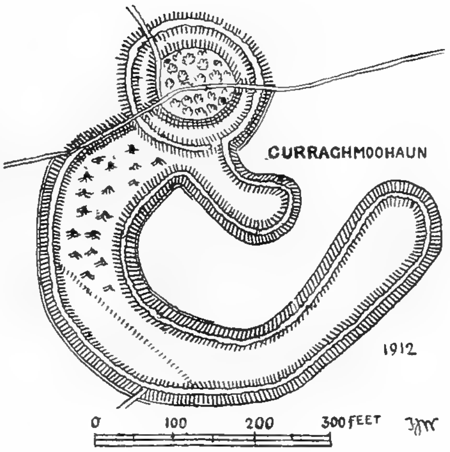
Gorteen group of Forts.

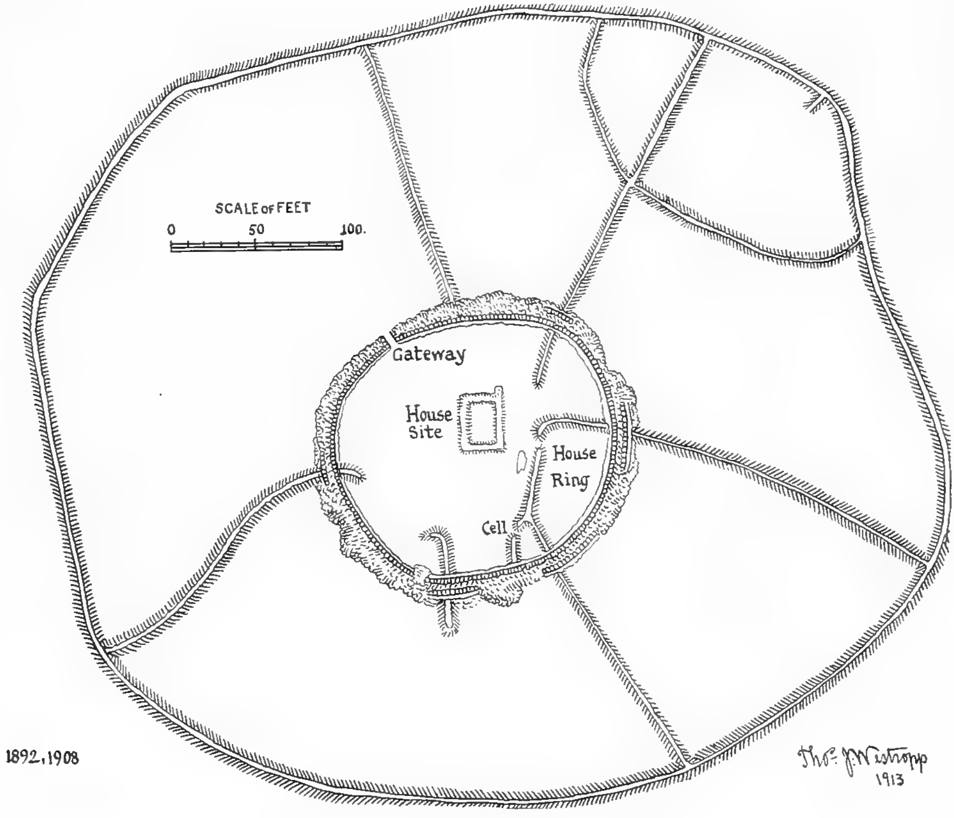


Castle Fergus group of Forts.

Westropp.—Ring-forts of Eastern Clare.







Cahershaughnessy.

Westropp.—Ring-forts of Eastern Clare.

perished, Rathcruachan has vanished, Ailinn's proud *brugh* has perished, Eman's *brugh* has vanished, save that its stones remain. The gentile's proud *cathairs,* whereon great duration was wrought, *they* have perished."[1] In "The Fate of the Children of Lir" we read:—"Nothing remained (of Sid Fionnachad) but unroofed green raths and forests of nettles."[2] Finn found the fort of Fornocht destroyed and grass-grown. No need to cite many other such statements. It is, however, I fear, a new thing that those sprung from the old races should be systematically carrying out a vast destruction rarely attempted, save on a small scale, by men of alien blood. The old beliefs that for ages guarded the forts and dolmens have nearly died; but no enlightened feeling has as yet taken their place. It is the duty of every Irish antiquary to cry for help while there is yet time to save the unvalued, but invaluable, heritage which the ages have handed over to us from the remote past of Ireland.[4]

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[1] "Calendar of Oengus" (R. I. Acad. Trans., p. xxix), Introduction. See editions by Whitley Stokes in our Transactions and the Henry Bradshaw Society. He fully confirms the traditional date in the latter edition.

[2] Proceedings, *supra,* vol. i, ser. ii, (1870-79), p. 217.

[3] "Dind Senchas" (ed. Whitley Stokes) in "Revue Celtique," vol. xv, p. 327.

[4] I must again record my thanks to Rev. John Bolton Greer for constant help in collecting these notes.

NOTE ADDED IN PRESS.

Mr. Hubert T. Knox tells me that the western fort of Mucklagh has a curved work similar to Curraghmoohaun, though less bent, and there are no attached earthworks. It is near Cashelmanannan and Rathcroghan.

V.

ON THE SO-CALLED PSALTER OF ST. CAIMIN.

By M. ESPOSITO, B.A.

PLATE VII.

Read June 23. Published September 12, 1913.

I.

The fragmentary ms. known as the *Psalter of St. Caimin*,[1] now preserved in the Library of the Franciscan Monastery, Merchants' Quay, Dublin[2] (MS.A.i), was first mentioned in 1639 by Ussher[3] and Ware.[4] The latter states that it was then "among the books of the Convent of Franciscans at Donnegall," but it is not clear whether he had himself seen it there. Ussher's account may be quoted in full:—"Habebatur psalterium cujus unicum tantum quaternionem mihi videre contigit, obelis et asteriscis diligentissime distinctum, collatione cum veritate Hebraica in superiore parte cujusque paginae posita, et brevibus scholiis ad exteriorem marginem adjectis. Atque illud S. Cammini manu fuisse descriptum communi traditione ferebatur."

The statement that this ms. contains a collation with the original Hebrew text is utterly false, and affords another proof that Ussher's works should only be used with extreme caution.[5]

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[1] St. Caimin of Inis Cealtra is believed to have died about 653. No separate accounts of his life, either Latin or Irish, are now in existence, and practically nothing is known about him. His name does not appear in the Bollandists' invaluable *Bibliotheca Hagiographica Latina* (3 vols., Bruxelles, 1898–1911).

[2] The valuable collection of mss. preserved in this Library has not yet been thoroughly catalogued. Some are not even mentioned in the very summary and inaccurate index published by Gilbert (*Historical MSS. Commission, Fourth Report*, 1874, Appendix, pp. 599–613). It is much to be regretted that none of the libraries of Dublin have as yet published accurate catalogues of their mss. The *Catalogue* put forth by Trinity College in 1900 is an almost worthless production, as I have pointed out in the *Revue des Bibliothèques* and elsewhere.

[3] *Works*, vi, p. 544.

[4] *Works*, vol. ii, ed. Dublin, 1746, *The Writers of Ireland*, p. 32.

[5] Ussher's statement was relied upon by G. T. Stokes (*Proc. R. I. Acad.*, Series iii, vol. ii, 1892, p. 195) to assert that Hebrew was known in Ireland in the early Middle Ages. Elsewhere (*Studies*, i, 1912, pp. 665–683) I have shown that there was no serious knowledge of either Greek or Hebrew in mediaeval Ireland. The writings of G. T. Stokes, like those of Ware and Ussher, are now of little historical value (cf. *Studies*, *loc. cit.*).

The fragment was seen by Colgan[1] before 1645, but whether he had access to it in Donegal or Louvain does not appear. His expression is "*propriis oculis conspeximus.*" At the bottom of folio 1*a* is a much-faded note, *Ex libris Conventus de Dunnagall*, possibly in Colgan's handwriting, and in the lower margin of folio 2*a* occurs the following interesting memorandum in Irish in the writing of Michael O'Clery :—

"Do réir ghnathchuimhne chloinne mheic Bruaidedha Flann & Bernard amhail do chualattar aga nathair & ag cach go coitchionn as é Caimin naomh o Inis Cealtra for Loch Deircc Deirc i tTuadhmumhain do scriobh an leabhar ina raibhe an duillennso. Ni machtn*adh* firinne do bheith acc an ǽs ealadhna sin oir is i tTermonn Chaimin atad i nionatacht & i naitreabhadh & ȧ sinnsir rempa. As fiadhain meisi an brat[h]air bocht Michel O Cleirigh go ffacadhas fein mac Bruaidedha na comhn*uidh*e i tTermonn Caimin. & a chlann iar na ecc som. As iadsein & Diarmait O Duibhcert[aigh ?] dorad na duilleanna so do leabhar Caimhin damsa an brathair remhráite & guidhedh gach aon dia ffeicenn iad ar ar nanmannaibh diblinibh."[2]

"According to the tradition of the family of MacBruaidedha, Flann and Bernard, as they heard it from their father and from everyone generally, it was the holy Caimin of Inis Cealtra on Lough Derg in north Munster who wrote the book in which this leaf was. It is not surprising that these learned folk should know the truth, for it is in Termonn Caimin they and their ancestors before them have been settled and in residence. I the poor Brother Michael O'Clery am witness that I myself have seen MacBruaidedha[3] dwelling in Termonn Caimin and his children after his death. They and Diarmait O Duibhceartaigh it was who gave these leaves of Caimin's book to me the aforesaid Brother,[4] and let everyone who sees them pray for both our souls."

The exact date at which this memorandum was written cannot be determined, but it must have been there before 1639—the year in which Ussher and Ware drew attention to the MS.—and it was from this source that they and certain more recent and equally credulous writers derived their information as to its supposed origin. The MacBruaidedha from whose

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To the Rev. H. J. Lawlor, D.D., D.Litt., belongs the merit of having successfully established this fact (cf. the notes appended to his edition of *Ireland and the Celtic Church*, 1907). I may, however, remark that he has far from succeeded in correcting all the errors contained in Stokes' book.

[1] *Acta Sanctorum Hiberniae*, i, 1645, p. 746.

[2] My friend Mr. R. I. Best has very kindly collated my transcript with the original, which is in places somewhat effaced and difficultly legible. The English translation is also due to the kindness of Mr. Best.

[3] I have not been able to trace the date of the death of this personage.

[4] From this it would appear that O'Clery had made another visit to the dwelling of MacBrody after the latter's death.

sons O'Clery got the leaves is the Conner MacBrody whose name appears in the *Testimonia* prefixed to the *Martyrology of Donegal*,[1] and to the *Annals of the Four Masters*.[2] These *Testimonia* are dated 11th November, 1636.

It appears to be equally impossible to ascertain at what date Michael O'Clery carried these fragmentary leaves over to the Irish Franciscan Convent of Saint Antony of Padua at Louvain,[3] where he died in 1643. Among the parchment MSS. found in the chamber of O'Clery's compatriot Colgan, who died in the same monastery in 1658, were "*Folia aliquot Hibernica, aliquot Latina*."[4]

It is possible that our fragments were among these *folia*; at any rate, they and the other Irish MSS. collected by O'Clery and his companions remained at Louvain down to the period of the French Revolution, when the collection was broken up, part of the MSS. being taken to Brussels and the remainder to the Franciscan Monastery of Sant' Isidoro, Rome.[5] Our Psalter found its way to the latter establishment, where it remained unnoticed till the entomologist Westwood[6] in 1868 devoted a few lines to describing it. He said nothing about its traditional origin, and correctly assigned it to the eleventh or twelfth century.

Shortly afterwards (1870) Cardinal Moran published an uncritical and inaccurate account of it in his *Biblical MSS. of the Early Irish Church*.[7] He believed it to be a genuine relic of the time of St. Caimin.

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[1] Ed. Reeves and Todd, 1864, p. li. [2] Ed. O'Donovan, i, 1851, p. lxix.

[3] No thorough study of the noble and remarkable work carried on by the Irish Franciscans and their associates at Donegal and Louvain in the middle of the seventeenth century for the preservation and elucidation of the documents dealing with their country's ecclesiastical history has as yet been made. We remain still in the dark as to most of the details of the careers of Fleming, O'Clery, Colgan, Ward, &c. The best general account of the movement is that of De Buck, *L'Archéologie irlandaise au couvent de Saint-Antoine de Padoue à Louvain* (Extrait des *Études religieuses, historiques et littéraires*, Paris, 1869).

[4] Gilbert (*Historical MSS. Commission*, *Fourth Report*, 1874, Appendix, p. 611).

[5] Those who wish to study the history of the Irish monastery at Louvain may read the *Irish Ecclesiastical Record*, vii [1871], pp. 31–43, 56–77, 193–216, 268–289; Gilbert (*loc. cit. supra*, pp. 599–613); Murphy (*Journ. R. Soc. of Antiquaries*, xxiii, 1893, pp. 237–250). These articles are not of much value, and a critical study of the original documents has yet to be made (cf. Tourneur, *Bibliothèque de la Faculté de Philosophie et des Lettres de l'Université de Liège*, Fasc. 15, 1905, pp. 61–66). From what has been stated above it seems most probable that O'Clery got the MS. from the sons of MacBrody in or about the year 1636, and had deposited it in the Donegal monastery before 1639. Ussher had seen it before the latter year, but he does not tell us where. It is possible that he was shown it by O'Clery, with whom he is known to have had relations. The latter may have taken it to Louvain in 1643.

[6] *Facsimiles of Miniatures and Ornaments of Anglo-Saxon and Irish MSS.*, 1868, Text, p. 88.

[7] *The Atlantis*, No. ix, 1870, pp. 77–79. The whole essay is full of errors and is of little value.

The first attempt at a really critical study of the MS. was made in October, 1871, by the Italian Celticist Nigra, who spent several hours in the Monastery of Sant' Isidoro. He discovered the Irish glosses in the MS., and assigned it to the middle of the eleventh century. Nigra's results were only published in 1885 by D'Arbois de Jubainville.[1] Shortly afterwards D'Arbois contributed a further note on the glosses.[2]

In the meantime, in 1872, by permission of the General of the Franciscan Order, all the Irish MSS. at Sant' Isidoro were transferred to the Franciscan Monastery, Dublin, where they now are.

The Celtic scholar Hennessy[3] published in 1873 a superficial account of the MS., and in the following year Gilbert mentioned it briefly.[4] Neither of them questioned its traditional antiquity.[5] Some years later (1884) Gilbert[6] reproduced four lines from the first page and a number of ornamental capitals.[7] He then stated that it "can scarcely be ascribed to a date so early as that of St. Caimin."[8] The MS. was seen in 1897 by Bruun,[9] who correctly dated it "about 1100"; and finally the Irish Glosses were edited by Stokes and Strachan,[10] and Gwynn,[11] who supplied no information as to its date or characteristics.

II.

The "Psalter of St. Caimin" consists of six unbound and dilapidated folios of fairly thick parchment, which appear to be now undergoing a process of gradual decomposition, no doubt the effect of dampness. These leaves contain a portion of Psalm cxviii (verses 1–16 and 33–116) in the Vulgate version with marginal and interlinear commentaries and scholia, and some Irish glosses. The latter are on folios 1*a*, 3*a*, 4*a*, 5*a*, 5*b*, 6*b*. The *format* is large folio, the largest page measuring 36 cms. × 26. A modern hand has numbered the pages in the lower margins 1 to 12. The ruling cannot be clearly discerned. The text of the Psalm is written in long lines in a large and beautiful semi-uncial Irish hand,[12] the ordinary letters being nearly a

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[1] *Bibliothèque de l'École des Chartes*, xlvi, 1885, pp. 344, 345.

[2] *Revue Celtique*, vii, 1886, p. 96.

[3] *Irish Ecclesiastical Record*, ix [1873], pp. 241–247.

[4] *Historical MSS. Commission, Fourth Report*, 1874, Appendix, p. 601.

[5] Hennessy expressed a doubt as to its being the actual work of St. Caimin, but stated that it was certainly as old as the Book of Kells.

[6] *Facsimiles of National MSS. of Ireland,* part iv, 2, 1884, Appendix, plate xxii.

[7] The reproduction is of little value from the palaeographical point of view.

[8] *Loc. cit.*, Introduction, p. cxii.

[9] *Enquiry into the Art of the Illuminated MSS. of the Middle Ages*, part i, 1897, pp. 83, 84.

[10] *Thesaurus Palaeohibernicus*, i, 1901, pp. xiv, 6.

[11] *Ériu,* 1910, iv, p. 182.

[12] Compared with the beautiful rotund hands of such early MSS. as the Books of

centimetre in height, and the capitals sometimes double that. The line of writing varies from 7·5 to 18 cms., and (not counting the commentary and notes) there are from 14 to 18 lines of text to the page. In the text we find a number of ornamental signs employed here and there to fill up space, thus: : ÷ ∸ : ⁜ . . . ; and as *signe de renvoi* to the marginal scholia ⊙ written under or above the word commented upon. Sometimes two dots are placed over or under letters (e.g. ë) where no expunctuation is intended. The punctuation is marked by the three signs ., .., . and the words are clearly separated. A calculation shows that assuming this MS. to have once contained the whole Psalter, it must have consisted of about 216 folios. Indeed, it must have been one of the finest of the later Irish MSS. Each of the sections into which this Psalm is divided begins with a large illuminated letter, and each verse with an ornamental capital of smaller size. These illuminated initials are in the style of those of the Psalter of Ricemarch, which was written at the end of the eleventh century.[1] The outlines are in black, sometimes with a beast's head at one end, while the other terminates in a simple spiral development. The interior spaces are filled in with patches of red, yellow, purple, and green. Of the ancient geometrical pattern work, etc., there is little or no trace.

With regard to the date at which these leaves were written. A glance at the MS. is sufficient to convince anyone acquainted with the palaeography[2] of Irish MSS. that the tradition connecting it with St. Caimin's time must be dismissed at once. When we proceed to make a more careful study of the writing—more especially of the pointed Irish minuscules of the prefaces and marginal scholia, which were evidently written at the same time as the text, and probably by the same hand—and of the *compendia scribendi* and illuminations, we are led to the conclusion that this MS. must be assigned to the latter portion of the eleventh or to the twelfth century. It exhibits the closest resemblance in general details to such MSS. as the Trinity College and Franciscan Libri Hymnorum,[3] the Gospels of Maelbrigte,[4] the Vatican

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Lindisfarne and Kells, the writing of our fragments appears degraded and betrays at once its late origin. The same thing is to be said of the ornamental initials.

[1] Cf. Lindsay (*Early Welsh Script*, 1912, p. 64).

[2] We are still without a scientific and exhaustive work on Irish palaeography. Much preliminary ground has been already broken by the admirable researches of Traube and Lindsay. A complete catalogue of all the extant Latin MSS. written in Irish, or at least insular, hands would be of great utility. The list of such MSS. preserved in Continental libraries given by W. Schultze (*Centralblatt für Bibliothekswesen*, vi, 1889, pp. 287–295) is neither complete nor always accurate. Workers on this subject will find Dom Gougaud's *Répertoire* (*Revue Celtique*, xxxiv, 1913, pp. 14–37) very useful.

[3] Cf. Bernard and Atkinson (*Irish Liber Hymnorum*, i, 1898, plates i, ii).

[4] Thompson (*Introduction to Greek and Latin Palaeography*, 1912, p. 382). Compare also the A hand of the Lebor na hUidre distinguished by Best (*Ériu*, vi, pt. 2, 1912, plate i).

Psalter[1] (Palatinus lat. 65), etc., all of which date from this period. On the other hand, we find none of the distinctive characteristics of the Irish MSS. of the seventh, eighth, and ninth centuries.

f. 1a: 35 cms. × 25; *Beati—iustitiae tuę* (Ps. cxviii, 1–7); 118, 7 *dedici* for *didici*; has suffered much from damp, the marginal notes being partly illegible.

f. 1b: *Iustificationes—tuos* (8–16); 11 *abscondidi* for *abscondi*, 16 *in tuis iustificationibus* for *in iustificationibus tuis*; between ff. 1b and 2a a leaf is missing.

f. 2a: 36 × 26; *Legem—Domine* (33–41); 35 *semita* for *semitam*, 39 *iocunda* for *iucunda*, 40 *et in* for *in*.

f. 2b: *salutare—tuis* (41–48); 47 *meditabor* for *meditabar*, *que* for *quae*, 48 *que* for *quae*, *mirabilibus* for *iustificationibus*.

f. 3a: 35·5 × 26; *Memor—dixi* (49–57); 54 *perigrinationis* for *peregrinationis*, 55 *in nocte* for *nocte*, 57 *dominus* for *domine*.

f. 3b: *custodire—tuum* (57–65); 62 *iustitię* for *iustificationis*, 64 *tua* is omitted; *Domini* for *Domine*.

f. 4a: 30 × 26; *Bonitatem—argenti* (66–72); 67 *ego custodiui* for *custodiui*, 72 *milia* for *millia*; the lower margins of this folio have been somewhat cut away, but the writing has been spared.

f. 4b: *Manus—confundar* (73–80); 73 *ut discam* for *et discam*, 74 *uerbo tuo* for *uerba tua*, 80 *inmaculatum* for *immaculatum*.

f. 5a: 31 × 25·5; *Defecit—tui* (81–88); 81 *in uerbum* for *et in uerbum*, 82 *consolaueris* for *consolaberis*, 85 *et lex* for *ut lex*.

f. 5b: *In—Domine* (89–97); 90 *generatione* for *generationem*, 92 *perisem* for *periissem*, 93 *oblifiscar*[2] for *obliuiscar*, *iustiones* for *iustificationes*, 96 *omni consummationi* for *omnis consummationis*.

f. 6a: 34 × 26; *toto—tuę* (97–106); 97 *toto* for *tota*, 100 *exquisiui* for *quaesiui*, 105 *tuum Domine et* for *tuum et*.

f. 6b: *Humiliasti—uiuam* (107–116); 107 *humiliasti* for *humiliatus sum*, 109 *tuis* for *meis*, 110 *a* for *de*, 114 *in uerbum* for *et in uerbum*. This page has suffered much from damp.

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[1] The similarity to this MS. is very close; cf. Bannister (*Pagine Scelte di Due Codici*, Tav. i–iv, ap. *Codices e Vaticanis Selecti, Series Minor*, ii, 1910); Ehrle et Liebaert (*Specimina Codicum Latinorum Vaticanorum*, 1912, Tab. 24, and p. xxi). Cf. also W. Stokes (*Academy*, xxxv, 1889, p. 26); Bannister (*Journal of Theological Studies*, xii, 1911, pp. 280–284; *Zeitschrift für Celtische Philologie*, viii, 1911, pp. 246–259); Lindsay (*Zentralblatt für Bibliothekswesen*, xxix, 1912, p. 62).

[2] Whitley Stokes, Warren, and others have tabulated lists of mis-spellings found in Irish MSS., which they regarded as characteristic Irish Latinisms. It is well, however, to remember that many of these forms occur in MSS. of undoubted Anglo-Saxon and even Continental origin; cf. Hessels (*Academy*, 1895, xlviii, p. 12).

The following is a list of the *compendia scribendi* which occur in this MS.[1] :—

I. Compendia Scribendi in the Text.

ae : ę.
am : ā.
anima : a̅i̅a̅.
auerte : aūte.
autem : h̄, ḧ̄, autē.
bene : ƀ.
con : ɔ.
dei : dī.
derelinquentibus : derelinqn̄tibꝫ.
domine, domini : dn̄e, dn̄i.
eius : ɔ̵.
eloquia : eloꝗ.
em : ē.
enim : ⫲
est : ?̣
et : &[2]
facta : fc̄a.
forte : f̄te.
in : ī.
laqueum : laq̄ū.
lumen : lum̄.
mea : mͣ.
meum : m̅m̅.
mihi : mᷝ.
ne : n̄.
nominis : no̅i̅s.
non : n̄, N̄.

oculos : oclo̅s̅.
omnium : ōium.
per : ꝑ, p̃.
pre : p̄.
pro : ꝓ.
propter : p̄p̄.
propterea : p̄pea (f. 6 a); p̅p̅e̅a̅ (f. 4a).
quam : ꝗ.
quando : qn̄.
quae, que : q̄ ; q3 (f. 6 b).
qui : qͨ.
quia : ꝗ.
quod : ꝙ.
quomodo : qm̄o.
quoniam : qm̄.
–rum : r̄.
–runt : rt̄.
saeculi, saeculo : sçlī, sclō.
secundum : sc̄dm, ÷.
sicut : sͥ.
sum : S̄.
sunt : st̄.
super : s̄r.
terra : t̄ra.
tibi : t.
timentium : tim̄tium.
tua, tuo : tͣ, tͦ.

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[1] With this list compare that of the *compendia* found in the Vatican Psalter drawn up by Bannister (*Zeitschrift für celtische Philologie*, viii, 1911, pp. 246-259). It will be seen that the two MSS. are closely related. Bannister assigns the Vatican MS. to the end of the twelfth, or even beginning of the thirteenth century. Our fragments would appear to be somewhat earlier. They are certainly earlier than the Corpus Christi, Drummond, and Rosslyn missals edited by Warren, Forbes, and Lawlor.

[2] For this symbol see the facsimile appended to this paper (lines 5, 7, 10, 14).

tur : tꝰ.
uerbum : ūbum.
um : ū.
us : ʒ.

usquequaque : usqͣque (f. 1 b); ūsquaque (f. 2 b); ūsqͣque (f. 3 a); ūsquaqʒ (f. 6 b).
ut : uͭ.

II. Additional Compendia in the Minuscule Commentaries.

ante : an̄.
antequam : an̄ꝗ.
argenti : a̅r̅ (f. 4 a).
aut : ā.
auerti, autem : aū.
ber : ƀ.
bono, bonum : ƀo, bōm.
Christus : Xp̃s.
cognoui : cogn̅o̅.
cuius : cs̄.
dicit : dt̄.
dicitur : d̅r̅.
dictum : dc̅m̅.
ecclesia : ęcła.
ergo : gͦ.
et : 7
faceres, factus : fc̅r̅es, fc̄s.
fraudes : fͣudes (f. 3 b).
frequenter : freqn̄t (f. 3 b).
gra– : gͣ, g̋.
gre– : g̃.
gur– : gᵓ.
haec : ħ.
hoc : ḣ.
hominum : ho̅i̅um.
ideo : idō.
igitur : igᵓ.
im– : ī.
ingreditur : ingḡdit’.
ipsum : ip̃s.

littera : lit̅t̅a.
misericordia : mi̅s̅da, misericor̅.
nobis : noƀ.
nomen, nomine : nom̄, noē.
nostra, nostris : nr̅a̅, nr̅i̅s.
nunc : n̅c̅.
omni, omnia : o̅i̅, o̅i̅a, om̄a.
particeps : partī.
populos, populus : plo̅s̅, płs.
postquam : pͭꝗ.
potest : pt̄.
pri–, primum : pͨ, pͨmum.
qua : qͣ.
quare : q̅r̅e.
quo : qͦ.
rerum : r̅r̅.
respondit : respo̅n̅.
sancta, sanctis, sanctorum: s̅c̅a, s̅c̅i̅s, s̅c̅orum.
scilicet : .S.
secundum : ¥.
sed : s̄.
sicut : s̄ut, s̄⁷.
suis : s̅s.
supra : s̅r̅a̅.
tanto : t̅n̅o.
ter : t̄.
uel : ƚ.
uer : ūr.
uere : ūe.

With regard to the marginal and interlinear commentaries.[1] To verses 1, 9, 41, 49, 57, 65, 73, 81, 89, 97, 105, 113, are prefixed short arguments. Owing to the loss of the beginning folios, the argument to verse 1 commences abruptly thus:

[f. 1a] . . . ut meritum diuini carminis honore tituli possit agnosci. Est enim ebreis elimentis ad rudes et docibiles in scola Christi populos instruendos tali ordine depictus ut ab unaquaque littera octoni uersus incipiant, etc. (cf. Cassiodorus, *In Psal.*, P.L. 70, 835B, C).

The argument to 41 runs thus:

[f. 2a]: Vau et ipse postulat congregatio sancta salutarem sibi Dominum debere concedi, ut inimicos de tanta remuneratione confundat et in lege assidua meditatione proficiat ipse ergo dominus atque saluator (*loc. cit.*, 849D).

Between the lines are brief notes and in the top and side margins are longer comments.[2] The following examples will suffice:

[f. 2a, on verse 37]: His̄: Ecce fecisti me concupiscere mandata tua et non diuitias mundi. Et inequitam in amore Dei et proximi. Vel equitas tui est confirmare me in mandatis tuis dum concupiui ea.

[f. 3a, on 57]: Portio a parte dicta est; illius enim partis sumus cuius uoluntatibus obaudimus; quod uerbum frequenter inuenis dictum, ut est illud: Filiis Leui non erit portio, neque sors in medio fratrum eorum, quia Dominus Deus est pars eorum uel portio (*loc. cit.*, 855A).

[f. 4a, on 70]: Coagulatum[3] est sicud lac cor eorum; agulum, coagulum compositum a con et agulum uel agelo cogilatum.[4]

My thanks are due to Mr. R. I. Best for assistance and advice during the compilation of this paper. To the Rev. Father T. A. O'Reilly, O.F.M., I am much indebted for allowing me liberal access to the MSS. in the Library of the Franciscan Monastery, Dublin.

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[1] These scholia are not original, but are extracted from the various patristic commentaries. Thus the passage on f. 1a: *Iosephus autem refert in libris αρχαιολογιας hunc psalmum et cxliiii*, etc., does not prove that the writer had read Josephus. He has merely copied it from the Pseudo-Hieronymian *Breviarium in Psalmos* (Migne, *Patrol. Lat.*, 26, col. 1187C); cf. D'Arbois (*Revue Celtique*, vii, 1886, p. 96).

[2] To some of these comments are prefixed the letters H or his̄.

[3] Above this word is written *obduratum*.

[4] Lege *a gelu congelatum*.

TRANSCRIPTION OF PLATE VII.

(*a*) TEXT WITH INTERLINEAR SCHOLIA.

custodire legem tuam.,
ut implerem legem
Deprecatus sum faciem tuam in toto
deprecatus hoc dixi
corde meo. miserere mei
promisionis tuę
secundum eloquium tuum.,
īnuenit quod petit dum non obliuiscitur opera dei. s. quod ego non potui a uia iniquitatis sensus meos
Cogitaui uias meas et conuerti
in hanc uitam ueni
pedes meos in testimonia tua
timore persecutorum
Paratus sum et non sum turbatus.
ut custodiam mandata tua
impedimenta demonum et hominum et persecutorum
Funes peccatorum circumplexi sunt
fidem que per dilectionem operatur
me et legem tuam non sum oblitus.,
de profunda tempestatione
Media nocte surgebam ad confiten
scio quod tribulor ad me iustificandum
dum tibi super iudicia iustitię tuę.,
Christus dicit qui particeps carnis humanę uel temptationis ut homines mandata custodirent et timerent
Particeps ego sum omnium timentium
te et custodientium mandata tua.,
dum iustificat impios
Misericordia domini plena est terra.
ut perficiam
iustificationes tuas doce me.,.

Teth bonum. Bonitatem. Populus beatus nonam litteram cantaturus ingreditur. In qua gratias agit humiliatum se fuisse ut ad iustificationes domini deuotissimus perueniret. Testimonia eius asserens sibi supra omnes esse diuitias nomenque presentis litterę pariter exponens. Bonum suum dicit uerbum dei humiliter meditari., [Cassiodorus, *loc. cit.*, 857B].

uox sanctorum in tribulatione digentium qui in aduersis probantur
Bonitatem fecisti cum seruo tuo
ut bonum me dilectaret
promisionem
domine secundum uerbum tuum.,

(*b*) MARGINAL SCHOLIA.

$\overline{\text{et}}$ (?). Vt custodiam uerbum'tuum. D. S. uultum. t. i. c. m. m. m. secundum e. t. Recogitaui u. m. ⁊ (?) conuertisti. p. m. ad testimonia tua. Festinaui et neglexi custodire m. t. F. impiorum implicauerunt. me. l. t. n. s. o. [*Psalterium Hebraicum*, P.L. 28, 1222c].

Medio noctis surgam. a. ɔ (?). tibi. s. iustitię tuę., P. e. s. o. t. t. et cus. precepta tua. M. tua completa est. t. precepta. d. m. Bene. f. s. t. d. s. u. t., [*loc. cit.*, 1222c–1223A].

$\overline{\text{his}}$. Faciem. presentiam tuam. nulla pars est in corde meo que te non cogitaret.,

libera me de captiuitate sicut promisisti.,

Cogitaui. confessus sum peccata per poenitentiam. et auerti. sensus meos a uia iniquitatis quia ego non potui nisi me conuertisses.,

Paratus. obeddens tibi fui et non cum tristitia.

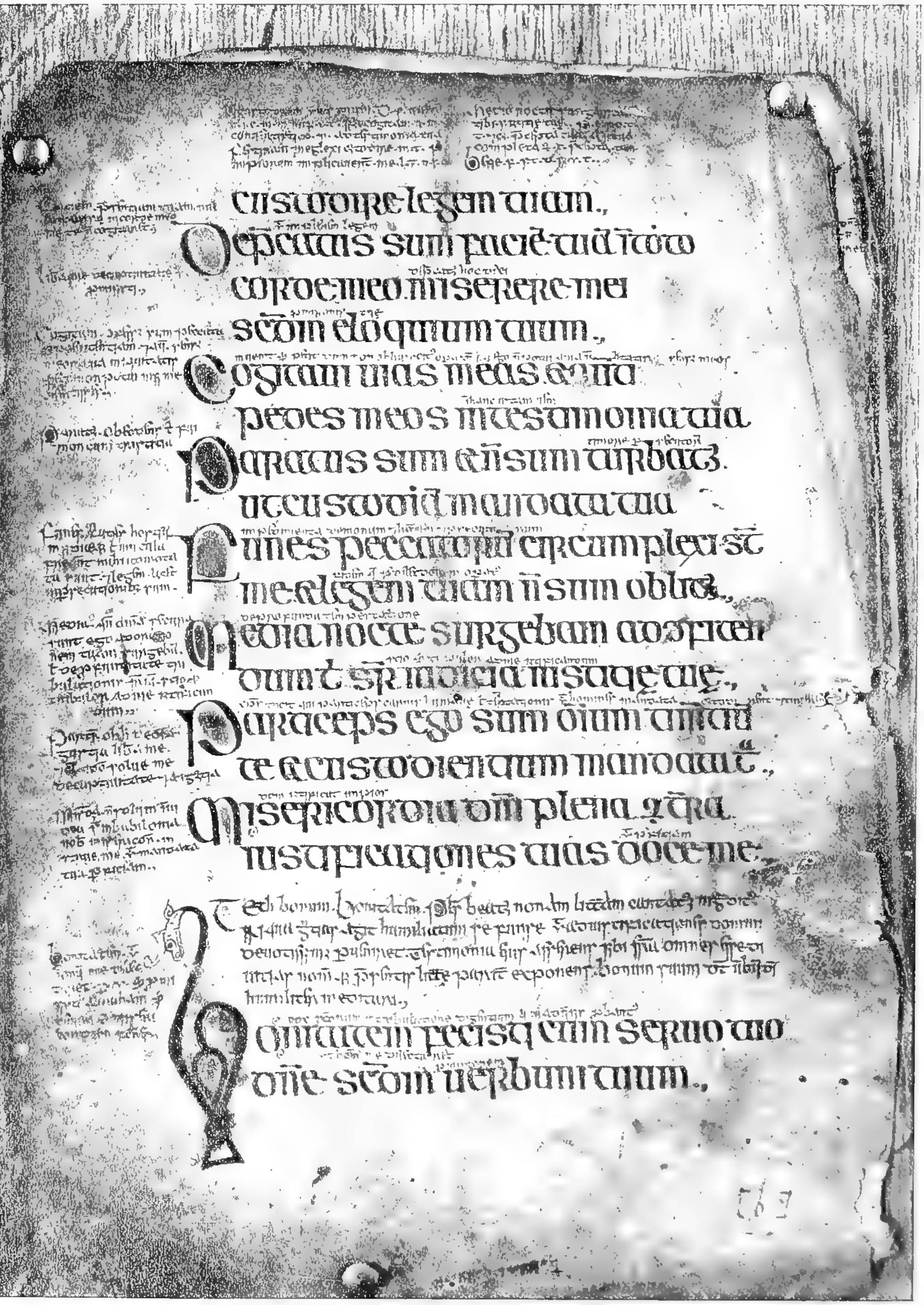
Funes. fraudes hostium insidueque uel uincula frequenter mihi admotata sunt. et legem. licet in persecutionibus sum.

Media. quando omnia secura sunt ego ad orationem tuam surgebam. uel de profunditate tribulationis. super iudicia. scio quod tribulor ad me iustificandum.,

Particeps. ob hoc de omni angustia libera me. et custodientium. ideo solue me de captiuitate et angustia.

Misericordia. non solum in iudea sicut in babilonia. nobis misericordia. instrue me ut mandata tua perficiam.,

Bonitatem. ut bonum me dilectaret secundum u. quod promisisti abraham pro semini eius misericordiam faceres.,



custodire legem tuam.,
Deprecatus sum faciē tuā in toto
corde meo miserere mei
scdm eloquium tuum.,
Cogitaui uias meas et cōuti
pedes meos in testimonia tua.
Paratus sum et ñ sum turbatus.
ut custodiā mandata tua
Funes peccatorum circumplexi sūt
me et legem tuam ñ sum oblitus.,
Media nocte surgebam ad confiten
dum t̄ sr̄ iudicia iustitiae tuę.,
Particeps ego sum omnium timentiū
te et custodientium mandata tuā.,
Misericordia dñi plena ē terra.
iustificationes tuas doce me.,

Bonitatem fecisti cum seruo tuo
dñe scdm uerbum tuum.,

Esposito.—The so-called "Psalter of St. Caimin."

fol. 3b (p. 6).

VI.

FORTIFIED HEADLANDS AND CASTLES ON THE SOUTH COAST OF MUNSTER.

PART I. FROM SHERKIN TO YOUGHAL, CO. CORK.

BY THOMAS JOHNSON WESTROPP, M.A.

PLATES VIII–XI.

Read NOVEMBER 10, 1913. Published JANUARY 23, 1914.

THE study of the fortified headlands of Ireland is one so neglected, and yet of such importance and interest, that I have especially devoted attention to it for the last eight years, besides having collected material for some of the remains from 1878 down. It was an almost untouched field in archæology, for before 1906, on the west coasts of Munster and Connacht, only three such forts had been adequately described, Caherconree and Dunbeg in Kerry and Dubh Cathair in Aranmore. There were also partial, and usually most inaccurate, brief accounts of Dunnamo in Mayo. Descriptions (usually with plans, sections, and illustrations) are now accessible for over 150 such forts; and our Proceedings have recorded many of those in Co. Mayo.[1] On that account I may crave permission to lay before the Academy a study of the forts along an important reach of the south coast. Enough is given of the history of the places to show at least their later owners, and who modified and strengthened their defences. Necessity for condensation prevents my going as fully as could be wished into the general topography, the rock-structure, or the evidences of submergence of the coast so impressive at Lislea[2] and elsewhere. I hope to draw the attention of antiquaries outside Ireland to the subject, as such turn more frequently to the Proceedings of the Academy than to other sources for special information on Irish "prehistory." Later on a sequel could be given on the other reaches of the south coast, along with a list of all the fortified headlands of the southern provinces and Connacht, and a bibliography which would place the broad lines of the subject on a fairly scientific basis.

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[1] Proceedings, vol. xxix, p. 11, and vol. xxxi, Part 2, p. 6, p. 19.

[2] Peat, full of roots and branches, is cut at low water, the bog being, it is said, 50 feet deep; roots and stems rise over the waves or lie on the beach.

It will be noted that destruction is hard at work on the forts along the Cork coast, more so even than in Kerry, Clare, or Mayo. The cultivation of land down to the very edges of the heads has led the farmers to remove the defences for building or top-dressing. On the wilder coasts cultivation is hardly possible, and the herdsman is less tempted to remove and destroy ancient remains than the farmer. Thus it is pressingly incumbent on Irish workers to secure and publish fully all that they can secure; for later generations of students will find little instruction left for them on the cliffs. There is now hope of this being well done in Co. Cork on the praiseworthy plan inaugurated by Sir Bertram Windle. Some day international study must become a force, and then the despised field records may be the current coin of the exchange, and the theories, notes of depreciated value, or cancelled.

There are some who call for "final results" at these beginnings of explorations, others who resent later history being given and "nothing about the origin or primitive builders." The time to satisfy the latter demands in full has not become possible as yet. In the historic period it were poor work to tell of the original structure and builders of a church and nothing of its restorers or adapters; this should also be recognized as far as possible in primitive buildings.

The time has not yet come to generalize about Irish forts of any description; we can only deal with each case on its own merits. Our profound ignorance may be forgiven silence, but hardly dogmatic assertions, should it venture on such, as some would have us to do. How widely such forts extend in time the few facts to hand show us clearly. Flint implements have been found in the forts at Howth near Dublin, and Shanooan near Dunmore, Co. Waterford. These may have been used by the first occupants, or may have been lost before the fort was dug or even the headland carved out of the solid land, or they may have been lost centuries after the place was fortified. Chipped flints are found on fortified headlands elsewhere, notably in the great complex fort of Trevalgue in Cornwall[1]; but they occur in others with finds even of the Iron Age. Of later periods, the Swiss and French spur-forts caps barrés) belong to the centuries from the Bronze Age down. Irish promontory-forts are recognized as prehistoric in our earliest records; we shall see this to be the case at Duncearmna. The great promontory fort of Cap Sizun (now, alas, I am told, entirely levelled) showed old Gaulish remains overlaid by those of Roman occupation at the beginning of our era

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[1] "Victoria County Histories, Cornwall," p. 452, and William C. Borlase in "Archaeologia." xliv (2), 1871-2, p. 423.

[2] "Ancient Forts of Ireland," p. 33, fig. 4.

Some of our forts were utilized by Danes, Welsh, or Normans, like the Doonegalls, Dunabrattin, and Baginbun; but it was not the Norse or Danes but "new coming nations this island shall rule that in outlying headlands abode ere the fight" of Clontarf in the "Weird Sisters' Song" of 1014.[1] Records and buildings show that occupation continued down to the sixteenth (nay, to the eighteenth) century; indeed, there is a farmhouse inside Dundeady, and lighthouses in several of the forts. Dunanore at Smerwick was made in 1579[2]; the outer works of Ballingarry in Kerry in 1638[3]; early adaptations, as at Dunbeg in Corcaguiny; and later ones, mostly of the fifteenth century, at the castles of the Dangan on Achill,[4] Dunlicka, and Cloghansavaun, Co. Clare,[5] Leck, Doon, Pookeenee, Ballybunnian, Browne's Castle, Ferriter's Castle, and Rinncaheragh in Kerry,[6] and a swarm of castles in Cork. These being the undeniable facts, it is folly to call for a theory of "the race that built the forts," or "the fort-building period."

"The race that built the forts"—the fort distribution in space forbids an answer: on the Ural Mountains in Russia; on the spurs of the Danube valley; in Bosnia, Hungary, Switzerland, France, down to the Alpes Maritimes; all over the British Isles; nay, in the New World in the spurs of the Ohio valley[7]—countless races made these most obvious of defences.

Four lists have been published. The first in 1879 by G. M. Atkinson in his preface to "The Ogham Inscribed Monuments of the Gaedhil,"[8] a careless, short, and confused list—"Dunmore, Dunbeg (Kerry), Dunworly, Duncathair (Dubhcathair, Aran), Knockadoon, Donour, Dunmanus, Dunabratton (Waterford)," and the Old Head—"all on the southern coasts" of Ireland. The second, an avowedly tentative list by Professor Macalister in 1898, in "An Ancient Settlement in Corcaguiny,"[9] gives the Big and Little Doon, Dooneendermotmore, Doonpower, Doonsorske, Portadoona, and Portadooneen in Cork. He omits the others with medieval castles. I gave a list in 1902 in "Ancient Forts of Ireland"[10] with eighteen names, and another in 1906[11] with twenty-seven. How far even the last falls short of the reality will be seen at the end of these studies. As it is, the group of the single section of the coast here given comprises in itself as many sites.

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[1] "Burnt Nial" (Niala Saga), ed. Dasent, 1900, p. 328.

[2] "The historic material is collected and the Fort del Oro described in Journal Roy. Soc. Antt. Ir., vol. xl, pp. 193–203.

[3] *Ibid.*, pp. 115, 119.

[4] Proc. R.I. Acad., vol. xxix, pp. 29–32.

[5] Journal R. Soc. Antt. Ir., xxxviii, pp. 44, 221, 222.

[6] *Ibid.*, xl, pp. 20, 24, 26, 29, 110, 206; xlii, p. 210.

[7] *Ibid.*, xxxviii, p. 31.

[8] p. 101.

[9] Trans. R.I. Acad., vol. xxxi, p. 209.

[10] p. 126.

[11] R. Soc. Antt. Ir., vol. xxxvi, p. 241.

I dare not assert completion, but at least I visited every likely site, besides long reaches of unpromising coast, and even if all the forts should not be recorded, at least I am sure that no exceptional or great fortress can have escaped so detailed a search.

Of the early districts along the coast a few must be noted. Chief of all is Corca Laidhe,[1] the O'Driscoll's country; it extended far westward, beyond our bounds, once past Mizen Head; but we begin in its political as well as its natural centre. The tribe of the Corca Laidhe[2] was of the same group as the Dartraidhe, Cabraidhe, Corcaoiche, and Cascraigh. They claimed to be of the race of Ith, son of Breogan (compare Ptolemy's "Brigantes," *circa* 250), the first of the Spanish Gaedhil to see Ireland. Their eponymous ancestor was Lughaid Laidhe[3]; his son Lughaid Maccon had a son Aenghus, "bloody spear," ancestor of the later Ui hEidersceoil or O'Driscolls. This family boasted that they were the first Christian tribe in Ireland, their clansman, Ciaran of Saighir, having been born at Clere (Clear Island, where his cross, well, church, and strand are still shown); he preceded the mission of St. Patrick, as did Declan of Ardmore, Co. Waterford, by fully thirty years. The Corcalaidhe (Corcaluighe) paid tribute to Cashel—"100 cows frisking and skipping," "sixty brown oxen," and "100 heavy hogs"; the prose version says 100 of each. Another tribute poem under their second name of Dairfhine assesses "300 oxen, 600 milch cows from the sept of Maccon."[4] These poems, attributed to the fifth century, possibly date in their present form late in the ninth (or even in the tenth) century. Finn, king of Corco Laighdi, died in 944.[5] In the early maps from the Upsal Portolan, about 1450 down, the name "Corcala" frequently appears with Baltimore and Glenbaron (or Castlehaven). The latter name must have been superseded by Corcala, as, while it appears on Angelino Dulcert's map, 1339 to 1436, the other takes its place in most of the maps from 1450 onwards. The name Korkly Balthamore is found in the decree against Finghin O'Driscoll in 1460. The pedigree of their chiefs is very broken; the connected part begins with Maccon, who died 1442; Finghin (denounced by the government in 1450[6]), 1472; Conchobhar died 1509; Conchobhar Finn; O'Mathgamhna; Sir Finghin

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[1] The classical work on this district is O'Donovan's edition of the tract in the Book of Ballymote, &c., in "Miscellany" of the Celtic Society, 1849.

[2] Cormac's Glossary, *circa* 900, gives Dairfine i (e) Corkalaigde, fine Daire Doimthig (ed. W. Stokes, p. 16).

[3] Lughaidh was king of Ireland A.D. 250.

[4] Leabhar na gCeart (ed. O'Donovan), p. 46, p. 43, p. 64.

[5] Annals of Ulster. There is a long list of Corca Laidhe chiefs from 766 to 1058 in the Annals of the Four Masters.

[6] Statute Roll, Henry VI.

in the reign of Elizabeth, and his rebel son, Conchobar O'Driscoll. Their chief was inaugurated in presence of MacCarthy More, who handed him a white rod in token of power, and took numerous imposts, down to the Elizabethan changes, "Ciod Ihye, Duff Yeeks or Black Rente, Dollysawny, and Baultynye or cess."[1] In the quaint lines of Hanmer,[2] "the Carties plaied the divells in Desmond . . . ; at length, through the operation of Satan, a bane of discord was throwen between the Carties and O'Driscoles, O'Donovaies, &c. . . ., and the Desmond in the end overcame and overtopped them all,"[3] the same vicious circle of events always recurring. The tribal land was also Cothluighe mór in 1215,[4] Coulymore, 1549. Colleymore and Colleybeg are best shown by the rural deaneries; these, in 1302, were Obathumpna, Ross, and Corkyghueragh (or Micrus to Akadun); the first lay between Thamolagi (Timoleague) and Ross-Carbery; and, in 1315, Colleymore is given as including the parishes of Myross, Glanbarahane, Tullagh (Baltimore), Creagh, Kilcoe, Aghadown, and Cleere. There were many subdivisions; from Baltimore to Loch Eidnigh (Hyne) lay Fethnahimghona, at Coosdoona; eastward lay the Ocowhigs and Ui Fithceallaigh (now Feelys and Fields) in Tuath Fithceallaigh from Dundeady to Cloghnakilty, The O'Driscolls once extended to the Old Head as the legend of Nede (*circa* 900) implies. Past Rosscarbery, or Tuath Ruis, O'Baithin,[5] or Ibane, has left its name on the maps. Round the Old Head lay Criochchursey or Courceys; past Kinsale, Kinelea;[6] beyond Cork Harbour, Imokilly.[7] As I hope, later on, to publish elsewhere a study of this most interesting coast, I will not add more to a paper confined so closely to a study of one set of remains, the fortified headlands.

TYPES OF PROMONTORY FORTS.

I ventured to put forward a classification of promontory forts at the beginning of my survey in 1906. The received English classification, in this,

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[1] Inquisition, Chancery, 1608.

[2] "Historie of Ireland" by Meredith Hanmer, D.D., Edmund Campion, and Edmund Spenser (ed. 1633), p. 201, under 1260.

[3] Overtopped even the Normans. The Lords de Courcey paid imposts to them, which the Crown, on Desmond's forfeiture, gave to the town of Kinsale. See Cal. S. P. Ir., p. 548, under June, 1588, for the imposts of the Earls of Desmond. Peyton's Survey and the great Desmond Roll abound in similar information: see Proc. R.I.A., xxvi (c), p. 72.

[4] Dublin Annals of Innisfallen, Trinity College Lib.; see also 1154, "Amlaeibh O hEidersceoil, prince of Cothluighe, slain in the gate of the church of Birr."

[5] Ui baghamna, Ui badamna, Obathumpna.

[6] Cenel Aedha, the patrimony of Barrach óсс, anciently called Insovena.

[7] Ui maccaile, or Ui mic Coille.

as in several other cases, does not meet the requirements of Ireland, as it includes crescent forts, and indeed any that use natural cliffs. In Ireland this would involve bringing together numerous types, properly classed, with far different congeners, so I have ventured to use a more elaborate classification. The types here used are—(*a*) The simple headland fort, with a single wall, or mound, with (or without) a fosse. (*b*) A similar form, but complex, with several earthworks and fosses, with (or without) a wall. (*c*) The entrenchment and citadel. (*d*) The multiple fort, with subsidiary entrenched headlands. I may add—(*e*) The platform, with a gangway natural or artificial; (*f*) The headland with a deep natural hollow at the neck; and (*g*) the fortified shore-rock, usually isolated at high water. Of these types I found no example of (*d*) in South Cork. It is, however, rare—Dun Kilmore, in Mayo; Doon Castle and Dunsheane, in Kerry; Dunabrattin, in Waterford; Baginbun, in Wexford; and the great Baily of Howth, in Dublin, virtually exhausting the list. Generally speaking, the defences are far slighter and weaker in South Cork than elsewhere: nothing like the great mounds of Bunnafahy, Doonegall, in Clare, or Dunsheane, or the walls of Dunnamo and Dubh Cathair, remains.

First Type (*a*).

The forts of the first type fall into groups, each consisting of a stone wall or of a fosse and mound. They may be grouped as curved or straight; but I do not regard the former as older than the latter, for, in many cases, the natural lines, ridges, and hollows of the site determined the builders to adopt one or other of the plans. Let us first note the curved works.

Carrigadoona, Inisherkin (Ordnance Survey Map No. 153.—Inis Sherkin, in Irish Inis Arcain (Hog Island, or Arcan's Island, if it be a proper name),[1] is the most western point included in this survey of the coast, being closely bound up with Baltimore, our starting-point. Local Irish derivation regards it as Inis Seircin, "little darling," but the evidence of documents dismisses this pretty fancy. It is not named by the early Italian maps; but the Annals give it as *Inis-arcain* in 1460; it is Inishirkan in 1534; Inisercan and Iniserc in 1570, and Inishirke in 1599. It even has a place in ballad poetry through "Inisherkin's ancient fame" being named by Davis in the tragic "Sack of Baltimore," along with "Carbery's hundred isles," and "Gabriel's rough defiles," the last being a beautiful blue dome, channelled

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[1] Arcan is possibly a personal name like "Hogg." In Irish names we have Mathgamhan, or bear; Sinnach, fox; Cu, hound; Faelchu, wolf; and several others taken from animals.

with watercourses, the most prominent feature of the bay. On Gaskanane Sound, opposite to Clear Island, in Slievemore townland, is a low but bold rock, the remnant of a far larger headland, known as Carrigadoona, the rock of the fort (*dunadh*). It is separated from the shore by a narrow, fosse-like creek, running into a low space between the raised rock platform and the plateau of equal height to the landward. A narrow heap of large, square-edged blocks lies along the end of the cove and curves across the neck to the sea; this wall is quite overthrown, and had no filling. It was about 8 feet to 10 feet thick. Just outside, on the low shelf, is a cist of the usual type, two slabs 3 feet 8 inches to 3 feet 6 inches apart, and 7 feet 6 inches long, and a second south slab to the west; it was probably 4 feet wide at the west end and about 8 feet long. The ends are torn up and the covers lie near; the interior is filled, probably by the great waves that break up through the gully. The slabs are, the southern, 4 feet 8 inches and 3 feet 10 inches long, overlapping each other by a foot; the northern is 4 feet 8 inches long. The cover slabs are 10 inches to 14 inches thick, and respectively measure 5 feet, 6 feet 2 inches each way, and 6 feet 10 inches by 4 feet. On the higher ground to the south-west is a standing slab, 6 feet 6 inches high, by 3 feet 4 inches by 8 inches, and near it four smaller slabs from 4 feet to 5 feet 6 inches long, and 12 inches wide.

PORTADOON (O. S. 151).—A small headland is defended by a curved fosse and mound about 120 feet long, on grassy cliffs in Scobaun townland. Another nearly levelled crescent wall is on the edge of a cliff above Sandycove, opposite Horse Island; but I see no reason for supposing it to be other than a wrecked ring-fort. Scobane, and the neighbouring lands of Dooneen, belonged to the O'Driscolls in early times. Fynen O'Driscoll *Carragh*, of Donalong was one of the last of the old owners who held Scoghbane in 1630. Daniel, the Mac Carthy *Reagh*, seven years later, granted it to Cahir O'Callaghan in trust. Charles, the Mac Carthy *Reagh*, succeeded, and held it down to 1651. Downing and Scobane were granted to Peter Hughes and James Malby, to whom they were confirmed in 1667.[1]

CARRIGILLIHY (O. S. 151).—It lies on the west side of the mouth of Glandore harbour, with a beautiful outlook, and is on a little headland over 50 feet high. It consists of defaced earthworks (overlaid by modern fences) and a slightly curved fosse, about 30 feet wide, running from cliff to cliff, and nearly 160 feet long.[2] Not far away in the same townland foundations of walls and

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[1] Inquis. Oct. anno v, Car. I; Book of Distribution, Cork, p. 232. Roll, xix Car. II, pars 6, *f*, No. 18, enrolled May, 1667.

[2] Plan, Plate X.

the remains of a large cemetery were found not long before 1750,[1] and Carrigullihy was held in 1641–1651 by Donagh O'Donovane *alias* Leagh.[2]

DUNNYCOVE OR DUNNYCOOHIG (O. S. 144).—A narrow, sloping spur, above a beautiful strand and row of little bays, falls precipitously to a lower rock-platform, to the south of which runs a dock-like creek, with parallel sides. Down the upper slope the fort-builders took advantage of a knoll of rock and a slight platform to make a small refuge. They dug a curved fosse, 12 feet wide, cut in the rock, and 6 feet deep to the south, but almost effaced to the north; and theyalso walled in a little platform below the rock. Later builders—probably the Barrys—built a peel-tower on the outcrop; it is now a heap of debris, sheeted with vetch, save for the north wall, which is 21 feet long and about 20 feet high. There was a turret to the south-west, commanding a small postern, and a breakneck path to the south creek. The lower platform is fenced by a wall 3 feet thick; it is 55 feet east and west, by 22 feet north and south inside.

The castle, like the others of the group, is attributed to the O'Cowhigs. The name appears as Dunhugge; "much was uncultivated, being on the march of the Irish" in 1302[3]; and Downecowhigge, 1631, in the Inquisition of David Lord Barry, Viscount Buttevant[4]; Downicar in Hibernia Delineata, 1683, map 21, and Dunny and Dunnycove in subsequent documents.

COOSBWEE (O. S. 144).—Over the little "yellow cove" with its remarkable cliffs (rose, salmon-colour, maroon, and yellow) and the strand on which the Dunworley beads continue to be found (after half a century),[5] I found an unmarked fort. The rocks are low with a high cap of yellowish earth[6]; and the sea has cut a deep cove into the fort headland. The mound is still perfect round its edge, though crumbling away at the cliff. If it had an outer ring,

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[1] Smith's "Cork," vol. i, p. 273. When Dean Swift stayed in Myross, June, 1723, he went on boat to Glandore, and recorded his impressions of the coast in a Latin poem, "Carberiae Rupes" still preserved.

[2] Book of Distribution, p. 230. The O'Donovan family abound farther westward. It will be remembered that Domnall mor Ua Briain, the last king of Munster, fatally opened his land to the Normans by a desolating war with MacCarthaig. All from Luimneach to Corcagh on to Mount Brandon was wasted. The Eoghanacht tribes, Ui Chonaill Gabhra (O'Connell) and Ui Donnabhain, fled beyond Mangerton (Ann. Innisfallen, Bodleian Lib.). They spread widely in West Cork; and in 1280 we find eighteen O'Dofnohans or O'Donovehans paying £36 15*s.* 4*d.* to the English Government for peace (Pipe Roll, No. 18 of xxvi Ed. I, 1297).

[3] Pipe Roll, Edw. I, No. 21, anno xxx, referring to years xxvii–xxxii.

[4] Inquis. Chancery, No. 66, Car. I.

[5] Journal R. Soc. Antt. Ir., vol. v, consec., pp. 59, 61; also Dr. Neligan's paper, "Cork Cuvierian Society," 1857. They are comparatively recent, and have given rise to a wild crop of conjecture and legend.

[6] For the ochres of Southern Cork, see Smith, vol. ii, pp. 368-9.

all trace has disappeared as the road passes the edge of the curved fosse. The ditch is 5 to 6 feet deep, and 12 to 15 feet wide in the bottom, and 23 feet to 25 feet at the road-level. The garth level is 10 feet above the ditch, the mound 6 feet 6 inches higher, 15 feet thick at the garth, and 6 feet on top. The main fragment of the garth is 57 feet long and wide. The mound remains shapely and fairly perfect for 39 feet, and then balances on the broken edge for 27 feet to the end of the fosse, and runs back on the spur.[1]

DUNSORSKE (O. S. 113).—It lies between Reanies and Roberts Head, near the hamlet of Killowen, on low, crumbling cliffs. Any doubts I had as to its character as a promontory-fort were removed by my visit. The remains of the headland run out in the shallow bay in reefs, and are sharp and evidently only exposed in comparatively recent times. So also the north ends of the earthworks remain nearly uninjured, and probably finished at that point from the first, the cliffs being also comparatively uninjured there, though freshly cut away elsewhere. The works were of unusual height and strength; they consist of two curved rings with a fosse between. The outer is 8 to 10 feet high outside (with traces of dry-stone facing and nearly perpendicular), and 12 feet thick. Like the inner mound, it is covered with furze and heather. The fosse is from 6 to 8 or 9 feet deep, below the field; 12 feet wide below, and 150 feet round; its north end is 5 to 6 feet lower than the middle; a road runs down its south end to a quarry. The inner ring is 30 feet thick below, and 6 feet on top; it rises 15 to 18 feet above the ditch, the upper part for 4 feet being of dry-stone work. The place seems now to be only called the *Dún* of Killowen.[2]

DOONEENMACOTTER (O.S. 89).—In Imokilly, near Ballycotton, is a fort which I must include in this group, though it was fenced slightly all round. This is made a note of distinction by English antiquaries; but so many cases are found in Ireland that I incline to believe that every headland was once slightly fenced for the security of the people and cattle taking refuge thereon. The shoreward defences are here, and indeed nearly always, stronger than and often different in character from the rest of the walling. The Dooneen stands at the junction of two deep stream-gullies, 30 to 50 feet deep. A lesser runnel lay to the south. The fort-makers selected this spur (fenced on two sides by almost perpendicular banks and for half the third side by a natural fosse), and cut a curved ditch for about 108 feet; but the path down it for bringing up seaweed from the rocky shore has

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[1] Plan, Plate X.

[2] View on Plate VIII; Plan, Plate X.

defaced and partly filled the fosse. They then made a mound with a facing of well-built flagstones, 6 inches to 10 inches thick, and often 2 feet square. The facing was 3 feet thick; the whole 8 to 10 feet thick; it rises 6 to 7 feet over the hollow, and 3 feet over the garth.[1] The interior was so deep in bracken that I could not distinguish any fences or house-sites there. The fort under the name of Tighykehernagh (kern's house) is mentioned by C. Fitzgerald in 1858 as the residence of a giant Ranageana or Geany, from whom Ballygeany townland across the stream was named. The O Gevenys, from whom Ballygeany is named, were vassals of the Cathedral of Cloyne: "O Gevenys sunt puri homines Sci Colmani et pertinent ad ecclesiam," says the Pipe Roll of Cloyne in the fourteenth century. As to the family from which the fort and townland are named, I find one named Mac Odris living in the district in the fourteenth century, and given in the Pipe Roll of Cloyne. In an undated deed, probably of the early thirteenth century, John Macodris holds Balymacbuoghan, and Henry and Patrick O Geveney certain messuages, I presume at Cloyne. In 1348 an Inquisition as to the tenants of John O Karny in Cloyne was found by a jury including Thomas Macodrys. Ones of 1354 and 1356 name Maurice Macodris. Of the burgesses of Cloyne, in 1402, in the time of Bishop Gerald,[2] Maurice O Geveny is named.[3] The family of Macotter or Cotter seems to be Normanized-Hibernicized Danes.

We now note the straight walled fortifications; but it is better to reserve those where later castles and walls form the bulk of the existing fortification, and treat of them separately at the end of the primitive forts, even where older traces unmistakably occur.

COOSDEARGADOONA, TOE HEAD (O.S. 150).—In Scullane townland, we find another walled headland. This fortress about twelve years ago (as I am told by Mr. Patrick Maguire, who lives at the old signal-tower above it) was in fair preservation. It has now been almost entirely levelled by two neighbouring farmers, for hardly necessary fences, with the callous disregard for their country's past increasingly characteristic of their class. The bold headland of Scullane, with its fine outlook past Castlehaven to the Squince, and on to Dundeady and Galley Head, forms a rugged set of knolls, with steep slopes thick in furze and heather, down to low cliffs and the stack of Scullane plumed with sea-fowl. Scullane is probably the "Scetan" (Scelan ?) of the Upsal map, 1450. It had a straight, massive wall of large, thin slabs of dry stone, about 6 feet high; this is 161 feet to

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[1] Plan, Plate X. [2] Gerald Canton, an Augustinian, 1394–1407.

[3] Pipe Roll of Cloyne, ed. R. Caulfield, pp. 2, 7, 8, 34, 45, and 56.

164 feet long (inside and out), and from 18 feet to 21 feet thick at various points. The foundations of each face remain, the outer being (as usual) of far larger slabs than the inner; but it is rarely 3 feet high, and the demolition is still going on. At 105 feet from the eastern cliff, on the edge of which the great rampart abuts, is the gateway. It was 4 feet 2 inches wide outside. The passage is marked along the east by a line of great slabs; they measure, going inward, 7 feet 5 inches by 3 feet 3 inches, 6 feet 3 inches by 3 feet 6 inches; the actual lintel still across the side-piers is 6 feet 3 inches by 2 feet by 8 inches. At 48 feet from the gate eastward a short reach of the outer wall is preserved; the slabs are from 3 feet 6 inches to 6 feet 6 inches long, and 8 or 10 inches thick. Few are under 3 feet 9 inches long. The interior was packed with smaller flags. I saw no hut-sites inside.[1] The western cove is locally named Coosdearg from the rich red heather on its sides. Farther westward is a great gully—a collapsed cave said to have been named Coosnasbesharee from a team of oxen which, when ploughing near it, took fright and ran with the plough over the precipice.

The next examples have all got fosses.

Faillnalour Inisherkin (O.S. 153).—The slight remains of a promontory-fort occur at the north-west corner of Sherkin in Cloddagh townland. It is one of a series of low reefs and rocks, the latter capped with deep beds of drift. The fosse is straight, about 25 feet wide and 60 feet long. To the south another point is called Reenaraha, 'the point of the rath'; but not even the slightest trace remains to justify the name, unless it got transferred from Faillnalour, as "Leimataggart" has got transferred to two other places even more distant from the real site in the Mullet of Mayo.[2]

Reen (O.S. 151).—The Rinn, or point, to the east of Castlehaven between it and the Squince, was once fortified. I found no early records; but it was part of the estates of the Barrys, Viscounts of Buttevant, and part of the Manor of Tymolegge: Edmond Hodnett of Court mac Shearii, held it at his death on 24th June, 1570, and was succeeded by his son James, till 1623.[3] The date of this "Entrenchment" is problematical. Perhaps (and most probably) it was a small promontory-fort (with a straight mound and ditch) which was walled in late times.

In 1586 Geffry Fenton wrote to Burghley recommending a bulwark to be placed on the eastern points of Castlehaven and Glandore, to "make it too hot for ships to enter."[4] We are not told that this was carried out at Reen; certainly it was not done on the east point of Glandore. Smith,[5] in 1750,

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[1] Plan, Plate X.

[2] Plan, Plate X.

[3] Inquis. Chancery, No. 95, Car. I, 1628.

[4] C. D. I. 1586, p. 192.

[5] "Cork," vol. i, p. 272.

states that the eastern point of Castlehaven was "called Galleon Point, on which are the remains of an intrenchment cast up by the Spaniards, and the ovens used by them are also still to be seen." I greatly doubt the story; nothing remains to mark the ruins of the "intrenchment" and the "ovens" as anything different from the early forts and huts; and the peasantry often attribute such structures to late persons, who, at most, only occupied them. The term "oven," too, may have been a corruption of "ouan," i.e. *uamh* (a cave), as in the case of "The Ovens," a village in the same county on the Bride.[1] The fort consists of two very shallow, straight fosses with an intervening wall and an inner one revetting a mound. The outer "fosse" is perhaps merely the shallow hollow one sees round some ring-forts, merely to supply sods for completing the fence. It is ill-defined, 21 feet to the south and 9 feet at the gangway, and hardly 2 feet deep. The next wall is irregular and probably modernized, bending out for 24 feet and abutting against a low ridge down the hill. Then it runs for about 42 feet to the entrance at the gangway, 9 feet wide and on for 51 feet, bending out again for 18 feet at the north cliff, and thus *concave* to the land. It also covers the path to two springs bursting out of the low ridge below the fort. Both facts seem to mark it as late. The inner space was a fosse, straight, and now nearly filled with the debris of the wall. It is irregular, 11 feet for most of the line, but widened to 21 feet at the south, and 17 feet at the north, by the bending of the outer wall. The old narrower hollow, 11 feet wide, is seen at the north end. The outer mound had stone facing of small flags, and was from 9 feet to 12 feet thick, and now only 3 feet to 4 feet high. The inner wall was of stone, nearly all removed. It runs from the southern ledge to the cliff, lying N.N.W. and S.S.E. At 51 feet from the south is a gap 9 feet wide, and another reach of 51 feet long to the cliff; then it turns sharply westward to fence the edge of the garth. The facing is of well-laid slabs rarely 3 feet long. There are no hut-sites in the garth.[2]

The "Spanish Ovens" seems to be a small hut with two oblong rooms; the northern is 6 feet wide and 8 feet 6 inches long, whence a narrow door, 2 feet wide and 3 feet deep, leads to the cross-chamber southward. The latter cell is 9 feet long, lined with slabs set on end; one angle is cut off by an oblique slab. The ruin lies 90 feet up the slope from the fort which is at the end of a shallow hollow.[3]

ROCHESTOWN (O.S. 137).—On a low reach of drift-capped cliffs at the

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[1] See Joyce, "Irish Names of Places," Part IV, chapter iii, formerly Athnovan, ford of the cave (Ath nUamhain). For the caves at the latter place, see Smith, "Cork," vol. i, p. 212.

[2] Plan, Plates X, XI.

[3] Plan, Plate XI.

junction of Rochestown and Glanavirane in Templetrine parish is a nameless fort, two straight mounds running east and west, with a fosse between, about 20 feet wide and 65 feet long. It is hard to believe that a structure on so friable a headland can be of any considerable age, though the sides may have been long protected by vegetation. John de Roche in 1358 held this district in trust for Milo de Courcey.[1]

DUNBOIGE OR BARRY'S CASTLE (O.S. 113).—The kin of Giraldus Cambrensis[2] have left their name stamped on the map of Co. Cork in Kinalea, at Barryroe, Barrymore, and elsewhere. The Barrys, viscounts of Buttevant, as we saw, claimed to derive that title from David de Barry, of Buttevant, in 1267, in which year he inflicted a severe defeat on the MacCarthys, and named Buttevant from his war-cry "Boutez en avant!" This, however, is a popular derivative, for Buttevant merely meant "out-post" (advanced Butte or Mote), and is found so applied at Château Gaillard, Corfe Castle, and Buttevante's Tower in the walls of Dublin.[3] In fact, the cry was taken from the Castle, like "Shanid aboo!" and "Crom aboo!" Philip de Barry, of Rincorran, was summoned to Parliament in 1302, for even then Kinalea had long been their appanage; they held the manor of Rincorne (Rincorran) and Rinmoibili, 1315, under the De Courceys of Kinsale. William, son of John de Barry, knight, and Philip, his son and heir, did homage and service for Kenalegh to Miles de Courcey, Lord of Kensale, in 1358 and 1378.[4] An "Inspeximus" of Edward III as to Miles, son of Miles de Courcey, and Rincorne, alludes to several of these Barrys. Then passed the fifteenth century; and in 1548 the Barry oge was Philip Barry, feudal Lord of Kynaleagh, to whom Mary and Philip confirmed the lands in 1553, along with the fish customs and harbour of Oyster Haven.[5] The castle, however, so far as my researches go, appears in documents only from the grant of Philip and Mary to Philip, father of Thomas, Lord Barry, in October 1553.[6] Philip had a second son John, whose son Henry Barry oge succeeded Sir Thomas, and died 20th April, 1617, leaving two sons, William, born 1607, who died at Youghal, 1623, and Philip, who succeeded him. Of the various lands we

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[1] An inspeximus of Ed. III in Carew MSS. Cal. "Book of Howth," &c.

[2] Olethan (Barrymore, &c.) was granted to his brother, Philip de Barri, in 1183 (Ex. Hib. Lib II, cap xx.)

[3] Journal R Soc. Antt. Ir., vol. xxxi, p. 87.

[4] Cal. of Carew MSS., "Book of Howth," p. 360.

[5] Cal. State Papers, Ir. See also Inq. Chancery, James I, No. 44. Sir Thomas Barry oge of Rincorran.

[6] Cited in a Chancery Inquisition of 1621. Philip was father of Lord Thomas, and is called Lord Barry and Barryoge therein.

need only give this place under the name of Dunbogey—Dwnbwoeg, 1601,[1] Downboeggye, 1616; this last deed cites an old rental of William Lord Barry, about 1461, calling it Dunboge. William fitzHenry Barry oge, of Rincorran, held Dunboige, Noghivale, and Le Reny (Reanies). Philip was aged fourteen when he succeeded. In 1637 he states that he derived chief imposts from Downeboggye and other lands.[2] It is Dunboige in the Inquisition of March, 1624, and in August, 1642, when its owners, Philip and John Barry, were outlawed at Kinsale.

The ruin of its old owners is told with grim formality in a Cromwellian Inquisition.[3] "Sep 29, 1657, John and David Barry, gents, late of Dunbogie, Irish Papists, on 23rd Oct 1641 & long before & since held Kileagh, Downebogie (30 Irish acres) and Ballinranglannie. They entered into rebellion against the King and thereby [oh! the irony!] his Highness Oliver Lord Protector of the Commonwealth by way of forfeiture was lawfully invested upon the attainder of said John & David Barrie." So he assigned the lands to the disbanded soldiers of Major George Waters for arrears. Henry Coolishie held it after the war; and on the Restoration got a confirmation in 1667 of 63 acres in Dunboige. Another civil war and confiscation followed in 1688, and in 1703 John Hodder purchased part of Dunbogy in Kinalea from the Chichester House Commissioners.[4]

Lewis says that the castle was levelled in the late war (about 1810), being used as material for the signal tower. Accordingly scarcely anything remains of the castle except a straight fosse cut in the rock; and about 18 feet wide, 5 feet to 6 feet deep, and 54 feet long. Rising from the rock-cutting was a peel-tower; only a few courses of good slab masonry on the rock and a shapeless heap of grassy debris remain; beyond the small platform behind it the Head runs out in a roof-like spur with steep-grassed slopes. There is a fine view of the cliffs from Nohoval cove to Flat Head. No forts remain along them.

SECOND CLASS (*b*).

The complex defences of which we meet such striking examples as Dunbeg, Dun Eask, and Duncanuig in Co. Kerry, and Kilmore in Achillbeg, Co. Mayo, are conspicuously absent on the south coast of Co. Cork. The only example is in Imokilly barony, not far from Cork Harbour.

DUNPOER (O.S. 100).—In Lahard townland in Imokilly, a bold, though not

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[1] Trans., 1601. No. 6539.

[2] Affidavit Southwell MSS., "Council Book of Kinsale," p. xxxviii.

[3] Exchr., No. 4. Cromwell.

[4] Roll, xix Car. II, pars 2, dorso, No. 32, and Roll, ii Anne, pars 8, dorso.

lofty, headland, Power (or Poor) Head, juts into the sea. The long frontage ends in abrupt cliffs to the eastward, and a stream-gully and short cove about 162 feet to the west gave the fort-builders a site which they strongly fortified. The ancient Anglo-Norman family of Le Poher, De la Poer, or Power, became well rooted in the neighbourhood. We find William le Poher paying scutage in 1172, and with nine associates bringing fifty horses to Ireland in 1184.[1] They owned Balycotyn not far to the east in 1277, and witnessed the charter of Alan, Bishop of Cloyne, granting Ballyban to the son of the Dean of Cloyne in that year.[2] John le Poher was sheriff of Co. Cork in 1279 and 1287. I do not know any early occurrence of the place-name; it is Donpuer in certain Elizabethan maps, copied very corruptly as "Doregnor" by Speed in 1610; this agrees with the local pronunciation, "Doonpoor."

The castle is said to have been built about 1595, and to have been destroyed not long afterwards, 1601–2, by James, "Sugan Earl" of Desmond, when its defenders were put to the sword or thrown over the cliff like Reymund's prisoners at Baginbun. Thomas Power of Inshiphearig, held Downe Phearigg (Dun-power), and enfeoffed Patrick Cronyne with it in 1617 and 1618 without the king's licence. It is called Downyphearigge in a deed of 1625. Power died January 16th the next year, leaving it to his own son Edmond, with dower to his widow Ellena Power.[3]

The headland was defended by an inner stone-faced mound running E.N.E. and W.S.W., being 6 feet thick and 138 feet long in the line of this wall and the fosse 10 feet wide. Before it a small peel-tower or gatehouse was built, perhaps earlier than 1500, with walls 6 feet thick of good slab masonry. It was 30 feet long and 17 feet wide, and stands 36 feet from the east cliff. The tower has been levelled; the wall is from 4 feet 4 inches to 6 feet thick; a fragment ending in window-jambs is 6 feet long and 10 feet high; the rest bends back 6 feet in 9 feet. There are no foundations in the garth. The mounds between the three fosses have been levelled and used for top-dressing on the adjoining farms, and all the stonework of the wall and the debris of the tower have also been removed for building-material—another slur on the farmers of south Cork. The second and third mounds are parallel to the wall, and from 15 feet to 18 feet wide. The fosses are about 10 feet wide below, and now only a couple of feet deep as a rule; but in parts, 4 feet to 5 feet deep, they are wet, having small springs in them; the

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[1] Cal. Documents, Ir., from Pipe Roll, xix Hen. II, R. ii, and xxxi Hen. II, No. 11.

[2] "Pipe Roll of Cloyne" (ed. R. Caulfield), p. 38: see also Irish Pipe Rolls, vii Ed. I, xvi Ed. I.

[3] Inquis. Chancery, No. 44, Charles I, April 5th, 1625.

outer is fed by a hearty little brook pouring down the west slope. The works extend 80 feet in front of the tower. Only the east end of the outer mound is fairly intact, 6 to 9 feet above the field, with a banquette 15 feet wide behind it, and 12 feet wide on top; a sort of small bastion juts out at the cliff for about 18 feet on top, 24 feet below.[1]

None of the platform forts conforms to the third type (*c*) in having an outer ward such as we find in the forts of Island Ikane and (though now levelled for farming purposes) the outworks of Danes' Island and Island Hubbock. It is certainly very rare elsewhere, the only case known to me on the west coasts of Connacht and Munster being Bishop's Island in Co. Clare, though perhaps Pierce's Island in Kerry was of the type. The fourth type (*d*), a main promontory with a lesser fortified headland, like the Baily on Howth, Baginbun, Dunabrattin, and Dunsheane, does not occur in the district of our survey.

THE FIFTH TYPE (*e*).

The platform-fort is of two varieties, the most characteristic having a deep natural hollow across the neck, usually crossed by a narrow gangway; to this (*e*) belongs, save as being further defended by a fortification to landward of the neck. The second variety is that where the platform, neck, and adjoining field are on the same level or slope, Nature having made the narrow gangway with deep gullies to either side, and man doing rarely more than making a slight fence or breastwork along the further edge to shelter himself from the missiles hurled from the landward.[2]

DOONEENDERMOTMORE, TOE HEAD (O.S. 151).—Close to Toe Head, opposite the picturesquely castellated rocks, called the Stags,[3] lies the fort, Dooneendermotmore. Toe Head seems to be the Toanadwnin, or Toghe, of the late Elizabethan records;[4] the first form embodying the name of Dooneen. Mr. Maguire tells me that most of its stone revetment was intact till very recently, when, about six years since, it was nearly all removed for building a labourer's cottage. The coast at this point is being rapidly cut away by the fierce waves that make the opposite Head of Gokane (Iokane) so dangerous and wreck-reputed. The headland of the Dooneen is of strong upturned strata; and

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[1] Plan, Plate XI.

[2] This type occurs at Caudebec in France: see "Ancient Forts of Ireland," fig. 3, p. 26.

[3] See the portolan maps giving Stackia, 1497; (St)aga off Corcala, 1544. The Stags, Castlehaven.

[4] May, 1601. Pardon to Tiege mac Donell og Cartie of Toanadwnin. Fiant 6539, p. 247. It is Twoh in Hibernia Delineata, 1683, map xxi.

though pierced under the fort by a beautiful natural arch, seems to have suffered but little (and that at the end) since the fort was made. Who "Big Dermot" was, with whom the name of the "Little Fort" is connected, neither history nor tradition seems to tell. It is in the townland of Gortacrossig.

The neck dips into a deep hollow, down to which runs a patch 6 feet wide for 15 feet, and exposed to missiles from the tower-like fort. At the actual neck in the bottom of the hollow the path for 12 feet is at most 2 feet 8 inches wide, sloping down to the sea like that in the legendary fort of Aeife, where Cuchullin so nearly perished, or in that of Scathach in the same saga.[1] The path ends at a steep up-slope under the revetment, which was of beautifully neat flag-masonry, 7 feet 6 inches thick and over 10 feet high outside. The garth is 90 feet long and 42 feet wide across, north and south. At its southern end, where the 1845 map seems to mark a house, is a curious souterrain. It has a small circular cell, 6 feet in diameter, at its western end, whence a passage 3 feet wide and high runs eastward for 15 feet; at 3 feet from its eastern end is a similar south passage 12 feet long under the wall to a natural staircase leading to a lower shelf on the south flank of the rock. I saw no other remains in the grassy garth.[2]

DUNOURE (O.S. 144).—This is one of a group of four castles and forts at and near Galley Head, attributed to the O Cowhig, but more likely built by the Barrys. We have already examined Dunnycove, the most eastern, as this is the most western. I learned but little of its history. Dermod, son of Tiege O Daley, made a deed of feoffment of the eight gneeves of land in Dunuoyre, October 29th, 1629,[3] and Dunowre was mortgaged with Dundeady and other lands by John Barry, of Liscarroll, to Sir Philip Percival, 17th April, 1640,[4] and confirmed to him after the war by the Act of Settlement in 1667.[5] Windele calls it *Dun uair*. The *Dun* must have closely resembled Dooneendermotmore, being a great flat-topped mass of silver-grey uptilted slate jutting out into clear shallow water. The path across the hollow of the neck is rarely over 3 feet wide, where it reaches the platform; a pier of flag masonry, evidently part of a gate-house, rises beside it. Some other low grassy mounds alone remain.

DUNOWEN (O.S. 141).—The third of the same group of castles occupies a prominent headland opposite to Dundeady and to the east. It is mentioned in "Corca Laidhe" before 1360 as a mearing of the Tuath Fithcheallaigh "from Goilin na Gaithneamha (Gyleen) to Inis Duine (Inchydoney in

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[1] See Proc. Soc. Antt. Scot., xxxiv, p. 60, for a similar Scotch fort.

[2] View, Plate VIII; Plan, Plate X.

[3] Inquis. Chancery, No. 425, Car. I.

[4] Inquis. Exch. No. 26, Cromwell.

[5] Roll xix, Car. II, pars 2, f. No. 3.

Clonakilty Bay), and from Dun Eoghain (Dunowen) to Glaisedraigheach."[1] O Fithcheallaigh was its hereditary chief, and O Cormaic, O Donnamhain,[2] O Dubhchon, O Croinin (Cronin), O Nuallain (Nolan), and others were the leaders. It formed part of the grants to Philip de Barri and his brother-in-law, Robert FitzStephen, about 1180, and is actually named when King John, on November 8th, 1207, confirmed a grant of FitzStephen, the cantreds of Muschere and Dunegan (*Dun Eoghain*) to William de Barri, son of Philip.[3] It continued to be held by his descendants; Downeowen was owned by David Lord Barry, Viscount Buttevant, at his death in 1631.[4] The original fort of Dunowen is supposed to be a large earthwork of the low mote type near the village, but the castle of Dunowen probably took over the name of the fort in whose ambit it was built. Windele mentions the cliff castles of Dunowen, Dundeady, Dunworley, Dunuair, and Dungcouhig as left by a king to his son.[5]

The headland had a natural hollow which was deepened into a straight scarped fosse cut through the rock, about 48 feet long, 8 feet deep, and 12 feet to 15 feet wide; the ends abut on precipices and steep grassy slopes. At its east end the rock-angle is revetted with masonry; there was probably a bridge or drawbridge here; the pier is 8 feet long, and barely 3 feet deep. The platform is about 12 feet over the fosse; it is fenced by a mortar-built wall, 4 feet thick, with a narrow ope into a passage 5 feet wide and 15 feet deep, with a pier or offset in the middle. The west wall runs along the cliff for 12 feet, and bends parallel to the porch for 21 feet, enclosing an irregular room, 27 feet by 12 feet. Beside this is a small yard in which my informant Mr. Michael Feen, and one William Donovan, about forty years ago, unearthed a slab, under which was a decayed human skeleton. Feen's grandfather "remembered the castle rising over 40 feet in Bonaparte's time, 100 years ago." A slab and ope like a sink remain in the west wall. The next room southward sets back for 4 feet, whence a wall curves for 16 feet southward to a cross-wall to the south of the court, 27 feet long, with a small gateway, leading to the seaward half of the head. Along the south-east of the yard is another oblong foundation of a house 36 feet by 21 feet inside, its walls 3 feet thick. From it a wall with two drains or sewers ran back to the gatehouse, for 18 feet, but has recently fallen down the cliff.

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[1] Miscellany Celtic Society, p. 53.

[2] Not the O'Donovans of Ui Cairbre, Aebhdha, Co. Limerick. The O'Donovans, of Mountpellier and O'Donovan's Cove, Lisheen, and the Squince, were of Ui Cairbre.

[3] C. D. I., vol. i, No. 340, Charter Roll, ix John m. 5.

[4] Inquis. Chancery, No. 66, Car. I.

[5] Topography of Cork (MS. R. I. Acad., 12, J. 10), p. 743.

PORTADOONEEN (O. S. 136).—On the low shore, mainly consisting of grassy drift banks on low rocks, to the west of Courtmacsherry Bay, is another platform-fort. The cove beside it was named Portadooneen. The little headland is over 60 feet high; across the neck runs a deep curved fosse; no outer fence remains; and the fosse was evidently a natural hollow cut into shape, and 10 feet deep. It is 6 feet wide below and 27 feet at the field; the inner ring rises 17 feet to 21 feet above it. The platform was fenced; the part above the fosse is 9 feet thick; but the curve of stones shown in the 1842 map has been all removed. The platform measures 69 feet in each direction, being nearly circular.[1]

BALLYTRASNA[2] (O. S. 89).—In Imokilly, not far to the east of Dooneenmacotter, already described, is a smaller spur-fort of similar type to the last. It, too, was a long drift-spur between two streams; the eastern and larger had cut a deep channel, which was utilized as a road for bringing up seaweed, the low neck-hollow being cut through for over 6 feet deep, and the stream diverted through the gap. The neck was only 12 feet wide, and the tower-like platform of hard earth rose 10 or 12 feet above it, with almost perpendicular sides, revetted with good masonry of small flags, three to five courses alone remaining to the north, and six to ten or twelve to the south-west, about 3 feet high, backed by a mound about 6 feet thick, hardly rising 2 feet above the earth. The whole was about 35 feet wide and 50 feet long. It is not marked as an antiquity on either the old or new maps.

KINURE, BIG DOON, AND LITTLE DOON (O. S. 113).—A bold peninsula in Kinure lies beside Oyster Haven, perhaps the "Eastern Haven,"[3] in contrast with Edelfiord or Kinsale Harbour, and possibly the "Godelfiord" Harbour, between Kinsale and Cork Harbour, in the early portolan maps. Two natural spurs steeply slope to the sea near each other on the south and east faces of

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[1] While this survey is in press, I find an interesting recent note (with two good illustrations) on this fort by Mr. James Buckley in the Cork Hist. and Arch. Journal, vol. xix, ser. ii, p. 126.

[2] Plea Roll No. 117, an. xi Edw. II, m 86, *dorso*, cites a charter of John fitzRobert le Poer to Eva la Poer, granting lands at Balytarsne, Seskynmore, Seskinfola, and Lysfolan. Year of "reign of King Edward, son of King Edward," obliterated, but evidently (1307–1317). It may refer to Ballytrasna, but is between names in Co. Waterford. The names of Galf le Poer and a place called Grenandownkenry also occur.

[3] If so, the Norse names in the maritime counties of southern Ireland may be listed as Laxweir and forgotten names of farms round Limerick city, Mikells-Tworedelb, and Tworedells Bog, 1652, Inis Uibhthonn (?), Smerwick, Oldernaze or Olderness, Edelfiord or Endelford, Oyster Haven, Godelford, Helvick, Crook, Waterford, (Reginald's Tower ?), Carnsore Point, Grenore, Tuskar Skerry, Wexford, Cahore, Wicklow (Wykinglo), Dalkey, Ostmanstown, Leixlip, Howth, Nose of Howth, Ireland's Eye, Lambay, Skerries, Holmpatrick, and other names now lost at Dublin, such as Thingmote, Langstein, Ostmanstown bridge, quarry, and green.

the peninsula, and are called the Little- and the Big-Doon. Baptist Boazio's map, about 1590, gives "Donbrow" and "Donemano" (Donemore) in corresponding positions, while Speed, in 1610, gives "Downemore Head" there, so they probably retained their Irish names at that time, Downemore being clearly "Big Doon." Ringvilly, near them, bore the interesting name of Rynmoibile in 1315, when Philip de Barry of Ryncorran went to law with John FitzThomas for having without license ventured "to waste, sell, or destroy his houses, lands, woods, and gardens";[1] evidently the woods included a *Bili* or venerated tree. The lands of Kinure were confirmed to Smithin Walton under the Act of Settlement in 1666.[2]

The "Little Doon" is formed by two narrow gullies with parallel sides, and very deep, only divided by a natural wall, coming up to a literal knife-blade of rock 18 inches wide in parts, never more than a few feet wide, and 50 feet high. The main neck is about 15 feet wide, and overlooks the interior. The fort was fenced along the edge of the cleft, but little remains. There is a clear foundation of a house just inside to the right (west) of the entrance, and what is possibly another foundation to the left.[3]

The "Big Doon" is even less interesting, though closely similar; I only saw it at some distance though with a strong glass. There seems to be a slight mound or wall-foundation across the neck. The sloping platform is oblong: and off its point is a rock-stack named Bullaun Rock, recalling the name Bullaunaleama opposite the isolated cliff-fort at Cuchullin's Leap at the mouth of the Shannon.

Castles.

I now have only to describe the structures where the forts have been overlaid (so to speak) and superseded by late medieval castles. Three of these are of considerable historic interest—Dunalong, Dundeady, and Olderness on the Old Head of Kinsale.

Dunalong, Inisherkin (O. S. 153). We have examined already two promontory forts, though of but little general interest on this island. The third, as its name implies, and a straight rock-cut fosse suggests, was probably a fortified *dún* before the O hEderscoill family made it one of their chief strongholds. It stands on a low headland with precipitous sides facing the sister castle of Dunashead in Baltimore. The marking of the latter port on foreign maps from about 1450 down agrees with the records showing the importance to which the place attained at least in the wine trade.[4]

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[1] Plea Roll No. 112, an. ix Edw. II. mem. 9 *facie*.

[2] Roll, xviii Car. II, No. 21.

[3] Plan, Plate X.

[4] See Proc. R. I. Acad. xxx. p. 418, beltario, 1450; balontum, 1500; boltamor, 1544.

Baltimore was a formidable enemy to Waterford; and it took two severe lessons before the O'Driscolls were permanently crippled.

The Poers seem to have been the irritant in every case; between these proud nobles and the merchants of Waterford there was no love; and the nearest Irish tribe with a sea front was that of O hEdersceoil. So far back as September 4th, 1368, they threatened an attack by sea; the citizens sailed out to meet them under John Malpas, the Mayor, but were defeated, and their leader died from his wounds on their way home. In 1413, when Maccon O Driscoll was chief, another mayor, Simon Wickin, organized an expedition, and bringing a cargo of wine on Christmas Day, was admitted to the port, and surprised the Castle of Balentemore. So bitter was the feud that in 1450 a statute denounces Finghin O Driscoll as having slain many English, and forbids the citizens of Waterford and Wexford to deal with his tribe or fish at Korkly-Balthamore, under penalty of £41. Finghin, in 1452 and 1461, landed at Tramore, but fell into ambuscades, where he lost 26 and 160 men. O'hEidersceoil og, his sons, and three galleys were taken; this discouraged further attacks on the English settlements for over seventy years. At last a chief (another Finghin) arose who knew not Waterford, and he or his followers took and plundered four Portuguese wine-ships, sheltering in his port, put the crews in fetters, and took seventy-two tuns of wine, February 20th, 1537-8.[1] The Waterford folk, under Pierce Dobbin, with only twenty men, released the Portuguese on March 3rd, and burned the castle. They returned with three galleys and 400 men twenty-four days later; fired on and took Dunalong, demolishing it, burning the Franciscan Friary, and destroying Baltimore and O'Driscoll's Island-Castles; the tribe never recovered. On that occasion Sherkin "fortress, being double-warded with two strong piles (peels) or castles and goodly walls, was cast down and razed to the earth and fallen into the sea." If this be literally true, then the buildings are of Tudor times alone. The citizens of Waterford entered the castle by "the bridge gate," probably by a drawbridge over the deep fosse, now so nearly filled up. This ditch is still visible to either side of the neck, though absolutely filled up along the front of the curtain wall: it is 8 to 10 feet deep at one end, and runs to the north into a natural cleft (which probably encouraged the older fort-makers to dig and quarry it), down which a narrow path leads to a spring of good water and to the beach.

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[1] 1539, xxix Hen. VIII, in Carew Cal., p. 474.

[2] See the Clogher MS. cited in "Corca Laidhe" (Miscellany Celtic Soc., J. O'Donovan, pp. 93–99, 136); and Dr. C. Smith, "History of Waterford," Bk. III, ch. ii; Statute Roll, 38 Henry VI, No. 10; and Carew MSS., No. 632; Carew MSS. Cal., last vol., p. 470.

The castle is called Dunalong (*dún na luinge*, the ship's fort), "the Garrison" and "the Platform." It is a picturesque building with its rich ivy up the walls and rocks, and the lovely view of the Haven and of Baltimore.[1] The headland seems revetted all round, the side walls rarely rising 3 feet above the platform, save to the north, where they have been retained to shelter some late houses and sheds. The main rampart, to the west, across the head, is far stronger and loftier, being 5 feet 6 inches thick and about 20 feet high; it runs beyond the enclosure out on the rock-ledge to the south, and at this point had a very small "sentry-box" of a turret, entered along the rampart and now smothered in ivy. Near it is a loop-hole, with a deep splay and lintelled head, just inside the courtyard. The castle gateway lies farther to the north and is 7 feet wide with square injured jambs and a rounded arch poorly built. The whole splays inward—an unusual feature in large Irish gateways. It appears to be flanked by a projecting turret to the north, but no loop-holes are visible.

The keep or peel-tower stands in the centre of the court and is greatly defaced and modernized. It was full of pigs and cattle on my visit, so I can only note that the upper stories are removed and only two stories of the vaulted basement remain; it measures 29 feet 3 inches east and west, and 27 feet 3 inches north and south. It had no dressed stone or architectural features, and every ope is now defaced.

Briefly to close its history, it was rebuilt, and remained a chief residence of the chiefs. Sir Finghin O'Driscoll, a weak old man, with a rebel son, let the Spaniards occupy his castles in 1601, but they were surrendered to the English, February 23rd, 1602. The latter pitied and spared the old man; and his family succeeded to the various islands. Some of their lands were, however, obtained fraudulently in 1608 by one Coppinger,[2] who sold his "rights" to Henry Becher.[3] Donough O'Driscoll died at Downelong, 1638.[4] The castle surrendered to the Cromwellian, Captain Barrett, in 1645. It was restored to Henry Becher by 1655,[5] and his descendants lived there far down the following century. It was a barrack about 1710. Lionel Becher, of Sherkin, used the monastery and a curing-house near it in the pilchard fishery worked by him, his son-in-law, Randall Westropp, of Cork, and

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[1] View, Plate, IX; Plan, Plate XI.

[2] Smith's "Cork," vol. i; pp. 276–278.

[3] The Inquisitions in the Public Record Office, Dublin; some are published in "Corca Laidhe." Pacata Hibernia, Book III, cap. ii (ed. 1819, pp. 517–520).

[4] Book of Distribution and Survey, Cork, p. 237.

[5] Queen Elizabeth granted lands in Kinalmeaky to Phane Becher by Patent, 30th September, 1588. They passed to his son Henry. See also Inquis., Exchequer No. 17, James I, 1611. Henry succeeded his brother Edward in 1616.

Robert Travers down to 1769, and seems to have resided in the castle.[1] In 1786 William Wilson gives a quaint note on the "Antient Castles that were once esteemed proof against the strongest shocks, but which now serve only as a monument of human edifices."[2]

DOWNEEN (O. S. 143). Following the road to the pier at the mouth of "the barred harbour of Rosscarbery," the Coroborg, Comborg, and Domborg of the early maps, we find an old laneway running westward up the steep bank. Along it one reaches a shallow depression leading down to a beautiful bay and cliffs where, apparently rising on the shore, is the little peel-tower of Downeen. It is attributed to the O'Cowhigs; but I do not believe they were the builders of the entire group of late castles from Lough Hyne to Clonakilty. The tribe name is found at Ballycouig (1300), Ardcoohig, a large fort behind the Seven Heads (Ardowhigg, 1640), Cluancouigg (1527), and, as we noted, Dunnacowhigg or Dunnycove. They were an offset of the O'Driscolls; and Smith accredits them with having built the towers of Dundeedy, Dunowen, Dunoure, Duneene, Dunocowig, Dunworley, and Dungorley,[3] most of which were probably built by the Barrys. If any one be an O'Cowig foundation, it is Downeen; for down to 1602 it was owned by the O'Driscolls. It is called Donynmore on a Hardiman map of 1590–1610. In June, 1602, Lieut. Saunders wrote to tell the President of Munster that he had taken a large boat belonging to Teg, brother of Connor O'Driscoll of the Downings, wherein was slain their brother Dary. After two days he "took the strong place of the Downings, which is seated on the sea disjoined from the land so as there is no coming unto it but over a little drawbridge of wood resembling the seat of Dunluce in Vlster."[4] The following month Sir George Carew ordered the demolition of the castles taken by Capt. Roger Harvey, "strongly seated upon rocks and necks of lands . . . Downegall and the Downings all are close to the sea."[5] In 1611 David Roche of Licklas held the lands, and in 1640 Dermot Carty held the Castle, but by 1655 Downnige in Rosscarbery parish was held by the Bishop of Ross.[6] It is mentioned by

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[1] His will, Prèrogative Series, Dublin, 1770, compare settlement of Randall Westropp and Peniel Becher, 1737, Dublin, Registry of Deeds, Book 92, p. 350, and Smith's "History of Cork" (ed. 1750), vol. i, pp. 276-9. There is a curious account of the pilchard fishery in Inq. Exchr., No. 54, in 1620, in an inquiry as to conduct of Edward Hunt, customer of Cork Harbour.

[2] "Postchaise Companion," p. 230.

[3] Smith's "History of Cork" (1750), vol. i, pp. 223, 257.

[4] "Pacata Hibernia" (ed. 1819), bk. iii, ch. ix.

[5] State Papers, Ireland, 1601-3.

[6] "Book of Distribution," p. 221.

Townsend and Lewis, 1815 and 1837, and George V. Du Noyer sketched it in 1853.[1]

It belongs to the class "*g*" of cliff-forts in the above table, being a shore-rock, and probably only reached by a plank even when used as a *dún* in its fort-days; the earthen mound running partly along the landward side of the rock alone remains in places. The tower must have been on a projection approaching the main cliff near enough to allow the use of a drawbridge, as at Lickbevune and Ballingarry in Kerry, the castle on Dorseys, and Dunanore on Clear Island. The rock eventually collapsed, bringing down more than half of the tower. The fragment is about 21 feet long, with walls 4 to 5 feet thick. There are two floors under a pointed vault, the lower with a neat pointed south doorway in the south-east corner leading to the island. Above the vault are two more stories under the roof; the lower has a plain lintelled south window and splay, and part of another facing the east; the upper has a defaced light to the south. A heavy corbelling widened the wall at the roof; the battlements are very thin. Though the masonry is externally good, round shore-stones are worked into the filling; those in Browne's Castle, Kerry, helped its collapse, but the mortar seems stronger at Downeen. A little stream hidden in cress and loosestrife runs down to the opposite cliff. The foundations of an oblong building about 45 feet long adjoin the tower to the south-west.

DUNDEADY, GALLEY HEAD (O.S. 144).—The last and largest of the Galley Head group of castles lies not far south from Donoure. It is said to have been an O'Cowhig castle, but all the buildings are evidently long posterior to the Barry occupation of the district. The Dublin Annals of Inisfallen say that the castles of Dundeady and Timoleague were founded by Nicholas Barry in 1215; but no building, or even earthwork, remains that can be attributed to that period. The Annals under 1260 also tell us that Dundeide, Dun Urlaing, Cuan dor (Glandore), and other castles were destroyed by Finghin Reanna Roin, son of Domhnall Got Mac Carthaigh.[2] Philip de Barri (brother of Giraldus Cambrensis), along with his brother-in-law Robert Fitz Stephen, had got in 1179 large grants of land. Three cantreds in Corcaia, namely, Olethan (Barrymore), Muschere (Muskerry), and Dunegan (Dunowen), were confirmed to William, son of Philip, by King John, Nov. 8th,

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[1] R.S.A.I. Lib. Sketches, vol. i, p. 385. See Rev. Horatio Townsend, "Statistical Survey of Cork," vol. i, p. 156; and Lewis under "Rosscarbery."

[2] O'Donovan, "Miscellany of the Celtic Society," p. 385; and note, Annals Four Masters (1215), pp. 187-8.

1207.[1] David de Barry was Lord of Buttevant (not "Viscount," as so often stated), and the family spread, fighting the Mac Carthys generation after generation, with little support from the Government.[2] In 1301 John de Barry appears as holding Obaun (Ibane, round Dundeady) with Muscry and Olethan, and the Obaun property of John Fitz Philip de Barry is also noted.[3] In 1316 David de Barry held Thamelag (Timoleague) and Rath (Rathbarry, at Dundeady and Dunoure); his plea was judged at La Britasche (Brittas, between Clonakilty and Dundeady). Another suit regarding the same land and Lislea (near Seven Heads) was heard in 1326.[4] This group of places is frequently met with in documents from the fourteenth to the seventeenth century (1316–1624) in almost the same words.[5] Dundeide was a mearing of Tuath on Aenghusa in Corcalaidhe, before 1360, along with Gaiblin an ghaith, Goilin na gaethneamhdha, or Goleen Bay at Dunowen.[6] In the reign of Elizabeth, Baptist Boazio's map shows Can Donnledi and the Hardiman map, 1590, Can Donnededy; Speed, 1610, marks Can Dondody. Some of the Barrys' retainers, Donell O Hicken of Downdedy, in 1601, and Fynan mac Carte of Downdeody, were pardoned in the war of 1602 and 1603.[7] David Barry, Viscount Buttevant, in January, 1599, made a long settlement of his lands with a strict clause that if any of his sons became rebels their rights should lapse to the next loyal brother.[8] It was fatal prescience. He and several of his sons died in peace. His son John "long before the rebellion" mortgaged Liscarroll and Downdeady in Ibaune to Sir Philip Percival (actually in April, 1640). Percival is recognized as the owner, in 1655, of Downedeady, Liscarroll, Dromcarbud, and Dunowre, and is mentioned at Dundeady in the Book of Distribution, p. 60. He was confirmed by the Act of Settlement in 1667; and his son John is named as joint owner.[9] I keep the notices of the Barrys together, so far, for clearness, but must note a few other facts. After the cruel sack of Baltimore by

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[1] Charter Roll, ix John, m. 5, "the Cantred of Cork given to his father Philip (de Barri) by Robert Fitz Stephen," dated at Woodstock, May 8th, 1207.

[2] Q. R. Ir. Excheq. 531, No. 21, C.D.I. 1299, p. 371.

[3] C.D.I. 1301, No. 801 and 1302.

[4] Plea Roll, No. 148, m. 4, dorso, also No. 114.

[5] See, e.g., Chancery Inquisitions, 53*a* and 95.

[6] "Miscellany," p. 53, from Book of Ballymote, 122*a*. The chief families were O hAengusa (O'Hennessy), Ua Corrbuidhe (Corby), Ua Dubhain (Duane), Ua Duinin (Dinneen), O Muadhain (Modan), O hAidhne (Hyney), O Mainchin (Mainnin), O Cuis (Hussey), O Cuile (Cooley), O Sinnach (Fox), and others. Ann. Inisfallen, H. 1, 7, Trinity College, Dublin.

[7] Fiants, No. 6539, p. 248 and 6670.

[8] Inq. Excheq. Cromwell, No. 26.

[9] Roll, ix Car. II, pars 2*f*, No. 3.

the Algerines under the Flemish renegade Murad Reis, led by the execrated Hackett in 1631, the authorities (whose slackness in not sending two warships on the coast, to defend the western bays, led to the tragedy) took belated precautions by establishing beacons at Dundeady and Dunworley; but the Moors after that only snapped up vessels along the coast, and did not land.[1] I find Daniel O'Driscoll, a member of the tribe that held Dundeady from prehistoric times, holding it so late as 1765.[2] I question whether any remains at Galley Head are of the thirteenth century. The probability is great (seeing that nearly every prominent headland[3] with a sufficiently narrow neck, from Sligo to Mourne round by the south coast, has been fortified) that the name Dundeady denotes a fortified headland, but it may have been one of the long, narrow wrecks of headlands near the lighthouse, now swept away. Of course the present fortification may easily have replaced and absorbed a long drystone wall, such as we find at Coosdergadoona, in sight of Dundeady, westward. The rocky ledge revetted by the present rampart may have attracted an early fort-builder, and though part of the shore of the east creek was sloping and low, still it formed no mean fosse, while the west creek was an absolute defence. I will notice a possible trace of an older wall later on. Though the headland is bold and bluff to the seaward, and with broken cliffs to the west, the neck is very low. Two creeks, one to the east, bending at right angles, with low shores, the other straight, with perpendicular sides, nearly isolate the headland, most of which is cultivated, yielding good crops. A grassy depression crosses it just behind the castle; and between it and the bays a long, steep-sided (or in parts precipitous) rock platform rises, the peel-tower standing on the western knoll. The rock ledges were revetted; that towards the land with an irregular rampart, 10 to 20 feet high, outside, but rarely 7 feet high inside. It abuts on the low cliff of the western creek. At 11 feet from it is a closed gateway 7 feet 2 inches wide. At 30 feet 8 inches is the next ope, a closed doorway 5 feet wide with a flat arch. At 46 feet 6 inches is the main gate, 7 feet 4 inches wide; the arch has been removed. About 80 feet from the creek the wall bends, and its lower part consists of large slabs of dry masonry, bonded with the natural rock, and perhaps the remains of the older promontory-fort. At 106 feet is a very unusual feature—projecting slabs like

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[1] Smith's "Cork," vol. i, p. 279. "Council Book, Kinsale," p. 276; also compare Lane Poole's "Barbary Corsairs." Cork Hist. and Archæol. Soc., vol. i, ser. ii, p. 18.

[2] Wills, Cork Registry, P.R.O.I.

[3] The exceptions are Nalhea in Aranmore, Iokane, Co. Cork and Illaunaglas in Truskliеve, Co. Clare; but the latter though denuded of its earthcap has a natural fosse in the rock—so very probably it was once fortified.

steps of a stile up which the rampart could be scaled. The wall here is 16 feet high, or 25 feet, including the rocky base, which gets bolder and more marked eastward. A small turret with two compartments—one a garderobe—projects at 152 feet. In the sloped wall beside it is a loop of two stones; the turret measures 12 feet 6 inches deep and 9 feet wide. At 172 feet 6 inches the wall again bends eastward for 63 feet, then sets back for 28 feet, and turning abruptly runs down to the cove, being over 266 feet to the turn, and 327 feet in all. Near the same point a branch wall curves along the top of the slope to another turret with two garderobes, 63 feet distant at the south-east angle of the rock-platform; the building is 18 feet by 25 feet.

The peel-tower or keep is 30 feet by 16 feet; has a projecting turret, 9 by 18 feet to the south-east; only the lower story remains under a corbelled vault. The top is reached as an outlook by a late flight of steps to the east. There is a broken spiral stair at the north-east corner; it has no newel; 10 steps remain. The wall is 4 feet 6 inches thick; the under room 16 feet 7 inches, divided by an arch, 6 feet wide between the piers, with recesses in each wall, 2 feet 6 inches deep. The ambreys and lights are of the plainest description. The attic under the vault had a door and passage leading to another reach of spiral stair in the north-west angle. No one remembers any remains of the upper story.[1]

From the lighthouse at the end of Galley Head is a noble view; over the Seven Heads the Old Head of Kinsale is just visible eastward, while westward the view sweeps round Ross Carbery, past Glandore and Castlehaven to Scullane, beyond which Clear Island and the Fastnets end the outlook.

Dunworley (O. S. 144).—The name is said to be *Dun mhuirgill,* I know not on what early authority, for in the record of the destruction (of the fort ?) by Finghin mac Carthaigh in 1260, it is called *Dun Urlaing.*[2] Smith, of course, attributes it to the O Cowhigs. In 1324 there appears in a serjeantry case in the Plea Rolls a place called Wyrmeley in Ocarbry,[3] which may be Dunworley in the Norman form. In later days it was held by the Barrys. Redmond, son of James Barry, held Downowrligg in 1573; and his son John in 1602 was pardoned, I presume, for some act during the rising of the Sugan Earl and the Spanish invasion.[4] Redmond died August 3, 1604, possessed of Dunorling or Dunuorling (which confirms the 1260 form of the name). John, who was then aged twenty-four, eventually enfeoffed it to Robert

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[1] Plan, Plate XI.

[2] Dublin Annals of Inisfallen, T.C.D.

[3] Plea Roll, No. 146, ann. xvii Ed. II, m. 8. I am not sure that this is not a slip for "Tymolag," Timoleague.

[4] Fiants 2249 and 6701.

Travers in 1623.[1] It passed to Sir George Hamilton, to whom Downerly was confirmed under the Act of Settlement in 1670.[2] Some part of the lands was left by Capt. John Sweet of Mohannagh, by his will in 1675; but Sir Robert Travers held it in 1655[3]; and it continued till very recent times in the hands of the Travers family of Timoleague.[4] Sir Robert Cox, 1690–1710, describes it thus: "Dunworley is fortified with a pittyfull castle inside on the neck of peninsula," to secure the cattle preys. Dr. Smith, 1750, tells us how there "is a peninsula of about 5 acres to which is a very narrow passage, and on this peninsula are the ruins of an old castle defended by square bastions to prevent people from landing. This was a place where the Irish formerly secured their cattle by night."[5] I do not understand his allusion to square bastions unless he (or his informants) multiplied the gatehouse. The day of my visit the headland was covered with cattle; and it was interesting to see them, when called out to water, going in single file, without delay or hustling, through the little doorways, the outer 3 feet 1 inch wide, by 5 feet high; the inner 2 feet 10 inches wide, and 5 feet 9 inches high. This shows how easily cattle might be brought through the small doors (but usually wider and higher than this gateway) in the dry-stone ring-forts.

The fort is a congener of the forts of the fifth type; two deep narrow coves (collapsed caves) named Cooshadurrus, nearly met in the middle. This neck was defended by a straight fosse, 40 feet long, 8 feet wide, and 6 feet deep at the ends, but filled opposite to the tower, like Dunpower and Dunalong; a small piece of the inner mound, about 9 feet long, rises about 8 feet over the fosse at the west end, beside the wall and the gatehouse. The turret is 19 feet 2 inches long, and is coarsely but strongly built. The small lintelled doors already noted adjoin the east wall inside. The room is irregular, from 9 feet to 8 feet 6 inches wide inside, by 12 feet 4 inches to 13 feet 6 inches long. It has a slit window, with a wide splay, in the south wall at the west end. The next floor rested on two long beams supported by two corbels each, and built into the east and west walls. Strange to say, another floor

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[1] Inquis. Chancery, No. 11 Car. I, June 11, anno i.

[2] Roll, xxii Car. II, Part 1, f. No. 12.

[3] Book of Distribution, p. 67.

[4] The following wills of the family are in the Cork Registry: Robert of Lislee, 1699; Robert, 1726; Robert Musgrave Travers, 1758; Francis, 1783; Walter, 1794; and Robert, 1795.

[5] "Regnum Corcagiense" (Cork Hist. and Arch. Journal, vol. viii, p. 173), Smith's "Cork," vol. i, p. 255. The belief is widespread, and doubtless based on a genuine tradition. Notable versions occur at Downpatrick Head, and Dunnamo in Co. Mayo. The impounding of cattle in forts at night is alluded to ("Senchas Mor," Rolls Series ed. vol. ii, p. 61) in early Irish literature.

rested on corbels barely 4 feet higher; the interspace was unlighted: it may have been a store; these lofts were reached by ladders, as in the turrets at the Old Head. The vaulted roof above the upper story is as unusual as the rest of the structure: it rested on two pointed arches, between which was a very small ope, a ventilator rather than a light, looking northward, but useless for outlook. The interspaces were spanned by stone slabs; the south-east corner is broken, with most of the top of the east wall. The roof is flat, and there seems no access to it. A wall runs westward on the cliff. The neck extends for 50 feet behind the gate, where it widens to about 60 feet. At 26 yards back is a low ledge, with a fenced enclosure in the north-east corner of the garth. I saw no hut-sites inside.[1]

OLD HEAD, OLDERNESS, DUN CEARMNA (O. S. 137).—The Old Head of Kinsale is the largest and longest promontory of the section of coast which we examine here and has the chief castle. The oldest legends told how, in a remote past, which later chronologists dated as A.M. 3667 (B.C. 1533), or A.M. 3501 (B.C. 1699), two kings, Cearmna and Sobharc, reigned in Erin,[2] and built at its opposite extremities Dun Cearmna and Dun Sobhairche or Dunseverick in Antrim. The Four Masters waver and some[3] support the assertion of the so-called "Annals of Clonmacnois" that the latter fort was built by Eremon about B.C. 1390. Keating[4] tells how Cearmna, who had slain his predecessor, fell in battle by Eochaidh Fabharglas, the blue-speared; at the fort, as some say. All we can deduce is, that early bards regarded the promontory-fort as remotely prehistoric, and with its sister fortress and Cathairchonrui (as the Triads attest) held it one of "the three (chief or oldest) forts of Erin."[5]

Another legend strikes one as more tangible than that of the brother kings. In Cormac's Glossary[6] we read how Nede mac Adnai the poet

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[1] Plans, Plate X. Giolla Coemain dates them B.C. 1380 in L.L.

[2] "Annals Four Masters," vol. i, p. 44; p. 490 (ed. O'Donovan) under A.M. 3667. "Ann. Clonmacnois" (ed. Rev. Denis Murphy), p. 32; "Ann. Ulster," vol. i, p. 368; Chron. Scotorum. "Keating's History," vol. ii, Book I, sect. xxv. Dún Cernmae is named as a limit in Ann. Ulster under 857. There was, however, another less celebrated Dún Cearna or Dún Bré (perhaps in Leinster), not to be confused with the Cork fort.

[3] Book of Ballymote, f. 23, says that Dun Sobairce and Dún Cearmna were built in the time of Eremon; the list in the Ann. Four Masters omits them.

[4] "History of Ireland" (ed. Irish Texts Soc. vol. ii), vol. i, sect. xxv.

[5] R. I. Acad., Todd Lecture ser., vol. xiii, p. 5. The only other early allusion to a promontory-fort on the south coast of Ireland known to me is *Oiléan O Bric* (or Danes' Island, Co. Waterford, Journal, R.S.A.I., vol. xxxvi, p. 251), fixed as the bounds of East Munster in the second century by the race of Oilill Olom (Keating's "History of Ireland," Irish Texts edition, vol. i, sect. iii, p. 127). Evidently the three forts in the Triads were selected as prominent outposts of each of the three coast-lines.

[6] Three Irish Glossaries (ed. Whitley Stokes), pp. 38, 39.

demanded a dagger from his uncle Caier, was refused, and bitterly satirized the chief. Caier, disfigured by the rhyme, fled to Cacher mac nEiderscéle in Dún Cermnai for shelter, concealing his name and rank. Later on Nede, who had taken the greyhound, chariot, and wife of his victim, drove up to the gate, and Caier indignantly betrayed his identity and fled. Concealing himself (presumably in a souterrain) under a flagstone, behind the Dun,[1] he was found by the dogs; Nede appeared, and his enemy fell dead of shame, but not unavenged—the rock burst into flame and exploded, and a splinter struck the satirist through the eye, piercing his brain. This story seems to imply that the fort was occupied by a member of the Corcalaidhe, among whom the name Eidersceol prevailed, and gave their descendants the name of O hEidersceoil or O'Driscoll. A poem of Cormac mac Cuillenan (*ante* 908), cited by Keating,[2] tells how, about 370, Criomthann, king of Erin, and his foster-son Connall Eachluath, king of Thomond, held Dun Cearmna among other forts in Munster.

It is a fair deduction that it, like Kinsale, was held by the Norsemen, for its name, down to the close of the thirteenth century, was Olderness or Oldernaze, which survives in an English form. As the Norse held Limerick, 812, and Cork in 820, it is possible that the names of Olderness, Edelfiord or Kinsale[3] Harbour, Oyster Haven, Osterhafn,[4] and Godelfiord date from the early ninth century. The actual history of the castle is far later, and begins under the De Courceys. It is the hard fortune of antiquaries to "spoil a good story," and modern research entirely discredits the descent of that family[5] from John de Courcey, the devastator of Ulster, and the story of his imprisonment being ended because he alone could face an insolent French knight who fled at the mere sight of him.[6] Late story ran that the injured nobleman refused compensation save the

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[1] These words clearly suggest the long fortified headland.

[2] Vol. i. p. 148.

[3] Edelfiord is a *quasi*-translation of the Irish ; *Edel*, *Ceann*, head or inner end ; *fiord*, *saile*, salt water creek. In the portolan maps it is Adelfronda in 1339 ; Adelforda, 1360 and 1497 ; Adelfrud, 1367 ; and Andelfronda, 1375. It is Endelford in the Patent Rolls Ir., 1395, and Kinsale de d Endilvorth on the old town seal.

[4] I owe this suggestion to Mr. James Mills, the Deputy Keeper of the Records ; if so, then Kinsale was the western haven.

[5] The old genealogists spent their time in inventing flimsy reasons to condone the wild statements of the pedigree, rather than in clearing away the debris. See generally "Lodge's Peerage" (ed. Archdall), vol. vi, p. 132, and the critical notes of G. E. C. in the Complete Peerage, vol. iv, and appendix, vol. v, p. 392, vol. viii, p. 435 ; also paper by J. Horace Round in "Antiquarian Magazine," vols. iii, and iv, and his "Peerage and Pedigree," vol. ii, p. 274.

[6] "Book of Howth," Cal. Carew Papers.

privilege to him and his heirs to wear their hats before the King. For all of this there is no contemporary evidence. Nor, in fact, is any known to me before 1662; Lord Courcy, "Baron of Ringrom . . . claimed a privilege . . . to be covered in the king's presence," as Fuller writes.[1] It has never been established before a competent heraldic court. The family springs from Patrick de Courcey, who married the daughter and heiress of Milo de Cogan, who brought him lands and claims to portions of the kingdom of Cork, before 1236[2]; there is no evidence to show who was Patrick's father; tradition is possibly right in saying Milo. Milo was a son of a John de Courci, junior,[3] a hostage for, and perhaps a kinsman of, the famous Earl in 1205.

The title was, of course, merely territorial; the family were lords of Rinrone, of Kinsale, and of Chrichchursi, but most usually Lord de Curci. The earliest mention known to me of their connexion with the Old Head is near the close of the century in the time of John, usually reckoned the fifth lord. John de Curci of Kinsale was slain in 1293 by Donald MacCarthy of Cork, and Donald Baskenagh of Kerry; his infant son, succeeded to Thaosaxe (Tisaxon), Crocheran (Croghane, near the Old Head), and Lisshiben in Oldernas. Vainly did Hubert, John's brother, call on the law for vengeance; for MacCarthy (prudently) "would not let himself be judged," and Baskenagh had "fled to the wilds of Kerry." MacCarthy was "among the Irish in waste places, where no serjeant or bailiff of the king would go to attach him" in 1279.[4] The Escheats and Wards Record (1303-6) mentions that Annora, John's wife, had dower in 1299 off Ballycouig (in Killbrittain), Belagh, Barretstown, Kempestown, Oldernast or Oldernase, Rinron and its mill, the weir of Tithsax, and the *prise* of fish at Kinsale, besides Ballwny, Glenardule, and Finwath, in Kerry, with rabbit warrens

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[1] "Worthies of England" (1662), Somerset, p. 26. No such grant is on record, but similar ones remain for persons with diseases in the head ("Peerage and Pedigree," vol. ii, p. 299).

[2] Cal. Documents 1293, No. 75, p. 39, 1302, No. 85, p. 43, Justiciary Roll (ed. Mills), 1297, p. 143, Close Roll, xxx Ed. I, m. 11; Patent Roll, xxi Edw. I, in 5; Cal. Inq. Hen. III, p. 64.

[3] Not "Young Milo son of John," as in Sweetman's "Cal. Documents Ir.," vol. i, p. 39. The text is not "Milo Fitz Jo de Courcy Juv (Juvenis)," but "Milonem fil. Johis de Courcey *Junioris*," in Patent Rolls, vi John, m. 4, which distinguishes John from th conqueror of Ulster. The Carew Calendar, last vol., p. 390, gives from Lambeth library, vol. 621, p. 75, an early charter of John de Courcey (of Ulster) and his wife Affrica, *ante* 1193, referring to John, son of the grantor's brother William de Courcey—was this "John Junior" father of Milo? Giraldus says John de Courcey had no issue by his wife Affrica, daughter of the King of Man. (Expug. Hib. Lib. ii, cap. xviii.)

[4] Cal. Documents Ir., 1293, No. 75, p. 39; 1302, No. 85, p. 43; Justiciary Roll Cal. (ed. Mills), 1297, p. 143; Close Roll, xxx Ed. I, m. 11, Patent Roll, xxi Ed. I, m. 5.

and fisheries.[1] We need not follow any further the history of the De Courceys,[2] but only that of Olderness. The "great sea-mark" figures in the early maps. Angelino Dulcert gives Cap Veio (Old Head) in 1339. Other maps give it as Cap Veco, 1360; Cauo Veyo, 1375; Cap Veio, 1460; C. Vicio, 1513, and C. Antiquo in 1518; there is no break in the records as Old Head from 1292 to our day. The family residence was more usually at Rinrone or Castle Park, places on the harbour of Kinsale and the Bandon River.[3] The De Courceys, like many other Normans, adopted the Irish name and customs,[4] and called themselves MacPatrick, whence the ring fort near Old Head is called Lisvicpatrick, and the Castle on the Head, Dunmicpatrick. It was probably in the fifteenth century that they added the three towers and the long cross-walls to the fosse and ramparts of Dun Cearmna. The great cliffs haunted by the eagle and falcon[5] defended it on all other sides, and the nearly overhanging hill had no terrors where even medieval siege engines were unknown. The family fortunes fell to their lowest ebb under Elizabeth; the castle, which Sir Henry Sidney had described in 1576 as "one of the fortificablest places that ever I came in," was mortgaged by Lord Gerald with "the manor of Down McPatrick *alias* the Old Head of Kynsale." He was fined and pardoned for this in 1587.[6] His successor John, the "sixteenth" Baron,

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[1] Carew MSS., vol. vi, 21*f*, 36*b*; Calendar, last vol., p. 371.

[2] The succession of the Lords was—1 (possibly), Milo, 1204, 1233; 2, Patrick, 1260; 3, Nicholas, 1280; 5, John (perhaps not "Lord"); 6, Miles; 7, Miles, died 1359; 8, John, d. 1387; 9, William; 10, Nicholas, died 1430; 11, Patrick; 12, Nicholas, died 1475; 15, David; 16, John, died 1535; 17, Gerald, 1599; 18, John, 1628: collaterals; 20, Patrick had twenty-three children, died 1663; (his grandson) 24, Gerald, d. s. p. m. 1759. After this I find no record of their residence at the Old Head.

[3] Castle Park, replaced by King James' Fort, a most interesting modern ruin, well worth study. The Hardiman map, *circa* 1602, shows "Lord Coursey's" castle on the south bank of the Bandon river, far above Rinrone, with a fine park.

[4] So did the Geraldines; the succession of the Earls of Desmond was virtually by tanistry. John, Lord de Courcey, who died 1358, had married an O'Brien of Thomond.

[5] Smith, vol. ii, p. 320, notes that the Earl of Kinsale, living at the Old Head, 1750, had an eagle from the cliffs, more than 7 feet across the wings. It is a mere (but curious) coincidence that the family arms have three eagles displayed. The seal of Patrick, eleventh Lord (*circa* 1450), has a two-headed eagle displayed. Giraldus (Expug. Hib., lib. ii, cap. xvii) mentions the arms of John de Curci—"pictas in clipeo aquilas." So the Kinsale family wore their arms with a difference in about 1430-50. It occurs on a deed of a later Lord Gerald, 1559. As to the falcons of this coast—there is a lawsuit (Plea Rolls, No. 117, an. xi Ed. II, mem. 18); John, Bishop of Cork, in 1318, impleaded W. fitzDavid de Barri, who "cum sequela sua II falcones, lauer. formel. in quod. nido ip. epi, vi et armis, contra pacem, cepit et asportavit." Philip Roche, June, 1535, sent a merlin, two falcons, and a sparrow-hawk to Thomas Cromwell, Earl of Essex, from Kinsale. For the seal "Sigillum Patricii filii Nicholai Courcey," see Cal. Carew MSS., last vol., p. 360.

[6] Cal. Carew MSS., last vol., December, 1600, p. 500.

mortgaged the castle to Florence, son of Sir Donough MacCarthy, Lord Gerald having himself married into that family. This alarmed the Government;[1] they took Florence prisoner the very day when he, having "compassed the title of Old Head," "minded to ryde thither to take possession." Sir Geoffrey Fenton alludes to MacCarthy's attempt to acquire it, and seems to have inspected it when he rode round the coast in 1595. It was handed back to Lord John to "ease her Majesty of the charge of the ward now kept there"; but was used as a watch tower in 1602, when Sir Richard Percy sent a sergeant and six men to it to watch for the Spaniards. Their reports picture vividly their anxious watch—they thought they heard ordnance out to sea or saw a "tall ship" in the gloom, or were told of small scouting-vessels rounding the head, but "the Spanish fleet they could not see," for none was sent after the fall of Kinsale.[2] Their approach to the place had been seen from it, September 23, 1601, and in 1667 watch was kept for the Dutch, and the English fleet caused much alarm. After the death of Elizabeth, Lord John and his son and successor Gerald enjoyed the royal favour; John surrendered Old Head, and got a re-grant by Letters Patent from James I, 1620; and he asserted his right to the title of Kinsale.[3] In 1647 Patrick, Lord Courcey, Baron of Kinsale, wrote to the Lord President of Munster petitioning for "the Castle of the Ould Head, detained from him under pretence of a warrant from his Lop [Lordship] for the service of the State."[4] The last of the family to reside at Old Head were Gerald, the twenty-fourth Baron, and his wife. She died at the Head in October, 1750.[5] He lived there for nine years more, and after his death the castle fell into ruin.

THE BUILDINGS.[6]—The castle stands at the foot of a low hill crowned by the old signal-tower, a relic of the old fear of French invasion under Napoleon.[7] It has a fine outlook to the Seven Heads, and Galley Head over them, and in the other direction westward on to the Doons, Barry Head, and

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[1] Cal. State Papers Ir.; also Journal R. Soc. Antt. Ir., vol. viii, consec, p. 388, and Fiant 5029.

[2] Cal. State Papers Ir., 1601–3, p. 478.

[3] "Council Book of Kinsale" (Richard Caulfield), p. xv, Egerton MS. 19,865. The petition was by Lord John and his son, Gerald, 1627, Ap. 2.

[4] Southwell MSS. ("Council Book Kinsale"), p. 331.

[5] G. E. C., Complete Peerage, iv, p. 396. In the same year (1750) Smith, vol. i, p. 241, however, says, "*two miles from the Old Head* is the seat of Lord Kingsale."

[6] The only paper on the Old Head in recent years, Cork Hist. and Arch. Soc. Journal, vol. xviii. (1912), p. 77, only gives a few lines on the ruins. John Windele's sketches are in MSS. 12 J. 9, R. I. Acad., George Du Noyer's in R.S.A.I. Collection, vol. viii, pp. 735–740. Windele has a tradition that the castle was first built by an O'Kearney, others say that "it was ruined by the French." Neither seems true.

[7] Smith's "Cork," vol. ii, p. 320.

Power Head. The castle has outside it a large fosse, straight, east and west from cliff to cliff, partly cut in the rock. Being so closely similar to other forts (such as Port Conaghra in Mayo, Doonegall in Clare, Brumore, Doon Castle, and Dunsheane in Kerry, Dunabrattin in Waterford, Baginbun in Wexford, and Dromanagh, in Co. Dublin), it may very probably be a remnant of the earlier promontory-fort,[1] but there is nothing to decide the question. It has no outer mound, and is of variant depth and width from 5 to 8 feet deep, 21 to 25 feet wide above, and usually 12 feet below. From 7 to 10 feet behind it, runs a mortar-built wall on a mound. This rampart is over 390 feet long, about 194 feet eastward, and 166 feet westward from the keep; the broken ends and dangerous edges at the cliffs prevent more accurate measurement. It had a central tower and two turrets; the eastern had fallen before 1842; the western seems on the point of collapse. They lie 76 feet to the east, and 105 feet to the west of the keep. The central tower is 27 feet 3 inches long and 21 feet wide, a plain peel-tower projecting 12 feet before the line of rampart. The basement floor is down two steps. It is irregular, about 12 feet 6 inches by 19 feet to 21 feet 5 inches. There is a spiral stair in the south-east angle, resting on a corbelling, and beginning at the second floor about 10 feet up, with rude plain steps and small slits. The walls vary in thickness from 5 feet 9 inches to 4 feet 4 inches. Slits in the west wall commanded the gateway, which adjoined the keep on that side; others are to the east and south. The next floor rested on rude corbels; it was entered by a door at the foot of the stair, and had slits; over it, and under the pointed vault, was an unlighted attic. The north-east angle of the tower is broken down. The top story over the vault had high battlements for shelter to the west, but no window in that direction; its east wall is destroyed, and the steps broken, though their ends remain in the well. Its slit windows faced the north and the south.

To the east of the basement is a room 9 feet wide, with a loop in the rampart. Next it is a sunken room, 35 feet 4 inches by 25 feet with a recess in the north-west corner, 4 feet 4 inches deep, and walls 6 feet 6 inches thick. The east turret has walls only 3 feet thick; and it is 12 feet 10 inches long inside, with a north light; nearly all has fallen At 8 feet from it is the end wall of a room.

On the west the gateway, 11 feet 3 inches wide, and wall are defaced, and a modern ruined house takes the place of the latter, and is 34 feet 6 inches

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[1] The Plea Roll, No. 101, an. 8 Edw. II, m. 7 d, gives a suit of Milo f. Jo de Courcy against Gilpatrick Oboghil "for debts in the fee of Dune." If this be Duncearmna, it is the only shadow of the name known to me as existing in Norman times. The Norse name had slain the memory of the prehistoric prince.

long. The rampart beyond it has a loophole. The west turret is a tall, thin structure, recalling Dunlicka Castle, Kilkee, before its fall. The injuries to the east window and south-east angle have cracked and settled the wall, and the upper part leans southward and must soon fall. It is very irregular inside, 7 feet to 7 feet 6 inches by 6 feet, the walls are only 3 feet 4 inches at the faces, and 2 feet 6 inches to the sides. A ledge for a floor remains 4 feet 6 inches above the present ground; another farther up has a decayed old floor with a trap-door[1] resting partly on an offset and partly on flags, so far as I could see in the gloom. It has lights to the north and east in the top story, and one to the east in the middle story just commanding the outer wall of the keep. A building adjoined it to the south, but is levelled. Traces of a wall 276 feet long are at the east cliff with a well-built pier at a salient angle at the end of the inner rampart and ditch. These lie 286 feet away from the inner face of the keep; the wall is levelled and even dug out; the fosse is 12 feet wide and rarely over 3 feet deep, being filled with debris.[2]

Conclusion.

The remains, given in their natural order, run from Sherkin to Knockadoon as follows:—

In Carbery: *Sherkin*; 1, Carrigadoona; 2, Faillnalour; 3, Dunalong (and perhaps Reenaraha)[3]; 4, Coosdoon (perhaps the shore-rock there was once fortified, as the name implies); 5, Dooneendermotmore; 6, Coosdergadoona; 7, Portadoona; the Battery cliff may have been fortified; 8 Reen Point; 9, Carrigillihy; 10, Downeen.

In Ibane and Barrymore: 11, Dunoure; 12, Dundeady; 13, Dunowen; 14, Dunnycove; 15, Coosbwee; 15, Dunworley; 17, Portadooneen (these three last in Barrymore).

In East Carbery: 18, Rochestown. In Courceys: 19, Dunmicpatrick (Old Head). In Kinalea: 20, Cummeradoona (a short headland-platform partly fenced by a natural gully); 21, Little Doon; 22, Big Doon; 23, Dunbogey (Barry's Head); 24, Dunsorske.

In Imokilly: 25, Dunpoer (Lahard); 26, Dooneenmacotter; 27, Ballytrasna; 28, Knockadoon (?).

It only remains for me to acknowledge much kind help and hospitality which I have received in collecting these notes, and without which they had

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[1] Windele (*loc. cit.*) says it had "a rude staircase" in 1844. This must have been only of wood.

[2] View, Plate IX; Plan, Plate XI.

[3] The name "point of the Rath" is significant, but the earth-cap is all washed away.

been more imperfect even than I fear they may prove to be. Dr. George Fogerty, R.N., was the companion and helper of my work from Sherkin to Roberts Head. Mr. Spencer Travers, of Dooneen, Co. Limerick, and his brother Mr. Travers, of Timoleague, gave me much assistance round Courtmacsherry. To Mrs. Stacpoole of Ardavilling, Cloyne, I owe the completion of my work along the coast of Imokilly. Mr. Francis Hyde Maberley, of Carrigaline, gave me some useful notes on the Doons of Kinure. In the Records I have to thank Mr. James Mills, the Deputy Keeper, and Mr. M. J. M'Enery for their usual kind and skilled suggestions, and Mr. E. C. R. Armstrong for a timely reference; while of my predecessors I owe especial obligation to O'Donovan's "Corca Laidhe" and to the less widely known books of that unsparing worker on Cork History—Richard Caulfield.

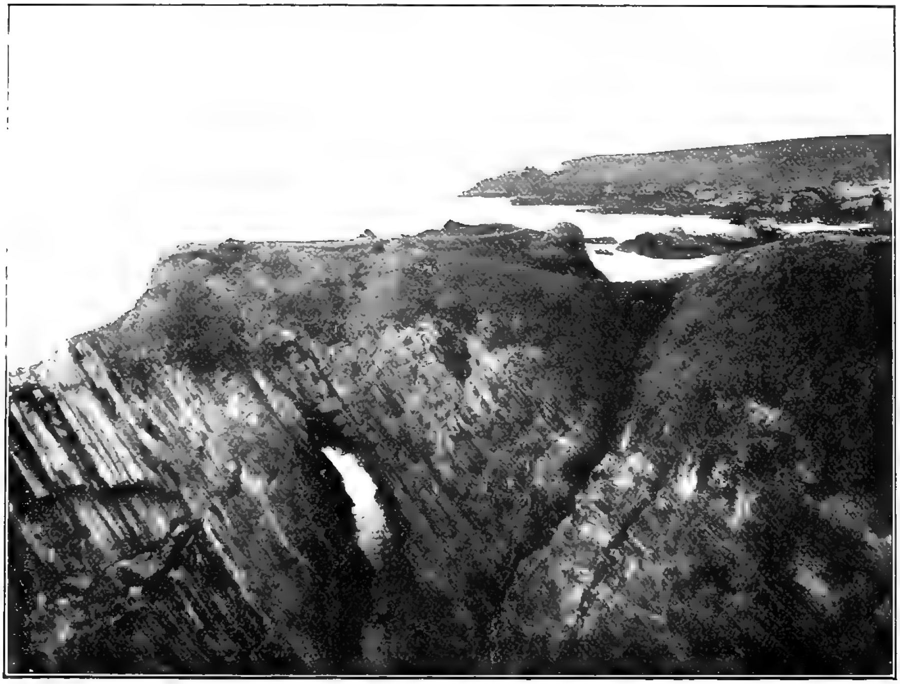
DESCRIPTION OF PLATES VIII–XI.

VIII. 1. Dooneendermotmore, Toe Head, from S.
  2. Dunsorske, Reanies, from N.

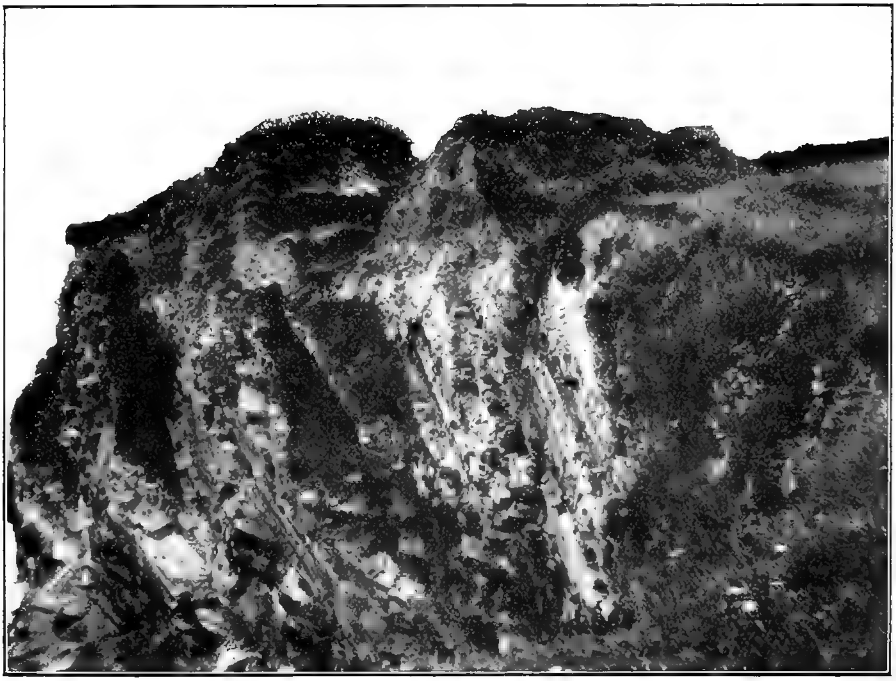
IX. 1. De Courcey's Castle, Old Head of Kinsale, from N.
  2. O'Driscoll's Castle, Dunalong, Inisherkin, from S.W.

X. Plans of Forts and Castles.

XI. Ditto. A, Keeps. B, Halls. C, Turrets. D, Later houses. E, Gateways. F, Fosses. G, Mounds and walls. H, Springs.



Dooneendermotmore Fort, Toe Head.



Dunsorske Fort, Reanies.

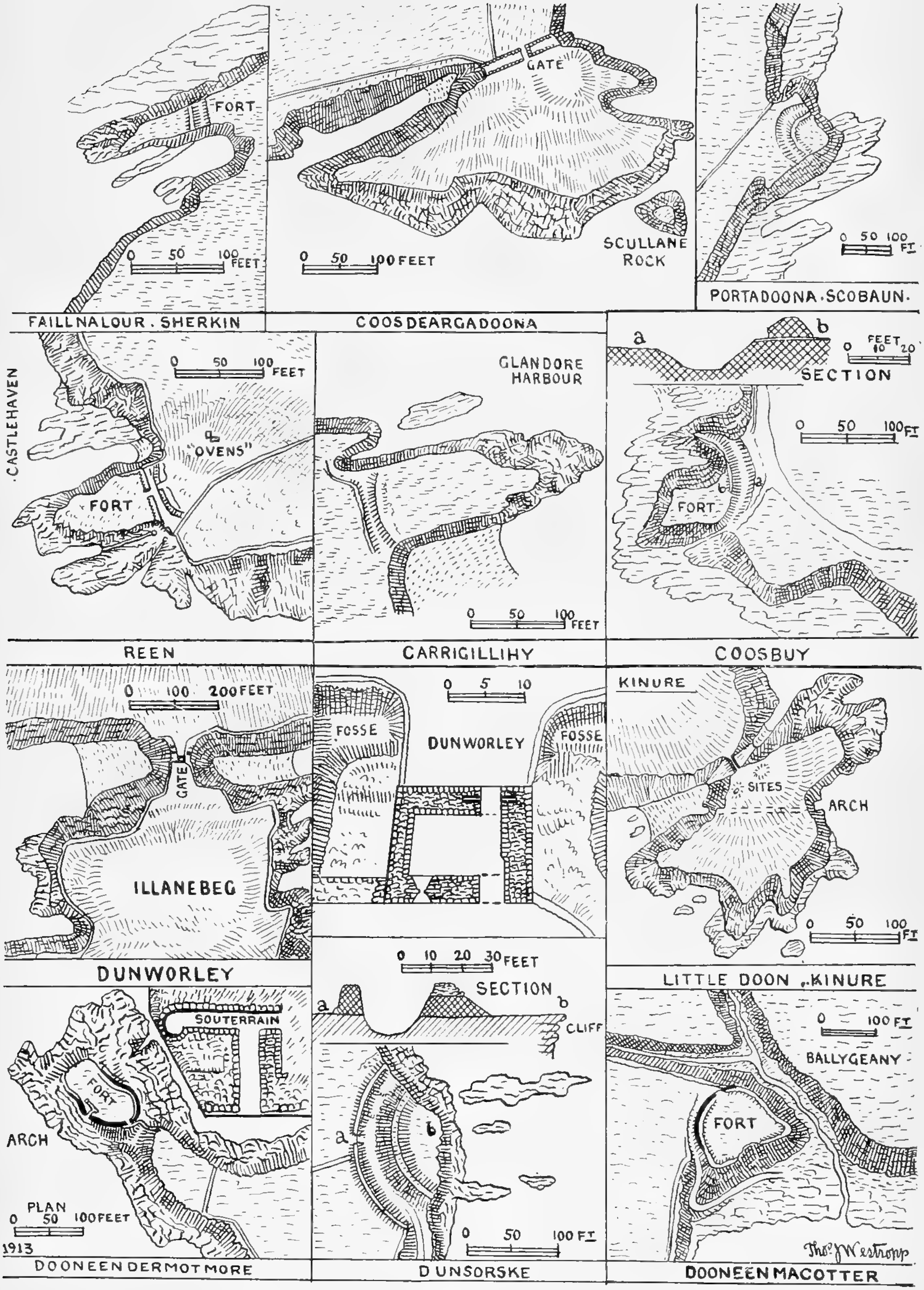
Westropp.—Fortified Headlands, &c., on Coast of Munster.

De Courcey's Castle, Old Head of Kinsale.

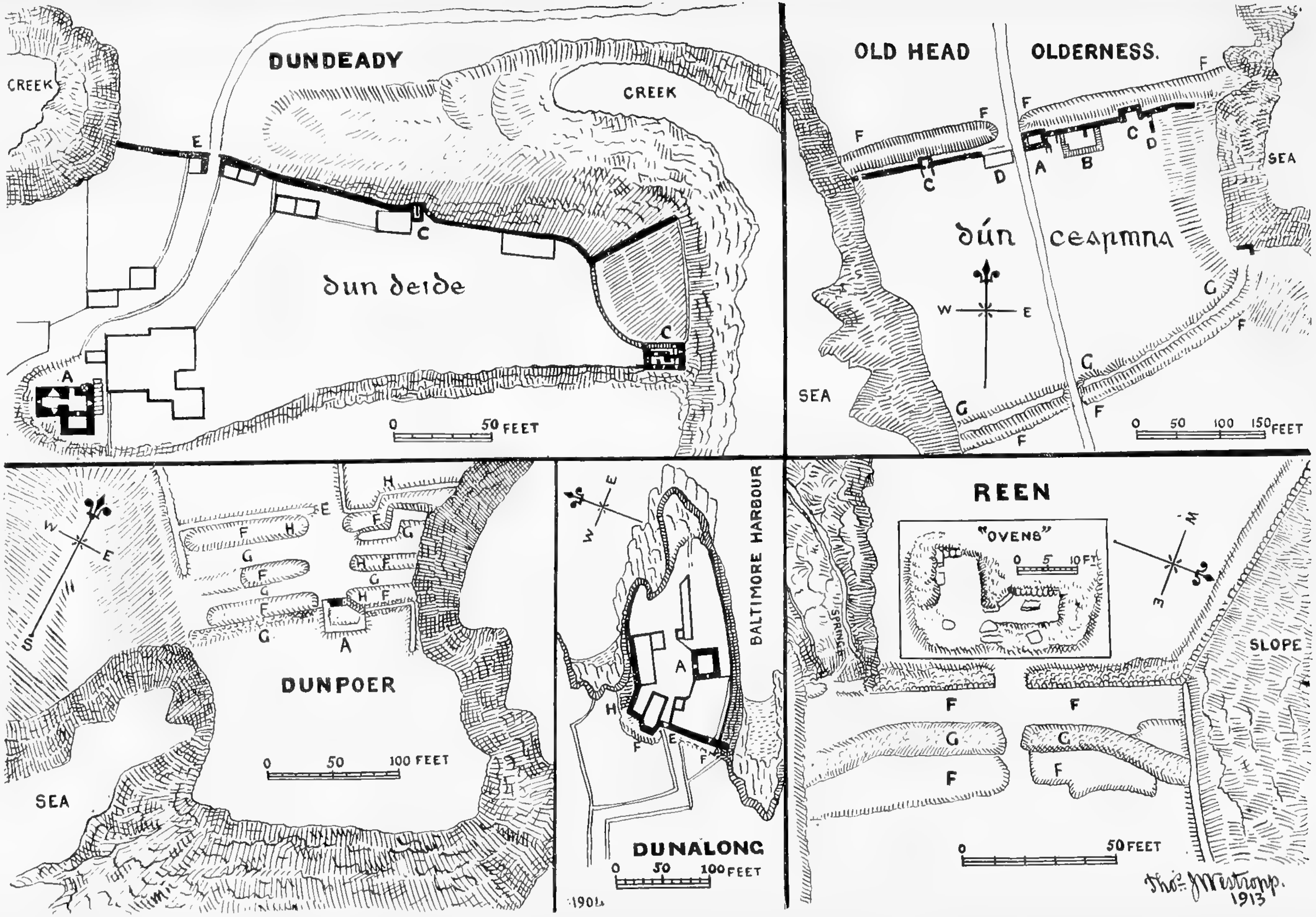
O'Driscoll's Castle, Dunalong, Iniskerkin.

Westropp.—Fortified Headlands, &c., on Coast of Munster.

Plate X.



Westropp.—Fortified Headlands, &c., on Coast of Munster.



Westropp.—Fortified Headlands, &c., on Coast of Munster.

VII.

PRINTING IN THE CITY OF KILKENNY IN THE SEVENTEENTH CENTURY.

By E. R. McCLINTOCK DIX.

Plates XII–XIII.

Read November 10, 1913. Published January 5, 1914.

Last year I was afforded an opportunity of submitting to the Academy a list of all known books, pamphlets, etc., printed in the City of Cork in the seventeenth century. Items of any printing in Ireland during that century are of interest; and it is important to record and preserve them, but particularly is this so of printing in our provincial towns.

Following as a precedent the "Cork" list, I now submit to the Academy a list of printing in the City of Kilkenny in the same century.

I wish to make a few comments upon it, and also to give some other information.

In the first place, it should be pointed out that printing in Kilkenny in that century arose through the political emergencies of the time, and of the wars, principally between the Royalist and Parliamentary parties. When the Catholic Confederation was established, they took up their headquarters and held their Parliament in the City of Kilkenny, and there continued until the Royalist cause was defeated. The printing in Kilkenny in the seventeenth century lasted that period, and then ceased there. Accordingly this printing was limited to a period of less than ten years, namely, between the years 1642 and 1649, inclusive. But that period must be divided into three parts, viz.—first, the printing done prior to 1646 for the Supreme Council; secondly, the Press of the Society of Jesus, which was taken over by the Supreme Council; and thirdly, the printing by William Smith, printer to the Duke of Ormonde during the very brief period he governed alone in Kilkenny for the King. I will deal with these three periods now more in detail.

It should be mentioned that the Confederate Catholic party first got over a press from the Continent; and such press was worked for a time in Waterford by Thomas Bourke, their printer. The output of that press will be dealt with in a subsequent paper; but printing in Waterford appears, so far as such press was worked by the Confederate Catholic party, to have certainly ceased in the year 1646. Whether Bourke's press was transferred from Waterford to Kilkenny is not perfectly clear. At one time I thought that this was what happened, as printing ceased in Waterford and became much more abundant in Kilkenny in the latter part of the fifth decade of that century; but Bourke's name appears on only one (which seems strange) imprint of Kilkenny printing, and some very interesting information has been kindly placed at my disposal by the Rev. E. Hogan, S.J., M.R.I.A., which I shall mention concisely here, as it throws light upon the printing in Kilkenny at this period.

In the custody of the Jesuit Order in Dublin is an original or contemporary copy of a valuable document dealing with disputes which arose between the Order at the time in Kilkenny and the Lord Nuncio and the Supreme Council of the Confederate Catholics. Father Hogan has kindly given me a translation of the third and fourth paragraphs of this document, which refer to the printing-press; and, with his permission, his translation will be printed as an appendix to this paper; but the substance of it may be given shortly as follows:—

The Society had in Kilkenny a printing-press in their House of Novitiate, which they used for printing certain documents in connexion with their Order. The complaint against them was that, when asked for the use of this press for the service of the Nuncio, they had refused permission, and that they had assisted the Supreme Council in carrying away the press so that it would not be in their power to assist the Nuncio. This they denied; and alleged that the press was taken from them by the Supreme Council by authority, and so they had no control over it at the time; and the report of the visitor, who was sent to inquire into this complaint, entirely confirmed this answer.

He states at some length that the press was used in the College of the Jesuits for their own purposes, but that in one sheet which was printed there Lord "O'Neale," who was one of the Supreme Council, was reflected upon adversely, and the Supreme Council took offence at this, reproved the Jesuits for it, and subsequently issued a proclamation prohibiting anything being printed unless it was signed by seven of the Councillors. This proclamation was made in April, 1648. The Council afterwards (in May) sent their secretary, and he took possession of the press, and also took over the men who worked at it, who were ordered to work for the Council's wages. It was only after this that when the Nuncio applied for the use of the press, the Jesuits could not accede to his request, as they had no further power over it.

Incidentally the name of the principal printer of the Order is mentioned, namely, Brother Nicholas Sarrazin. The facts of the matter appear to have been made clear to the Nuncio ultimately.

The interesting part of this record, and one throwing light on the matter of printing, is this, that it shows that not only was there a press at Waterford, but that the Jesuit Order had its own printing-press, and that it was taken over bodily by the Supreme Council, and used, in part at least, for their own printing in Kilkenny.

Now, in some of the extant printed pamphlets published in Kilkenny, there is undoubtedly some difference of type. My attention was drawn to this fact some time ago (before I knew of this second press) by Mr. Robert Steele, the eminent bibliographer. Therefore, there seem to have been two presses used by the Supreme Council at Kilkenny, or one at Waterford and another at Kilkenny. The press at Waterford was ultimately seized by the Cromwellian party when they obtained possession of the town in August, 1649.

The total number of items given in the subjoined list is forty-four. Some of them are merely reprints of documents originally printed in England or elsewhere. Others, conversely, are only known by the existence of a reprint in London of the Kilkenny-printed pamphlet. For some no place of printing is given; but trom the type and ornaments or date, or from the nature of the contents, it seems almost certain that these were printed there. The first two items in the list are uncertain. The third item is of great interest, being a political drama in verse, and one of the very earliest pieces of dramatic printing in Ireland. Some of the items are of a religious nature, and more are political.

The fact that there was a press in Kilkenny in use by the Jesuits suggests that the first few items were printed at it, and not at Bourke's press. The last imprint with Bourke's name is dated 1646, at Waterford.

I was fortunate enough to secure some of these very rare pamphlets at a sale a couple of years ago, a volume of them being sold in Dublin at an auction of books from the County of Waterford or Cork—I am not quite sure which now. And I think that the copies in my possession are probably unique. Two or three I presented to the Academy as specimens of printing, and they are now in a glass case in this room. Some of these pamphlets are in Latin, and many are included in the "Carte" collection in the Bodleian Library, Oxford. Others are known by references to them in histories and other similar works.

At the end of the decade (1649) when the Marquess of Ormonde had, on behalf of the King, again obtained possession, and the work of the Supreme

Council had come to an end, it would seem that he employed his own printer, William Smith, for printing in Kilkenny, probably using one of the presses of the Supreme Council. Smith afterwards removed to Cork, as will be seen by reference to my Cork list. It is quite possible that some of these rare Kilkenny pamphlets have not been known to historians, and they will be found worthy of examination. They represent various sections of the parties that were in power at Kilkenny at the time, and, as showing the different views of that day, are deserving of attention.

The extant copies of Kilkenny printing are scattered, and comparison is very difficult. Could they be all brought together, a close examination of type, initial letters, and ornaments would enable a fairly accurate decision to be arrived at as to which press was used in printing each item, viz. the original press or that of the Jesuits, and which was used by Ormonde's printer.

LIST.

1642. A Discourse between two Counsellors of State ye one of England and ye other of Ireland.

Printed at Kilkenny *Decr.* 1642. 4to.

[*Vide* The Irish Librarian, vol. ii, p. 33.]

1642/3. Oath.

[*Query* at *Kilkenny.*]

1645. A Tragedy of Cola's Furie, or, Liranda's Miserie. Henry Burkhead. (In five Acts: in Verse.)

"Printed at *Kilkenny*: 1645. And are to be sold at the Signe of The White Swanne, in Kilkenny M,DC,XLVI." Sm. 4to. Title leaf + 3 leaves (Epistle Dedicatory, &c.) + 62 pp.

[British Museum, / C. 21. c. 24.]

Note:—On the verso of the title-leaf is "Names of the Chiefe Actors," i.e. Characters. No printer is given.

[1645 ?] Two separate Documents of "Articles of Agreement between his Majesty's Commissioner and the Deputies of the Confederate Catholics," both dated the 25th day of August, 1645.

Prited [sic] at Kilkenny by Command of the Councell and Committee." 4to. No title. 7 pp. + 1 p. (imprint). Sigs. A–A4.

[E. R. McC. Dix.]

1645/6, March 3rd. Order of the General Assembly of the Confederate Catholicks of Ireland. Dated at Kilkenny.

Ordered to be printed—Sine Nota.

[Bodleian—Carte, 16,617.]

1646. A Survey of the Articles of the late Rejected Peace Concluded In the Marques of *Ormond's* Cabinet in *Dublin*, the 29 of *July*, 1646, and there published, as if the same were concluded the 29 of March before, In which Survey it is proved by notable observation upon some of the said Articles, that the said Peace is destructive of the Catholique Faith, disadvantageous to His Majesty, pernicious to his Catholique subjects, and Favourable only to rebellious Parliamentary Heretiques, &c., &c., &c. The First Part. "Walter Enos, Dublinian, Priest, and D. of Divinity."

4to. 7 leaves + 70 pp. + 1 p. (errata). Folds in two, or foliowise.

[Brit. Mus. / G. 5594 ; T.C.D. / Press A. 332 :—wants one leaf (errata).]

Note :—The preliminary seven leaves have separate signatures : the signatures of the paginated leaves are A–S 1.

1646. The Second Part of the Svrvey of the Articles of the late Reiected Peace Wherein the Invaliditie and Nvllitie of the Said Peace is proved out of many heads or causes. Walter Enos, D.D., Treasurer of Ferres.

4to. 129 pp. (last blank). No title-leaf. Signatures A–V in fours. "Printed at Kilkenny, by permission of Superiors and approbation in the yeare, 1646."

[R.I A. / H.T.—Box 43 / 23 ; Univ. Library, Cambridge, / Hib. 7. 646. 19 ; *Vide* also Hazlitt : Bibliographical Collections and Notes, Third Series, 1887, p. 75.]

Note :—This appears to be a continuation of the First Part, although with separate signatures and pagination.

1646. Proclamation "By the Ecclesiastical Congregation of the Clergy of Ireland, *For avoyding of unnatural distinction betweene the old Irish and the old and new English, betweene Septs and Families*," &c. Dated at *Waterford* the first of September, 1646.

S. sh., fol., within a border.

[R.I.A.]

Note:—No imprint, but Kilkenny ?

1646. A Declaration of the General Assemblie of the Confederate Catholicks of Ireland, Suppressing Protestations, touching the Conditions of Peace or War, &c. Dated 4th July, 1646.

A broadside (14 × 12$\frac{3}{8}$). Second issue. Roman letters.

[Bodleian Library, Oxford—Carte MS. xviii, fol. 8.]

Note.—This Declaration was printed at Waterford in 1645.

1646. The Articles of Peace, made, concluded, accorded. and agreed upon by and betweene his Excellency Iames, Lord Marquesse of Ormond, Lord Lieutenant Generall and Generall Governor of His Maiesties Kingdome of Ireland, His Maiesties Commissioner, to treate, and conclude a peace, with his Maiesties Roman Catholique Subjects of the said Kingdome, &c.

Date of Articles—28 March.
„ „ Ormonde's Proclamation—30 July.
„ „ Council of Confederate Catholics—4 August.

"Kilkenny, Printed by Authority in the yeare, 1646." 4to. 28 pp. (including Title page, p. 2 blank).

[E. R. Mc.C. Dix.]

1646. Reprint of the Proclamation by the Marquis of Ormonde, Ld. Lt., &c., publishing the Articles of Peace & dated 30 July, 1646. S. sh. fol.

[P. R. Office London /S.P.I. 261 (38).]
N.B.—No printer is given.

1646. The Decree of Excommunication, by John Baptist Rinuccini Archibishop and Prince of Firmo, and by the Congregation of secular and regular Clergy. Dated at Waterford, 1st September, 1646.

Folio. S. sh. (11½ × 7¾). Roman letter.

[Bodleian Library, Oxford—Carte MSS. xviii, fol. 414, and lxv, fol. 328; R.I.A.
Note.—There is no imprint: it may have been printed at Waterford.
Note.—Mr. Robert Steele says that the type of this "Decree" is different from the type used by Bourke, and suggests that Rinuccini had a separate press of his own; but the surrounding ornaments are the same as those used by Bourke in his press.

1646. A Declaration of the Council and Congregation (of the Confederate Catholicks) against plundering the goods of the Roman Catholiques inhabiting within the English Quarters. Dated at Kilkenny, 28 September, 1646.

Folio. S. sh. (13⅜ × 8). Roman letter. S.N.

[Bodleian Library, Oxford—Carte MSS. xvii, fol. 616.]

1646. A Decree of Excommunication Against such as Adhere to the Late Peace. By John Baptist Rinuccini, Archbishop and Prince of Firmo, and by the Ecclesiastical Congregation of the Clergies of the Kingdom of Ireland. Dated at Kilkenny, 5th October, 1646.

Folio. S. sh. (10⅞ × 7½). No arms. Roman letter.

[Bodleian Library, Oxford—Carte MSS. lxv, fol. 330.]
Note.—There is no imprint.

[1646?] The Marques of Clanrickard's Engagement of the nineteenth of November, 1646.

4to. No title. 8 pp. (unnumbered). Sigs. A–A2 & B–B2.

Note at end:—"By the Councell & Congregation Whereas an Instrument intitled the Engagement of the Marques of Clanrickard . . . was presented unto us importing propositions . . . we have directed them to be sent to the presse, &c."

[E. R. McC. Dix; Univ. Library, Cambridge, /Hib. 7, 646, 18.]
Note.—No imprint, but Kilkenny.

1647. Orders and Establishments made and concluded upon by the Generall Assemblie of the Confederat Catholiques of Ireland mett at the Cittie of Kilkenny the 12 day of November Anno Domini 1647 concerning the Government of the Kingdome.

"Printed at Kilkenny, 1647." 4to. No title. 18 pp. (last page misnumbered 17 instead of 18). Sig. A–A4: B–B4: & C1.

[E. R. McC. Dix.]

1647. Orders to Bee observed by all Commanders Officers Soldiers Quarter-Masters and others in the thoroughfare of the Army or any parte of it.

"Kilkenny, 1647." 4Bo. No title. 7 pp. (unnumbered) + 1 p. (blank). Sigs. A–A4.

[E. R. McC. Dix.]

1647. By the General Assemblie of the Confederat Catholickes of Ireland. An Establishement for the Courte of Generall Judicature. April 2. (Signed "P. Kearnie.")

4to. 4 leaves A–A4. 20 cm.

[Univ. Library, Cambridge, / Hib. 7. 647. 30.]

1647. An Oath, The Propositions mentioned in the Foresaid Oath, and an Order of the General Assemblie of the Confederate Catholicks of Ireland, Dated 12th March, 1647.

[*Vide* London reprint entitled: "The Bloody Diurnall from Ireland," &c., in the Brit. Mus. / E. 386. (16); T.C.D./Press, A. 4. 1; Nat. Liby., Dublin—Thorpe Collection, vol. iv; Bodleian Library, Oxford—(3 copies)—Wood, 509 (15); Gough, Ireland, 68; Bliss 2, 2328; E. R. McC. Dix.]

1647. The Establishments made by the General Assemblie mett at the Cittie of Kilkenny the 12. day of November Anno Domini, 1647.

"Printed at Kilkenny in the yeare of our Lord 1647."

4to. No title. 8 pp. Sigs. A–A4.

[E. R. McC. Dix.]

1648. Queres concerning The Lawfulnesse of the present *Cessation* and of the *Censures* issued against all Confederats adhering unto it. Propounded *By the Right Honourable the Supreme Councell to the Most Reverend and most Illustrious* David, *Lord Bishop of* Ossorie, *and unto other Divines.* Wit Answers Given, And Signed by the said Most Reverend Prelat and Divines.

"*Printed at* Kilkenny, Anno 1648." 4to. ($7\frac{3}{8} \times 5\frac{1}{2}$.) Collation as follows:—Sigs. Title-leaf and 2 leaves following have neither signatures nor pagination. Then follow B, C, D, E, F, G, H, I, K, L, M, N, O, and P, all in twos. The recto of Sig. B has no pagination, which begins on the verso of B and continues to P (recto) = 52 pp. The verso of P is blank, as is also the recto of P2,—the verso of which is printed with flowers in nine perpendicular lines in a frame.

[R.I.A./T.—Box 56/6—*missing*; Nat. Lib., Dublin; T.C.D.; Univ. Libry., Cambridge.]

1648. [Manifesto] by the Supreme Council of the Confederate Catholicks of Ireland. Dated 29th May. Protest against the Nuncio's attempt to oppose cessation of arms, &c.

Sm. fol. (16 × 12).

[*Vide* Madden: Irish Periodical Literature, vol. i, p. 136.]

Query.—Is this a repetition of some other entry? See next item.

1648. Proclamation of the Supreme Council of the Confederate Catholiques of Ireland complaining of the Nuncio, Rinuccini, for interference and admonishing the Confederate Catholicks not to be withdrawen from obedience to their commands. Dated at Kilkenny, 27 May, 1648.

A broadside (14½ × 9).

[Bodleian Library, Oxford—Carte MSS. xxii, fol. 108.

1648. Declaration of the Supreme Council of the Confederate Catholicks of Ireland, admonishing all prelates, etc., not to molest those approving of the late Cessation, etc. Dated at Kilkenny, 3rd June, 1648.

Arms. Roman letter. A broadside (13¾ × 8½).

[Bodleian Library, Oxford—Carte MSS. xxii, fol. 122.]

1648. Proclamation of the Supreme Council of the Confederat Catholicks of Ireland, against Malitious Reports, and re-affirming their former Declaration of 22nd May, last, etc. Dated at Kilkenny Castle, 7th July, 1648.

Arms. Roman letter. A Broadside (15⅜ × 9½).

[Bodleian Library, Oxford—Carte MSS. lxv, fol. 418, & xxii, 145—two copies.]

1648. An Oath, in pursuance of the *Oath of Association* taken by the Lords and Gentlemen met at Kilkenny, the 20th of June, 1648, and by the *Supreme Council* directed to be taken by all the *Confederate Catholicks* With Declaration as to the meaning of the word Excommunication.

[*Vide* P. Walsh's History of Irish Remonstrance, Appendix, etc., p. 331.]

[1648.] The Copie of the Major and Baylifs of the Towne of *Weixford* their Letter directed to the Right Honourable the Supreme Councell of the Confederate Catholickes of *Ireland*, &c., &c. Dated "14 July, 1648."

4to. 1 leaf (blank) + 5 pp. + 1 p. (blank) = 4 leaves.

[E. R. McC. Dix.]

Note:—No imprint, but Kilkenny?

1648. Manifesto by the Supreme Council, etc., against the Lord Nuncio and inhibiting the Meeting of the National Synod appointed by him for 15th August, at Galway, etc. Dated at Kilkenny, 28th July, 1648.

A broadside (14¾ × 9¼). Roman letter.

[Bodleian Library, Oxford—Carte MSS. xxii, fol. 158.]

1648. Declaration of the Supreme Council, etc., withdrawing their protection from all persons joining or assisting Owen O'Neill, etc. Dated at Kilkenny, 13th August, 1648.

(*Thomas Bourke,* Printer to the Confederate Catholicks of Ireland.) Folio, S. sh. (11½ × 7½). Arms. Roman letter.

[Bodleian Library, Oxford—Carte MSS. xxii, fol. 167.]
NOTE:—Printed on one side only.

1648. Manifesto, by the General Assemblie of the Confederate Catholiques of Ireland, against the Declaration (dated 30th August, 1648) of the Nuncio condemning the Cessation. Dated September, 1648.

A broadside (13¼ × 8⅛). Roman letter.

[Bodleian Library, Oxford—Carte MSS. xxii, fol. 185.]

1648. A Declaration made by the Maior, Towne Councell, Recorder, Sheriffs, and Burgesses of the Towne of Galway, of Their Acceptance of the Cessation, Concluded by and betweene the Right Honourable the Supreme Councell, and the Lord Baron of Inchiquin, and of their Ioyning in the appeale to his Holynes.

Kilkenny, Anno Domini 1648.

4to. 6 pp. (last blank). Sigs. A-A4.

[E. R. McC. Dix.]

1648. Declaration, by the General Assemblie of the Confederate Catholiques of Ireland, of their Endeavour to preserve and advance the Roman Catholiques Religion, &c.

Dated at Kilkenny, 14th September, 1648.

Folio. S. sh. (10⅝ × 7½). Roman letter.

[Bodleian Library, Oxford—Carte MSS. xxii, fol. 208.]
NOTE:—Printed on one side only.

1648. Eppellatio Supremi Concilii Confoederatorum Catholicorum Regni Hiberniae interposita coram Illustrissimo ac Reverendissimo D.D. Nuncio Atque ac Summum Pontificem Facta.

Kilkeniae, Anno Domini 1648.

4to. Title leaf × 10 pp. (Device on t.p.).

[E. R. McC. Dix.]

1648. A Letter in Nature of an Appeale, written by the Maior, Towne-Councell and Corporation of Galway unto the most illustrious and most Reverend Lord the Lord Nuncio.

"Printed at Kilkenny in the yeare of our Lord 1648." 4to. 6 leaves, first blank and last also blank.

[E. R. McC. Dix.]

1648. Proclamation by the General Assemblie of the Confederate Catholiques of Ireland, of Pardon to All Who before 25th October should Submit, except O'Neill and others. Dated at Kilkenny, 30th September, 1648.

A broadside (13¾ × 10¾). Arms. Roman letter.

[Bodleian Library, Oxford—Carte MSS. lxv, fol. 421 & xxii, fol. 262—2 copies.]

1648. The Copie of a Letter from a Gentleman in London, to his friend in Dublin, Together with the coppie of a Speech delivered by his Majestie to the Lords Commissioners at *New-porte* in the Ile of Wight, upon his Maiesties departure from the Ile.

4to. No title. 7 pp. + 1 p. (blank). Sigs. A-A4.

[E. R. McC. Dix.]

Note:—No imprint, but Kilkenny?

1648. Order of the General Assemblie of the Confederate Catholiques of Ireland, Declaring Owen O'Neill a Traitor and Rebell against the King. Dated at Kilkenny, 30th September, 1648.

A broadside (15⅓ × 11¼). Arms. Roman letter.

[Bodleian Library, Oxford—Carte MSS. xxii. fol. 261.]

[1648]. Forraigne Intelligence, By Letters from a Gentleman in London to his Friend in Dublin.

4to. No title. 4 pp.

[E. R. McC. Dix.]

Note:—No imprint, but Kilkenny.

1648. The Declaration of Owen O'Neill published in the Head of that parte of the Ulster Army adhering to him, together with The Right Honorable the Supreme Councell of the Confederat Catholicks of Ireland Their Answer thereunto.

Printed and published by order of the said Councell, 1 of July, 1648. 4to (6¾ × 5¼). 16 pp.

[Marsh's Library, / Cashel Loan Collection.]

1648. A Declaration of the Commons of *England* in Parliament assembled; Expressing their Reasons and Grounds for passing the late Resolutions touching *No Further Address or Application* to be made to the King. (London, 1647.)

REPRINT. 4to. Over 16 pp.

[E. R. McC. Dix—imperfect.]

1649. Proclamation, by the Lord Lieutenant-General, &c., of Ireland (Marquis of Ormonde). Announcing Treaty of Peace, &c. Dated 17th of January.

"Printed at Kilkenny, by *William Smith.*"

[Public Record Office, London—S.P.I. 266 (13); *Vide* Calendar of State Papers (Ireland), 1647-1660, &c., p. 40.]

1649. Proclamation, by the Marquis of Ormonde. Dated 22nd January, 1648/9.

"Printed at Kilkenny by *William Smith.*"

[R.I.A. / glass case.]

1649. Proclamation, by the King (Charles II). Dated 17th February, 1648/9.

[Bodleian (Carte) 65,460 & 23,507.]

1649. Certain Acts and Declarations made by the Ecclesiasticall Congregation, of the Arch-bishops, Bishops, and Other Prelates, met at Clonmacnoise, the fourth day of December, 1649. And since concluded.

[*Vide* London reprint in R.I.A. / T.—Box 62/1, & in B.M.; *and also see* "Declaration of Lord Lieutenant of Ireland," in R.I.A./ T.—Box 64/3.

APPENDIX.

EXTRACT.

5TH CHARGE AGAINST THE JESUITS.

FIFTH CHARGE.

That being required by the Dean of Ferns, Auditor-General to the Lord Nuncio, and that under precept, to permit the ordinations of the said Lord Nuncio and the Ecclesiastical Congregation to be printed, as they had a press in their house of Noviciate, they at first refused permission, and immediately afterwards, as is believed, they took measures to have the said press carried off by the Supreme Council to the incredible injury of the Ecclesiastical party which was never afterwards able to print its ordinations and necessary answers.

REPLY of the FATHERS to the FIFTH CHARGE.

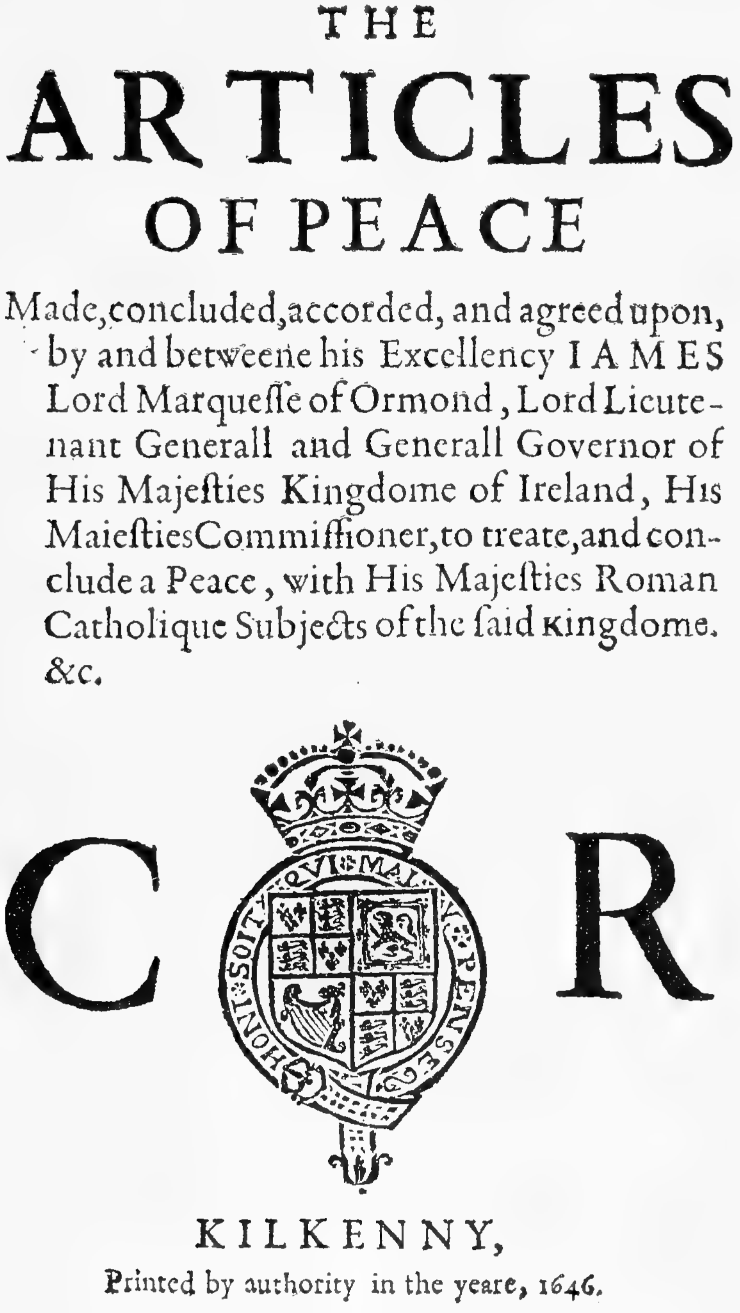
Before we had been required by the Dean to print those writings the press was taken from us by the Supreme Council on public authority as is plain by the rescript and decree of the Council. From that time we had nothing to do with it. As for what is said that it was by our procurement that the press was removed, that is a mere invention, and on this matter F. Yong has elsewhere written at more length to the most Illustrious Nuncio.

The Visitor's OBSERVATION.

This accusation is a mere calumny, founded however on a very likely yet a false presumption as I clearly shewed the most Illustrious the Lord Nuncio; for we had a press in the Noviciate, chiefly for the use of the College, but it chanced that a sheet was printed in which the Lord O Neale[1] was assailed. The Supreme Council took this ill and administered a sharp reproof to our Fathers for suffering that sheet to be printed, and afterwards by strict proclamation prohibited anything from being put in print which was not signed by seven of the Councillors. That proclamation was made on the 20th April, 1648. Then on the 28th of May of that year, the Supreme Council sent their Secretary, Bagot by name, and he took possession of the press in the name of the Council, as appears by public and authentic deed; the workmen too, who served the press were ordered in future to work for the Council's wages and not ours. Two days later the Dean came into the Noviciate to have printed the sentence of excommunication dated the 27th of May and published at Kilkenny on the 29th of that month. Father Yong, Master of Novices, was then absent and the Dean spoke to our Brother, Nicholas Sarrazin, a printer, and going into the chamber in which the press was, he saw the same workman as he was accustomed to see previously, and he thought that the press was still in our power, although Brother Sarrazin fully explained to him that the Supreme Council had taken control of it two days before. When Father Yong returned and learned from the Brother the cause of the Dean's coming, he went at once to his house to call upon him and see if he could do him any service. After the Dean had said by way of preface that he knew the Jesuits bound themselves by a special vow to show obedience towards the Sovereign Pontiff, he gave command as Apostolic Auditor, in virtue of holy obedience, that Father Yong should allow some opinions and ordinations to be printed at his press, and immediately the Father threw himself on his knees and answered that he reverenced the authority of the Sovereign Pontiff in all his ministers; but for two days past the press had ceased to be in our power, as the Supreme Council had taken possession

---

[1] Doubtless Sir Felim, who was a Councillor.



THE

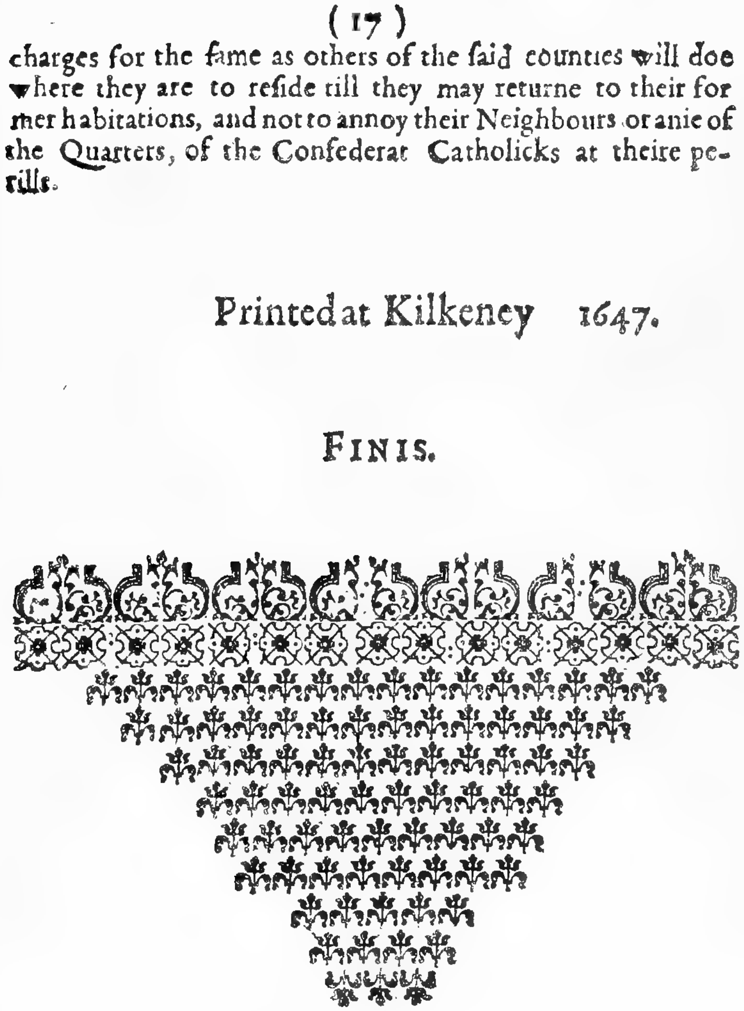
ARTICLES OF PEACE

Made, concluded, accorded, and agreed upon,
by and betweene his Excellency IAMES
Lord Marqueſſe of Ormond, Lord Lieutenant
Generall and Generall Governor of
His Majeſties Kingdome of Ireland, His
Maieſties Commiſſioner, to treate, and conclude
a Peace, with His Majeſties Roman
Catholique Subjects of the ſaid Kingdome.
&c.

C R

KILKENNY,
Printed by authority in the yeare, 1646.

Dix—Printing in the City of Kilkenny in the Seventeenth Century.



(17)

charges for the ſame as others of the ſaid counties will doe where they are to reſide till they may returne to their former habitations, and not to annoy their Neighbours or anie of the Quarters, of the Confederat Catholicks at theire perills.

Printed at Kilkeney 1647.

Finis.

Dix.—Printing in the City of Kilkenny in the Seventeenth Century.

of it, to which the Dean made no other answer than "the devil is here." On the following day F. Yong wrote an account of the whole matter to the most illustrious the Lord Nuncio, with the greatest humility and appealing to God as witness; and after so sincere a letter the most illustrious Lord Nuncio would not have reopened the accusation if he had been well acquainted with the good faith and candour of the man. All this I explained to the Lord Nuncio at Galway, and, as I think, I satisfied him; indeed he assured me of it.

VIII.

ON SOME RECENTLY DISCOVERED OGHAM INSCRIPTIONS.

By R. A. S. MACALISTER, M.A.

Plates XIV. XV.

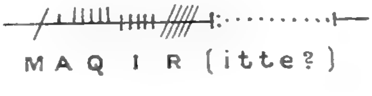
[Read November 29, 1913. Published January 24, 1914.]

Several previously unknown inscriptions in the Ogham character have recently come to light, which it is desirable to put on record.

I. Kilkeehagh, Co. Kerry (Plate XIV).

This stone stands on the boundary between the townlands of Kilkeehagh and Gleenesk, on the slope of Drung Hill, near Mountain Stage Railway Station, barony of Iveragh. It is well known in the neighbourhood under the name of *Leacht Fhionáin*, or "Fionán's Grave," though the inscription supplies no warrant for this name. There is an account of the stone signed M. J. Delap, in the *Kerry Archaeological Magazine* for November, 1913, without any reading of the inscription, but adding the interesting information that it was formerly a place of pilgrimage, people coming thither "all the way from Limerick." It is marked "Laghtfinnan Penitential Station" in the O.S. map, Kerry sheet, 63, in the lower left-hand corner.

There is a mound of loose stones, about 100 feet in diameter and 5 feet high, on the north side of the old road which runs round the brow of Drung Hill to Caherciveen, on the townland indicated. The stone stands in the middle of this pile, 3 feet 3 inches high; maximum breadth, 1 foot 2 inches; maximum thickness, about 8 inches. It is of a red, slaty stone, much scaled, and the inscription (which is on the edge turned toward the road) is much injured. It reads:—



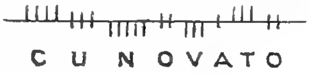
Up to the R all is plain. A line sloping off on the B-side from the following vowel looks like the tail of an × at first sight; but it is merely the edge of a flaw running over the face of the stone. The second vowel-point after the R is possible, but doubtful; after this comes 8½ inches in which both sides of the angle are spalled away and no trace of writing remains. Following this blank space there are doubtful traces of an I, but the last notch is the only certain member of the letter; it is just 4 inches below the top of the stone. The restoration above suggested is a mere guess on which nothing can be built; the inscription is, indeed, so mutilated as to be quite useless.

The notes on which the foregoing description is founded were taken by me in 1910. I first heard of the stone in 1907, from the Hon. Albinia Brodrick, who kindly wrote to me informing me of its existence.. Being abroad at the time, I was unable to visit it till the date above mentioned.

II. Drummin, Co. Roscommon (Plate XV, 1).

County Roscommon has so far yielded only two ogham monuments—the well-known pair in the cave at Rathcroghan. The discovery of a third in the same county is therefore an event of some importance. It was found by Mr. Igoe, of the Ordnance Survey, and by him communicated to Dr. Douglas Hyde, who, after examining it, and assuring himself that it was a genuine ogham, informed me of the discovery. Being in the neighbourhood, I was enabled to visit it without delay: Dr. E. C. Quiggin, of Cambridge, who was with me, checked the reading here given.

The monument stands in a copse on the left-hand side of the road leading from Belnagare to Rathcroghan, on land belonging to O'Conor Don and occupied by Mr. Doyle, townland of Drummin, O.S., Roscommon, sheet 15, middle of bottom. There are two stones evidently marking a grave, standing 5 feet 1 inch apart. The foot-stone, which is uninscribed, is 3 feet 1 inch high, 1 foot 9 inches broad, and 9 inches thick at the base. The headstone is 30 degrees west of north from the first, is 3 feet 7 inches high, 1 foot 4 inches broad, and 1 foot 8 inches thick. It bears the following inscription:—



The V is faint and the end is fractured; there might be a few more vowel notches lost, but the probability is that we have the whole inscription. The name is very interesting. The second member is evidently a genitive of *vātis* "a prophet"; this seems to be a new element in Ogham names.

The first member, with the vowel *o* (which is certain) has so far been found in South Britain only: as in *Cuno-mori*, *Cuno-vali*, *Cuno-cenni.* The same or a similar element is also found in Ireland, but hitherto it has always been spelt with *a*; as *Cuna-cena*, *Glasi-conas*, *Assi-cona*, *Cuna-netas*, *Cuna-legea*, *Neta-cunas*, and, on the Isle of Man, *Cuna-magli.*

III–VIII. Knockshanawee, Co. Cork.

On the townland of Cnoc Sean-Mhaighe, called "Knockshanawee" on the Ordnance Map, near Crookstown, is a small rath-cave, in which Mr. Cremin, of Cork, discovered some Ogham inscriptions.

An account of the rath appears in the *Journal* of the Cork Historical and Archaeological Society, 1911, p. 59, but without any attempt at deciphering the inscriptions, which, indeed, would have been impossible in their situation in the cave. Sir Bertram Windle wrote, asking me to join him in an examination of the souterrain; and I accordingly visited it with him and Mr. Michael Murphy, of Cork, on the 4th April, 1913. The cave was completely closed up, and the son of Mr. O'Connor, on whose farm the fort is situated, kindly opened it for us. I found Ogham-writing on two lintels and on one supporting stone: my decipherments were, *Branit . . . . . s*, *Qikabi magi Luguni*, and *Icanacci* respectively; but I recognized that in the position of the stones it was impossible to be certain of either the accuracy or completeness of these transcripts. We agreed that it would be necessary to open the cave and to expose the whole series of lintels. This was done in October, 1913, on two days' visit to the site. We had the advantage of the company of Sir John Rhys, who joined us; and the following readings were taken by him and me jointly. In our company also was Mr. Cremin, the original discoverer of the stones; Mr. Murphy, whose local knowledge is well known, and was of the greatest service; Rev. M. J. Murphy; and last but not least, the Rev. C. Coakley, C.C., of Farran, who rendered us invaluable assistance in many ways. Not only were the three stones which I had seen on the previous visit properly examined, but three additional inscriptions, whose existence could not be so much as suspected, came to light, making six in all. The stones, which had thus been completely lost to sight, were very properly removed to Cork, and are now housed in University College, where their exceptionally interesting inscriptions can be examined by all.

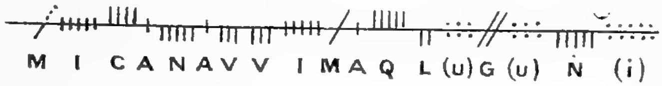
There is a very bad plan, and some photographs, of the fort itself in the *Journal* of the Cork Society above referred to. The centre of the fort is, as is frequently the case, raised above the surrounding country. It is surrounded by a vallum with a fairly deep fosse outside, and traces of a second vallum outside. A faint ridge might possibly be a third vallum; but it requires a lively imagination to accept this. A flat boulder, on the face of the inner vallum, turned toward the fosse, is alleged to be the entrance to caves, but we found nothing to confirm this.

The souterrain, which was not quite in the middle of the enclosure, was a passage running in a line N.N.W. from the entrance. It was 14 feet 8 inches long, 4 feet 6 inches high, and 4 feet wide. The walls of the cave were the boulder-clay, unlined with stones of any kind. A small passage, unlined with stones, leads off from one corner to a small and much dilapidated beehive-cell. The roof was formed of lintel-stones, two of which, being broken, were supported in the middle by pillar-stones set upright. There were in all eight lintels. The inscriptions were on five of these, and on the northern of the two supporting stones. (See Plate XV, 2.)

A woman told us a local legend to the effect that a field close by the fort was called *Cillin*, and had once been a burial-ground, and that it had been transported in a single night to Kilbonane, about a couple of miles away. This obeys the rule first established by Brash, that there is always an ancient burial-ground close by when ogham stones are found in a souterrain. The tradition *possibly* may also rest on an actual nocturnal raid on the cemetery by the rath-builders, and the surprise of the neighbours, not in the secret, to find the stones gone. Such tales of the transfer of cemeteries are told elsewhere in the country; but the coincidence in this case is worth passing mention.

Beginning at the inner (northern) end of the souterrain, the following are the measurements and inscriptions on the stones:—

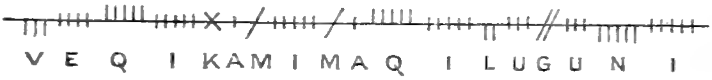
(1) First lintel: slate, 6 feet 5 inches long, by 1 foot 10 inches broad, by 7 inches thick. The inscription, as is usual in Co. Cork, is scratched in fine lines, and has suffered badly by the scaling of the stone. It could, however, be completely deciphered:—



There is a gap of 4 inches between the first two words, and of 2½ inches between the second and third. Such careful word-spacing is rare in Ogham inscriptions. The upper half of the first M can scarcely be seen; the U's of LUGUNI are very faint, and the I in the same word is gone altogether.

Leaving for the present the names, we may notice an important point with regard to orthography: I refer to the spelling MAQ for MAQI. This has been found elsewhere, and has been explained in various ways. But the very close connexion between this stone and the next shows that the simplest explanation is, after all, correct—that it is a mere abbreviation. The letter I takes up a good deal of space, and is troublesome to cut. It can easily be supplied by the reader; and therefore I for one would be inclined to abandon all explanations which seek to account for the appearance of words and names in their crude form by calling in extra-Celtic syntax to account for them. In such an inscription as LUGUQRIT MAQI QRITTI I have for some time been inclined to see in the first word merely an abbreviation for LUGUQRITTI; and this inscription, taken in connexion with what is an apparently absolutely contemporary and closely associated inscription (No. 2), confirms me in this interpretation.

(2) The supporting stone of the second lintel. It is 5 feet 9 inches long, 1 foot 3 inches broad, and 9 inches thick. The inscription is neatly cut; and, though the scores are minute, there is no doubt of the reading at any part of its course. The first two letters have been crowded into a little indentation that has been spalled out of the edge. The last notch is very faint, but it is quite certain.



As is my usual practice, I transcribe × provisionally by K. I have long held that this was a guttural, not a labial; and Professor Marstrander and Professor MacNeill have both subscribed to this view. I attach peculiar importance to the present inscription, as, except in the Coligny Calendar, we have not found any ancient Celtic dialect in which P and Q appear side by side. The reading here is certainly × · / · · · · ·, – *kami*, not the frequent word × · · · · · · ·, *koi*.

Here, then, we have another "son of Lugunos" commemorated, and the general similarity of the two names corroborates the *à priori* probability that we have to deal with the monuments of two brothers. Thus we have two contemporary inscriptions—

Micanavvi maq Luguni
Veqikami maqi Luguni—

and it must surely be agreed that the *maq* of the first of these, in the light of the second, is a mere abbreviation.

The father's name is easiest; and we may take it first. It is one of the commonest and most widely spread of ogham names. It appears in Meath, at St. Cairan's; in Waterford, at Windgap, near Carrick-on-Suir; in Cork on one of the Ballyhank stones, now in the Royal Irish Academy's collection; and in Kerry on the splendid monument at Droumatouk above Kenmare. As *Luighne* it is familiar in MS. literature. It is presumably one of the numerous names, personal and local, which testify to the honour in which was held the great god *Lugh*. I need not apologize for the suggestion of a pagan name occurring on this monument; the brilliant observation of Professor MacNeill that oghams and ogham orthography represent an ancient pagan tradition has thrown a flood of illumination on many dark corners of their study. It explains how the rath-builders were so lacking in reverence for them. It explains how the medieval grammatical speculators, though constantly muddling over ogham-writing, never once referred to an actual example to illustrate their theories—for the stones themselves were heathen and unclean. It may even be, as Prof. MacNeill once suggested to me in conversation, that they were sought for building-material by the rath-builders just because of their demoniac associations—on the *similia similibus curantur* principle they may have been expected to ward off the evil influences of the unseen world.

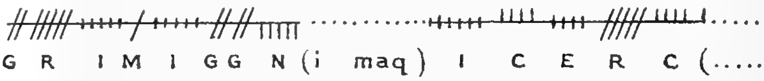
What are we to make of *Micanavvos* and *Veqikamos*? It is nothing more than a coincidence that these two names curiously correspond, beginning with a labial, a slender vowel, and a guttural, and ending in *-os*, preceded by *a* and a labial. It was this coincidence that led me to look for and to find the faint initial M of the first name; otherwise it would scarcely be worth mentioning. But there is enough general resemblance between the two names to justify us in seeing a uniform *taste* in nomenclature at work, and to confirm us in regarding these as the monuments of two brothers.

When the time is ripe for producing that great desideratum, an onomasticon of Irish personal names, it may be possible to find precedents for the two remarkable and unusual names which Lugunos bestowed on his sons. I have not had time to do more than hunt up such of our texts as have been indexed, and have failed to light on anything comparable. *Micanavvi* may possibly be a compound of *Mica*, a name appearing two or three times in the Martyrologies, and another name which we find in St. Columba's pedigree, in the form *Mac Naue.* But till the onomasticon is produced, very little can be said about the names on these stones.

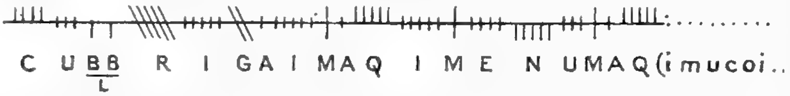
At any rate, they have supplied solid evidence as to the interpretation of the long misunderstood abbreviation *maq*, and further welcome light on the × symbol.

(3) The second lintel: a very rough flag of slate, 1 foot 10 inches broad, 6 inches thick. It was broken into two fragments, respectively 6 feet and 3 feet 4 inches long, supported by the stone last described at the fracture. We found, however, that it was impossible to fit the two fragments together, so that the fracture must have been made by the rath-builders, probably to make this very heavy stone easier to transport. The middle piece was lost as also the original top, so the inscription is imperfect in two places.

The last letter might be a Q, but the spacing rather suggests a C followed by the first score of another letter. The writing is very rough; and the decipherment of this fragment gave us more trouble than that of all the rest put together. The name GRIMIGGNI is new, and I cannot find any Celtic name with the Teutonic-looking element *Grim.* The diminutive termination is here spelt with a double G; this orthography has only once been found elsewhere, on a fragment from Mangerton Mountain, now at Adare. The fragmentary CERC . . . is also rather problematical.



(4) This remarkable stone was the third lintel. It is 10 feet 2 inches long, 1 foot broad, and 10 inches thick; the top was missing, and with it the end of the inscription; and the remaining part was very fragile, and broke in two along the line of an old crack when the monument was being moved. The letters were carelessly cut, and, like No. 3, gave us much trouble. The inscription, however, when read, proved to be as follows:—



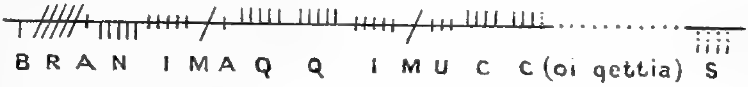
There are several points to notice about this inscription. First, as a matter of calligraphy, the cross-scores in the first name slope the wrong way, and in the rest of the inscription are vertical to the axis. There is an ambiguity about the group of scores following the first U; they might be BB or L. Next we notice the formula of the inscription, including an intermediate line in the genealogy between the principal and the eponymous name. As a group of *two* such extra names is quite unprecedented, the last word must be the remains of *maqi mucoi*, not of *maqi* alone.

Here, again, we meet with puzzles in dealing with the names. Indeed this group of Oghams is, from the point of nomenclature, quite the most remarkable ever discovered. First we notice the rare and anomalous -AI genitive termination, found also in QETAI, ROTTAIS, GEBBAIS, and TANAIS, if the two latter early readings of mine on the stone at Chute Hall, near Tralee are correct. If the BB reading be accepted, we should have to analyse the name into CU-BBRIG-, a compound of *Cu*, 'a hound,' and the well-known root *brig*—meaning 'brilliant' or something of the kind. The difficulty of this is that we should have expected CUNO-BRIG-. On the whole, I am now inclined to read CUL-RIGAI. *Cul* is a word explained in Cormac's Glossary as a chariot: a few examples of its use will be found cited in Meyer's

Contributions to Irish Lexicography. The chieftain Cul-rix would therefore have a name similar in meaning to that of the Aeduan chieftain Epo-redo-rix, of whom we hear from Caesar. As for MENU, there is on one of the Drumloghan stones a name similarly declined, MANU; but the vowels do not allow us to compare them further. A compound of the name, which in the earliest ogham orthography would have probably been written **Menu-viccas,* appears on the well-known Inchagoill stone in the form MENUEH, the H being meant for CH.

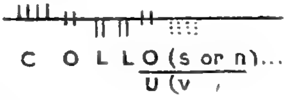
The stone was fractured immediately after the Q by the rath-builders, and the further steps of the genealogy are lost.

(5) The seventh lintel: red sandstone, 6 feet 6 inches long, 2 feet 3 inches broad, and 10 inches across. The inscription began 2 feet 8 inches down from the top on the left-hand side, ran up to and over the head, and down on the right-hand side; but the rath-builders had smashed away the whole of the writing on the right-hand angle except the tips of the scores of the final S, which is 1 foot 8 inches, down from the top—



Between BRANI and MAQQI is a space of 1½ inches, which is worn, and contains no definite trace of any letter. A faint mark which might be A is discernible, but on the whole is probably to be rejected as a mere accident. This is the only case in Co. Cork, of the peculiar spelling MAQQI MUCCOI, with double letters: an orthography specially characteristic of the Corkaguiney group of inscriptions. It is not at all impossible that we have here the monument of some wandering Kerryman; I suggest QETTIAS as the restoration of the patronymic, as that name is established in Corkaguiney; there is just about space for it, and the missing scores must have been on the H side. The name BRANI is familiar, though it has not hitherto been found uncompounded in Ogham inscriptions.

(6) The eighth lintel: red sandstone, 5 feet 9 inches long, 2 feet 8 inches broad, and 9 inches thick; the stone is very irregular in shape and the above are the maximum dimensions. The rath-builders had smashed away the top of the stone, leaving only the few letters which occupied the first eleven inches of the inscribed angle—



The last letter is badly injured by a flake on the B-side, through which the scores can be dimly traced. The inscription is, however, too fragmentary to be very instructive.

It is worth noticing that the townland marches with that of Roovesmore, where three inscriptions were found in a similar souterrain many years ago, and carried off to the British Museum. These inscriptions also present unusual names, and very likely came originally from the same cemetery.

On the whole, this new find of Oghams is easily the most important that has been made since the Ballyknock stones were found in the same county, over twenty years ago. And though there were fifteen inscriptions in that group, and only six in the newly discovered series, in intrinsic worth the two finds may very suitably be compared with one another. It is for every reason, both national and scientific, to be hoped that Sir Bertram Windle will be encouraged to go on with the work that he has so magnificently inaugurated by making available the series of ogham stones which some vandals of the middle ages buried out of sight in the dark crypt of Cnoc Sean-Mhaighe.

NOTE ADDED IN PRESS.

The mutilation of No. 5 of the Knockshanawee series is an excellent illustration of the mutilation of Ogham pillars by the destruction of the ancestral names, to which I have already called attention. It cannot have been meant merely to make the stone more convenient for building, as may have been the case of No. 4, which is similarly mutilated.

Fig. 1.—Carn at Kilkeehagh, Co. Kerry.

Fig. 2.—Ogham Stone at Kilkeehagh, Co. Kerry.

Macalister.—Recently Discovered Ogham Inscriptions.

Fig. 1.—Ogham Stone at Drummin, Co. Roscommon.

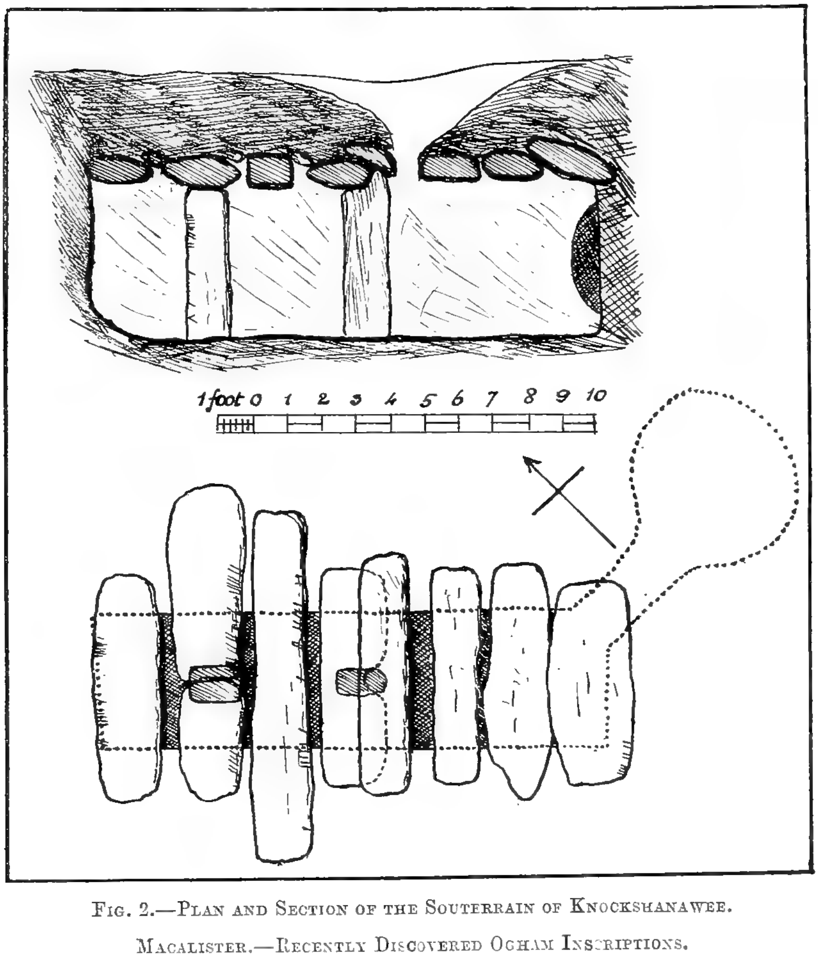


Fig. 2.—Plan and Section of the Souterrain of Knockshanawee.

Macalister.—Recently Discovered Ogham Inscriptions.

IX.

THE EXCAVATION OF LOCHPAIRC CRANNOG, NEAR TUAM.

By R. A. S. MACALISTER, E. C. R. ARMSTRONG, and
R. LLOYD PRAEGER.

Plates XVI, XVII.

Read November 29, 1913. Published January 24, 1914.

The townland of Lochpairc is situated about a mile and a half north-east of Tuam, on the south side of the road which, after skirting the north wall of the Birmingham estate, turns abruptly on reaching Loch Levally, and runs on to Dunmore (Galway six-inch map, Nos. 29 and 30). The exact situation of the crannog here described may be defined by reference to the six-inch map, as lying one inch south of the letter *A* in "Loughpark."

Our attention was drawn to this structure by Dr. T. B. Costello, M.R.I.A., of Tuam, who had himself obtained some antiquities from it, as described below. We have to express our deep obligations to him for the trouble he took in making our share of the work as easy as possible, by conducting the necessary preliminary arrangements with the local proprietors, and by selecting and engaging workmen. To the kind hospitality of him and of Mrs. Costello our sincere thanks are due.

The crannog, as we found it, was an insignificant circular mound, shaped like an inverted saucer, with a shallow ditch around it. It was so inconspicuous that most wayfarers would pass it by unnoticed; and it is one of the numerous ancient monuments that are ignored on the Ordnance map.

With regard to its structure and dimensions, there is little to tell. The ditch is so exactly circular that some artificial means must have been adopted in laying it out—most probably the use of a rope as a radius tied to a post in the middle. It may be remembered that we have already noticed the same characteristic—the mathematical circularity of a structure—in our account of our excavation at Longstone Rath. The mound is slightly irregular; but it is still approximately circular, and the deviations from that shape which it now presents may possibly be due to the trampling of cattle and other destructive causes.

The outer diameter of the ditch is 146 feet. The diameter of the mound, which is concentric with the ditch, ranges from 107 to 110 feet. The present depth of the ditch is 1 foot 6 inches below the level of the surrounding field; and the mound is only 4 feet above the same level (Plate XVI, fig. 1). A subsidiary ditch, almost effaced, can be traced on the top of the mound as shown in the plan and section. The only other surface-indication to be noted before the excavation began was a slight depression on the north side, indicating the site of the landing-stage presently to be described.

Trial-pits sunk in the field surrounding the site showed a foot of marly loam, underlaid by 2 to 3 feet of white marl full of Limnaea and other fresh-water mollusca. Below this was peat with stones, also full of shells, and then water came in. Excavation of the ditch showed that it had been dug through the loam, and on through a foot or more of the marl, and had subsequently silted up to the extent of a foot or so with loamy material.

The antiquities described below prove that this dwelling is not very ancient; and the facts observed in examining its construction show that the old lake was approximating to its modern condition when the site was selected for a dwelling. The surrounding fields, still liable to winter floods, and drained by deep and always running ditches, were at the time a lake, very shallow, though of considerable extent. Otherwise it is not easy to see how the ditch, which is so conspicuous a part of the structure, could have been laid out and dug. The small elevation of the mound, which there is no reason to suppose was ever very much higher, accords with this view. The stony margin of the old lake, 2 to 3 feet above the level of its old bottom, was easily discernible in places in the surrounding fields.

The usual method of building crannogs was adopted in this case. A stockade of piles being driven into the soft lake-bottom, material was heaped up inside, till an island was formed rising above the surface of the water at its highest flood.

The material used was varied. In some parts large stones predominated. Elsewhere marl had been used in quantity; in other places peat—all now full of bones and ashes. The presence of a continuous outer coating of stones and rubble, devoid of remains, on the sloping periphery of the crannog, suggests a strengthening and enlarging of the site at some date late in its history by the conveyance from the mainland of a considerable quantity of material. This ring of later material both enclosed and overlay the mass of bone-bearing peat and marl. The observed fact that it stopped abruptly on the inner edge of the slight inner ditch which is shown on the plan and section, and was at once succeeded by almost pure ash, full of bones, &c., suggests that the edge of the inner ditch marks the line of an inner palisade, or the wall of the dwelling, inside which the domestic activities of the settlement were carried on.

On the north side of the mound there was a depression about 10 feet wide, running roughly in the line of the diameter of the mound. On excavation this proved to be a passage, marked out by two irregularly placed rows of stones—in all probability a landing-stage. A section was cut in the line of this passage, and another at right angles to it at the place where it encountered the surrounding palisade. The positions of the piles, and of the one surviving horizontal timber, are shown to an enlarged scale (Plate XVI, fig. 2). Nothing of special interest was found in this part of the excavation.

Of the dwelling-places that presumably were erected on the top of the artificial island not a vestige remained, not even the holes in which upright timbers might have been set; although such holes, marking the sites of vanished piles, were found at the landing-stage. At a point marked in the plan were a few flat stones side by side, perhaps part of a pavement. The whole soil of the mound, which was dug very thoroughly (at least two-thirds of it being turned over to the foundations), was black with ashes, and permeated through and through with bones of animals. At the bottom were a number of large stones. It would appear that the builders had first laid a stratum of boulders in order to afford a solid foundation for the structure.

The objects found in this crannog do not require detailed description. They are all late in date and present no remarkable features. All the more important objects are illustrated, so it will be unnecessary to do more than give a brief general description sufficient to explain the figures.

Thirteen bronze pins, with ornamental heads, were found; some were broken, and all were heavily patinated. (Plate XVII, figs. 32, 33, and 38–48.) All these pins belong to common types, and similar examples have been found in other crannogs, in the settlements of the sandhills on the coast, and in street-excavations in Dublin. They are probably not much earlier than the ninth century A.D. A bone pin, with an ornamental head (Plate XVII, fig. 36), another with a flat head (Plate XVII, fig. 37), were found, also four bone needles (Plate XVII, figs. 50–52 and 54), and five portions of pins or needles.

The only other objects of bronze found, in addition to the pins, were a child's bracelet and a pair of tweezers. The bracelet (Plate XVII, fig. 28) is an unornamented strip of bronze, bent into a circular form, with overlapping ends. The tweezers (Plate XVII, fig. 26) are rather nicely ornamented; similar objects are common among crannog finds.

Only two wooden combs were found. Both of these were in a very fragmentary condition; one has been repaired (Plate XVII, fig. 27); the other was too broken to treat in any way (Plate XVII, fig. 30). The ornamentation can be seen from the figures. Combs are so common in crannog finds that it was rather a surprise to discover only two specimens. Two goats' horns, which had been slightly carved at the open ends, were found. These, no doubt, had served the purpose of handles for knives (Plate XVII, figs. 15 and 16). Two wooden harp-pins were found (Plate XVII, figs. 34 and 35). Harp-pins have been found in other Irish crannogs. See the index to Wood-Martin's *Lake Dwellings of Ireland* for references. Two bones that had been pointed, and used as implements, were also found (Plate XVII, figs. 7 and 8).

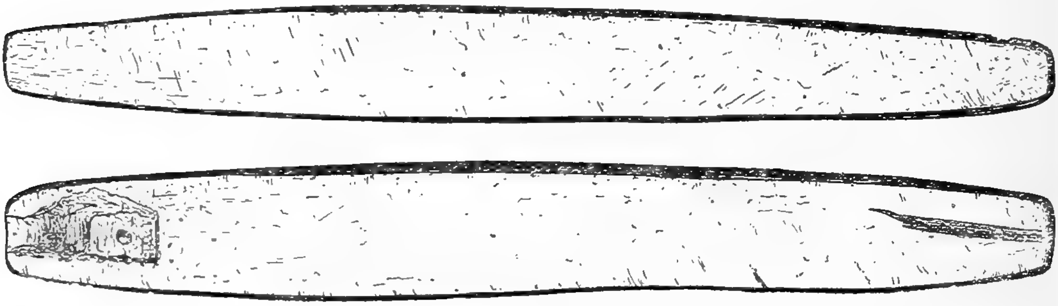


Fig. 1 (about $\frac{1}{3}$).

Nine sharpening-stones of various sizes were obtained. One very large specimen was found on the surface of the crannog by Dr. Costello previous to our excavations (fig. 1). It measures 17¾ inches in length, and evidently had an attachment of iron at one end. Some of these stones appear to have been used for sharpening the points of implements or weapons, as they show indentations on the face (figs. 2 and 3). One small ornamental specimen composed of calcified shale, with a bronze attachment, was found; this was probably a touchstone for testing metals (Plate XVII, fig. 10).

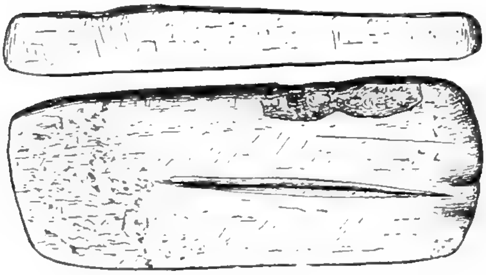


Fig. 2 ($\frac{1}{4}$).

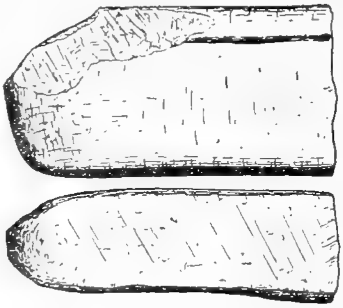


Fig. 3 ($\frac{1}{4}$).

As might have been expected, iron objects formed the bulk of the finds.

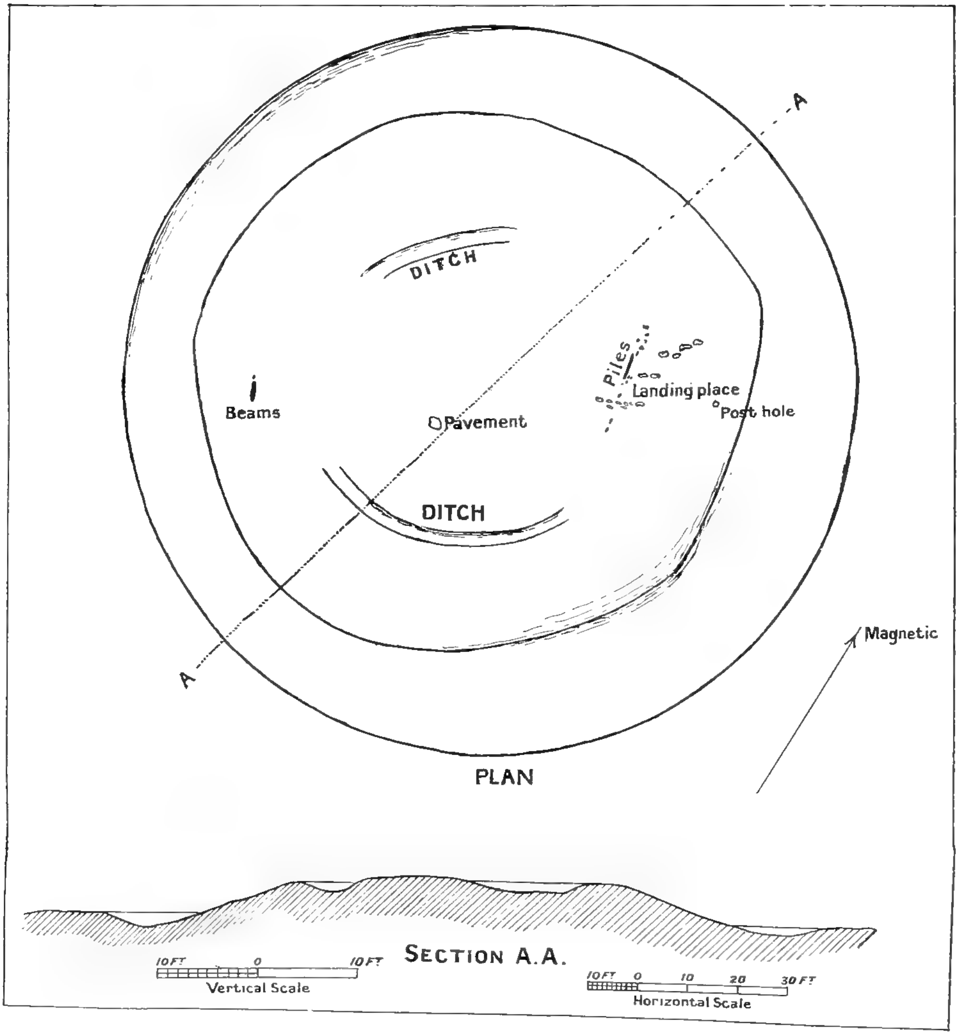
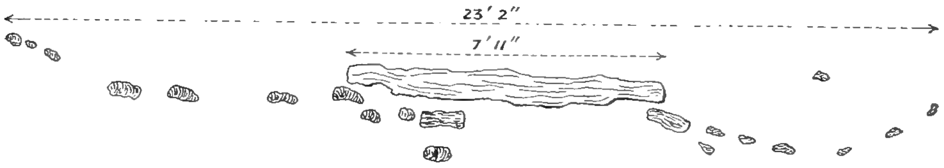


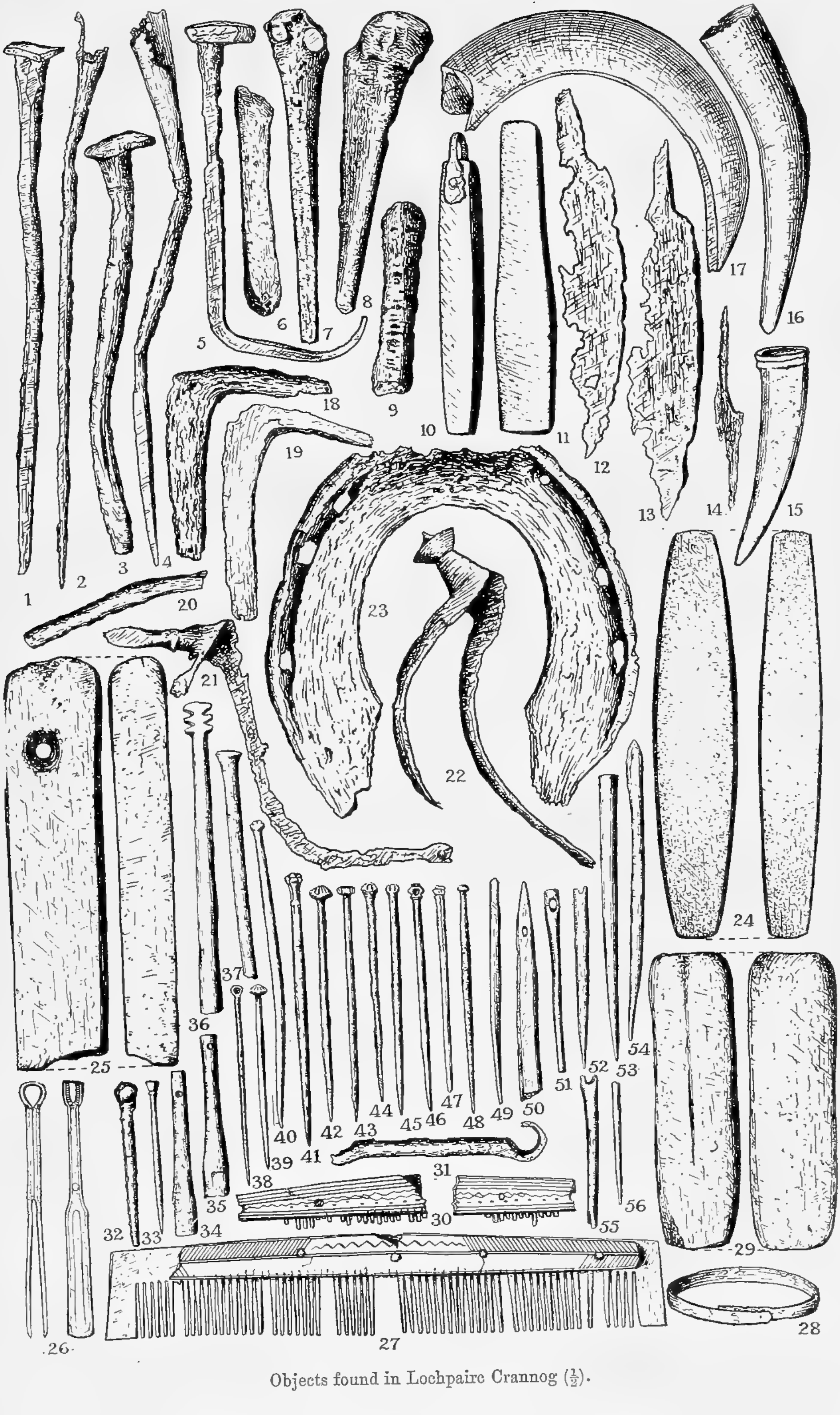
Fig. 1.



Piles at Landing Place

Fig. 2.

Macalister, Armstrong, and Praeger.—Loughpairc Crannog.



Objects found in Lochpairc Crannog (½).

These include three knives (Plate XVII, figs. 12–14); two spurs: one of these (Plate XVII, fig. 22) is a prick-spur, and is probably Norman; the other is considerably later, but is so much broken it is impossible to place a date upon it; a horseshoe of ordinary type (Plate XVII, fig. 23), twenty-one nails with large flat heads and long points (Plate XVII, figs. 1 and 3), a small object with a hook at each end, which was possibly portion of a horse's bit (Plate XVII, fig. 31); several long pointed objects with small sockets at the lower ends (Plate XVII, figs. 2 and 4), two objects which may have been some kind of staple (Plate XVII, figs. 18 and 19), and about twenty indeterminate fragments of nails and other objects.

Among the miscellaneous finds were three rounded pebbles, probably used as hammer-stones, a flattish stone that may have been used for polishing or sharpening objects, and a small leaden bullet.

A hazel-nut was also found. The remains of pig were very numerous in the crannog, and among the tusks the largest found measured $6\frac{1}{4}$ inches round the outer curve, and $\frac{7}{8}$ of an inch in thickness (Plate XVII, fig. 17).

Dr. R. F. Scharff, Keeper of the Natural History Collections in the National Museum, Dublin, has kindly reported as follows upon the bones found in the crannog.

The following species could be identified from the bones:—

Ox, horse, pig, red deer, sheep or goat, and two or three kinds of birds. The bones were much broken, as if they were the remnants of various meals. The pig had the appearance of the domestic pig, but, owing to the absence of any complete skulls, the identification is uncertain. Sheep and goat are very closely related in their osteology, and no complete bones were present to identify with certainty. Some of the deer-bones were extremely large and must have belonged to exceptionally large stags. The presence of antler-tips only showed that the antlers had been used for the manufacture of bone implements.

Mr. A. C. Forbes, Chief Forestry Inspector to the Department of Agriculture, kindly examined the remains of the piles and other wooden objects from the crannog, and reports that they consist for the most part of oak, though some pieces are probably birch and willow; but the wood is too decomposed to allow him to identify them with certainty.

X.

THE COURT OF CASTLE CHAMBER OR STAR CHAMBER OF IRELAND.

BY HERBERT WOOD, B.A.

Read FEBRUARY 9. Published MARCH 12, 1914.

THAT the history of Ireland is still an untilled field is borne in upon us by the consideration of the striking fact that the Court of Castle Chamber, which exercised its powers for nearly a century in Ireland, has, up to the present, failed to find its historian. It is true that various scattered references to it will be found in the histories of this country; but no account of its constitution and working has yet been produced. However excusable this want of interest might be in the case of a Court of inferior jurisdiction, no such plea can be maintained for neglecting this Court, which it was the aim of the government to fashion in all respects like the Court of Star Chamber in England, a Court which Bacon described as "one of the sagest and noblest institutions of this kingdom,"[1] and which Coke, in his *Institutes*, described as "the most honourable Court (our Parliament excepted) that is in the Christian world, both in respect of the Judges of the Court, and of their honourable proceeding according to their just jurisdiction and the ancient and just orders of the Court."[2] It is with the hope of throwing some light on the proceedings of this Court in Ireland that I have ventured to read this paper before the Royal Irish Academy.

The official name by which this Court was known was that of the Court of Castle Chamber, as appears by the Commission of 1581; but it is curious to note that the very heading of this Commission runs: "Commissio specialis pro Camera Stellata in Hibernia." When we consider that it was the intention of the government that this Irish Court should in all respects correspond with that of the Star Chamber of England, it is not surprising to find that the Court was sometimes designated the "Castle Chamber," and sometimes the "Star Chamber." This confusion of nomenclature makes it frequently very difficult to determine, when we find a reference to the Star Chamber, whether that of England or Ireland is intended.

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[1] Bacon, "History of the Reign of Henry VII," ed. 1641, p. 63.

[2] Coke's *Institutes*, part iv, c. v.

To trace the history of this Court in Ireland, it is necessary to go back to the early forms of our Constitution. The King, with the assistance of his Council, was the source of all justice, and any administrative, judicial, or legislative powers exercised by others were derived from him. But whilst he devolved upon Courts of law certain legal powers, and upon Great Councils or Parliaments certain legislative functions, he did not exhaust thereby his royal prerogative; but in certain cases he, with the advice of his Privy Council, still continued to exercise legal and legislative functions. To us at the present time the overlapping of the powers of these bodies in the infancy of the administration seems difficult to understand; and it is one of the most intricate problems the historian has to solve to trace the gradual evolution of the administration from its original indefinite composition to the fixed and orderly conditions which exist at present. As Mason well points out: "The authorities usurped or legally enjoyed by the Privy Council in Ireland were very considerable, extending indeed to comprehend legislative, executive, and judicial powers to an almost unlimited extent. . . . They granted exemptions from the penalties of the Statute and Common Law in numberless instances; but their encroachment on judicial authorities was most remarkable."[1] And again, he says: "The Privy Council were at all times ready to encroach upon the other authorities of the State, nor is it strange that in troublesome times, and in a distant and disordered land, the limits of power should be indistinctly traced and constantly trespassed on."[2]

But though the conditions in England were not so lawless as in Ireland, we find the King through his Privy Council frequently exercising these arbitrary powers, and thereby coming into conflict with Parliament. Indeed, in England we find special sessions of the Council being held for judicial purposes as early as the time of Henry V, for in the eighth year of his reign (1429-30) it was laid down that, of those causes determinable at common law, the only ones to be tried before the Council—that is, in the Star Chamber—were those in which the complaint was against a man of great influence or where the suitor was too poor to prosecute his cause in the inferior courts, or in which the Council saw other reasonable causes. However, the powers of the Council in the Star Chamber were not fixed upon a statutory basis till by 8 Henry VII, c. 13, its functions were limited to cases of maintenance, giving of liveries, having retainers, embracery, jurors receiving money, untrue demeanours of sheriffs in false returns and panels,

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[1] Mason, "Essay on the Antiquity and Constitution of Parliaments in Ireland." Appendix 3.

[2] *Ibid.*, p. 19.

routs and riots. This Act did not apply to Ireland, where, in consequence of the different conditions which existed there, events had followed a different course. As in England the Privy Council, so in Ireland the Lord Deputy and Council had, from early times, possessed and exercised judicial functions; but the first indication we get of any special sessions of the Council for judicial purposes is in an Ordinance of 1534 where we find it laid down: "Item, that the lord chancler, calling to him a Juge of every of the Kynges courtes, & such other of the lordes & counsayle as shalbe present in terme tyme, shal syt twies every weke, during terme season, in the counsayle chamber, there to receyue and here such compleyntes as the Kynges subiectes shal exhibite and take order therein accordyngly."[1]

Here we get the germ of the Court which was afterwards to develop into the Court of Castle Chamber. The obligation to meet only in term time was rendered necessary by the fact that the Lord Chancellor and Judges were required to attend. It is probable that the Privy Council found themselves unable to decide the cases coming before them without such legal assistance. We may suppose that it was to this Court that reference was made in the Irish Act of 28 Hen. VIII, c. 13, § 4, by which offences of ecclesiastics in maintaining the Pope's authority, &c., were to be certified into the Castle of Dublin, and might be tried by witness on confession before the King's Council there. But it had apparently ceased to exist before Elizabeth ascended the throne; for we find in 1562 the Earl of Sussex, the Lord Deputy, reporting to Her Majesty that "great numbers of disorders and riots and taking of possessions by force be daily committed and left unpunished, for that there is no place to hear and determine these matters but at a Council Board, which for the most part is occupied with other affairs of greater weight; and therefore it were necessary to have a like Court of record established here by Parliament as the Star Chamber is in England, to order the like causes here."[2] He immediately received orders "to appoint a session of a Council for riots and like the Star Chamber." There is no evidence of any Commission being issued to create this Court; but that it was so created we have proof not only in a letter from the Queen to Sydney in 1566, in which she speaks of "that place which was erected by our cousin of Sussex, and named the Castell Chamber to resemble our Starr Chamber at Westm^{r}," but also in the appointment of Thomas Walsche, clerk, to be clerk of the Castle Chamber in 1563[3]; and in the following year, grants to the attorney-general, solicitor-general, and serjeant-at-law

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[1] Cal. State Papers (Ireland), Hen. VIII (Lemon), vol. ii, pt. 3, p. 209.

[2] Carew MSS., p. 343.

[3] Fiants, Elizabeth, No. 565.

were made for their diligence in the Castle Chamber.[1] In 1566 the new Lord Deputy, Sir H. Sydney, wrote to Cecil that the Earl of Sussex had been of opinion that no great effect had followed the erection of the Court, yet "Nevertheless I finde y^t a Court y^s necessary and of a great consequence here, as I must both allowe and greatly com̃end the erection, and also desier you that y^t may be furder established by sending me hither the orders of the Starre Chamber, especially that which is to be observed by the Clerke and the order of the processes and the forme of the seal thereunto belonging together w^t such authority as the Clerke hath there for the accepting of recognizances and cancelling of bonds, whereof yf advertisement might com̃ence before the next terme, that Court suld be fully established, w^{ch} being yet in his infancy was worth to the Queene this last terme [*torn*] abought an hundredth pounds."[2] A draft Commission was made out, and corrected and approved of by the Lord Deputy; but I cannot find any enrolment of the Commission. Such as it was, it was still found to contain some imperfections. For instance, the Privy Council discovered that it gave no authority to the Lord Keeper, in the absence of the Lord Chancellor, to issue decrees or impose fines for offences. Accordingly the Lord Deputy and Privy Council, in 1580–1, applied for a new Commission to remedy the acknowledged defects of the old one. This was issued, and is interesting as being the first Commission for this Court of which we find any enrolment.[3] It was directed to the Lord Deputy, Lord Chancellor, Lord Treasurer, Chief Justice of the high bench, the Chief Justice of the Common Pleas, Chief Baron of the Exchequer, and the Master of the Rolls (of whom the first three were to be of the quorum), "with power to call as associates unto them such and so many of the lords spiritual and temporal and such of our Privy Council or Justices of any our Benches . . . as they or any of them . . . shall think meet to sit and join with them." The Court was designated "a particular Court to be holden within our Castle at our City of Dublin or in such other place where the ordinary term shall be kept, in that our realm, and that the same our Court shall be called the Castle Chamber of our said realme of Ireland." It was also laid down that the Court was to sit every Wednesday and Friday during term time. To this Commission was appended a note of all such causes as the Star Chamber at Westminster determined, "with all manner and form of the proceeding as well by process as otherwise."

We hear of no fresh Commissions during the remainder of the reign of

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[1] See Fiants, Elizabeth, Nos. 652–4.

[2] Cal. State Papers (Ireland), 1509-73, p. 290.

[3] Pat. Rolls (Eng.), Eliz. (Misc.) No. 1606.

Elizabeth; but as, with the accession of a new monarch, another Commission was necessary, we find that such was issued in the first year of the reign of King James.[1] It was very similar to the Commission of 1581, and insisted that the judgments of the Commissioners were to have the same validity as and to conform in all things to the procedure of the Star Chamber, which was fully set out in an accompanying document. The Commissioners to whom it was directed were the Lord Deputy, the Lord Chancellor or Keeper of the Great Seal, the Treasurer, Vice-Treasurer, Chief Justice of the King's Bench, the Chief Justice of the Common Pleas, the Lord Chief Baron, and the Master of the Rolls; and of these the first four were to be of the "quorum." There was given the same power to call in associates as we find in the Commission of 1581.

The commencement of the reign of Charles I saw a new Commission, which was framed on the model of that of James I. This Commission was urgently called for by Lord Falkland and the Council in a letter to Lord Conway, on 15th April, 1625, with the caution that, if the winds delayed its arrival, they would presume to renew it under the Great Seal of Ireland. Whether from the winds or some other cause, there was delay, for it was renewed by the Lord Deputy on the 27th April, 1625, whilst the new Commission was not signed by the king till the 1st October of that year. This Commission was directed to the Lord Deputy, Lord Chancellor or Keeper of the Great Seal, the Treasurer, the Chief Justice of the Common Pleas, and the Lord Chief Baron of the Exchequer.

During the reigns of James I and Charles I the Court was overwhelmed with work; and consequently, to expedite business, the King, by letter of the 24th September, 1634, ordered the Court to sit as often as there was work for it, and not only twice a week in term time.[2] It is interesting to note that at the same time, in the second session of the Parliament of 10 Car. I (cap. 3), in an Act against fraudulent conveyances, it was expressly enacted that the Act was not to restrain or impair the jurisdiction, power, or authority of the High Court of Castle Chamber. In the third session of the same Parliament an Act was passed against maintenance, embracery, champerty, &c. (cap. 15). Under this Act an action could lie in the King's Bench for cases which had hitherto come under the cognizance of the Court of Castle Chamber; but there was an express stipulation that the Act was "not to extend to restrain or limit the power of the Court of Castle Chamber in this realme, but that the Court may at any time proceed to the punishment

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[1] Pat. Rolls (Ireland) 1 Jas. I, pt. 2, No. 2, m. 6.

[2] Cal. State Papers (Ireland), 1633-47, p. 78.

of any of the offences or misdemeanours mentioned in this Act, according to their discretions."

By another chapter (cap. 17) in the proceedings of the same session of Parliament, statutory force was given to the Court to do that which it had formerly done by the King's prerogative, viz., punish the deflowering of maidens that were inheritors under sixteen years, or the marrying them without consent of parents. Indeed the intention of all these Acts was apparently to give statutory validity to proceedings such as had formerly depended on the King's prerogative alone, without depriving the Court of the power of trying such cases if it so desired.

By a letter of the 29th November, 1639, the King ordered the renewal of the Commission, and directed that the Lord Chancellor, the Chancellor of the Irish Exchequer, and the Master of the Court of Wards should be of the "quorum"; but I have been unable to find any enrolment of such a Commission.

In 1641 the Court was unable to sit for some time on account of the absence of some of the Judges, who were being impeached.

In this year the Court of Star Chamber in England was abolished by the Long Parliament, which justified its action on the ground that the Court had exceeded the powers conferred upon it by the Act of 1487. But the Court of Castle Chamber was not touched, as we find that it continued to exist till 1649, when Robert Shee preferred his Bill in that Court against Thos. Butler for champerty, maintenance, and other offences. During the Commonwealth its powers were in abeyance; but with the accession of Charles II an attempt was made by the Crown to renew so useful a Court. On the 26th February, 1665, a Bill was read for the first time in the Irish House of Commons "for punishing several offences in His Majesty's Court of Castle Chamber." It was adjourned for the assistance of the law officers; but on the 5th March, after very careful consideration, the second reading was refused. The Government, not to be baulked, transmitted another Bill out of England of a similar nature; but the House threw it out on the ground that it agreed verbatim with the Bill they had already rejected. The Lord Lieutenant ruefully wrote to Secretary Arlington that "The House of Commons here do not suffer bills that concern the King's revenue and his prerogative to pass with that readiness they were wont. That concerning the Castle Chamber they have thrown out."

Although there is no evidence of the Court having sat after 1649, we find that in 1666 both a new clerk and marshal were appointed, and continued to receive their salaries till 1672, after which time no payments to officials of the Court of Castle Chamber are to be found in the Treasury Ledgers.

But as the Court had not, like the Star Chamber in England, been abolished by Statute, it may have possibly been considered by some that it still technically existed, as we find that in 1695 Mr. Weaver laid on the table of the House the head of a bill "for regulating the Privy Council, and for taking away the Court commonly called the Star Chamber or Castle Chamber." But the Journals of the House do not disclose any further proceedings in the matter.

We must now consider the class of cases which were, by virtue of the King's prerogative, tried in this Court. They included riots and unlawful assemblies, which were very numerous; unlawful retainders and maintenances, embraceries of subjects, untrue demeanour of sheriffs in making panels and false returns, refusal of sheriffs to execute writs, the taking of money by jurors, perjury of jurors upon acquittal of felons, with wilful perjury of witnesses, forgery of deeds and writings, slander, extortion of sheriffs or other officers, mayors and sheriffs executing office without taking the oath of supremacy, sedition, abduction, trespass, disobeying of proclamations, disclosing state secrets, &c. These clearly comprise some causes of actions which might have been tried in other courts, as, for instance, cases against sheriffs, which the Exchequer was quite competent to try.

Accordingly the question arises as to why this extraordinary Court was necessary when the ordinary Courts were in existence. The answer given on one occasion[1] was that the Common Law Courts were unable to deal with such cases as conspiracy, perjury, forgery, &c. So, instead of strengthening the ordinary Courts, the course was taken of forming a special Court of certain Judges and officials, with the assistance of some Lords Temporal and Spiritual, and Privy Councillors, to determine such cases, in the hope of eradicating these evils by heavy fines and imprisonment. But another reason for forming this Court was to be found in the condition of the country both here and in England. We find it set down in the Statute 8 Hen. V that the only cases to be tried before the Council—that is, the Star Chamber—were those "in which complaint was against a man of great influence or the suitor too poor to prosecute his cause in the inferior Courts, or in which the Council saw other reasonable cause." It was this spirit which largely influenced the first Tudor King in his government of England, and which was further manifested in the action of Henry VIII and Elizabeth. It was to restrain the rapacity and lawlessness of the higher classes that this Court was formed. And we cannot doubt that the same desire actuated the Tudor sovereigns in their government of Ireland. It was to protect the Commons against the

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[1] Cal. State Papers (1647-60), p. 172.

high-handed proceedings of the Anglo-Irish nobility that Poynings' Law was passed, forbidding any bill to be submitted to the Irish Parliament which had not first been approved of by the King. In 1586 the Solicitor-General of Ireland wrote to Burghley: "We here are glad to plead for all the poor complainants in the Castle Chamber without fees, otherwise the poor subject should be oppressed with countenance." Thus the Court did not hesitate to condemn the members of the nobility or high ecclesiastics when it saw fit, whether in cases brought against them by their poorer countrymen, or in cases of disloyalty against the Crown. The Bishop of Leighlin was fined £20 and imprisoned for eight days for uttering words against the Lord Deputy in 1593–4[1]; and about the same time even the Attorney-General himself was ordered to be tried in the Court of Castle Chamber. Lord Inchiquin, too, was fined £500 Irish and imprisoned for harbouring a Jesuit in 1616. But a Court which was instituted as a protection for the poor against the rich, and which was mainly so till the end of Elizabeth's reign, took on a different complexion with the advent of the Stuarts. By virtue of their prerogative they utilized this Court as an instrument for forcing upon their subjects a policy which they detested. In the reign of James I in Ireland the Court devoted much of its time to prosecuting those who refused to take the oath of supremacy, and jurors who refused to present against the recusants. It usurped the functions of the High Commission Court, and was taunted with being a "Spiritual Consistory."

In mentioning above the various Commissions which were issued for holding this Court, it was stated that the Commissioners had the right of calling to their assistance such Lords Spiritual and Temporal, and such Privy Councillors or Justices of any of the benches, as they should think meet to summon. We accordingly often find that the Lord Primate and Bishop of Meath were present; but the presence of officials such as the Treasurer at Wars, the Master of the Ordnance, the Vice-President of Munster, the Marshal of the Army, and the Secretary of the Council is difficult to explain, unless they were present as Privy Councillors.

The Commissioners, with their associates, were given full power to hear and determine all bills, complaints, supplications, and informations touching riots, &c., just as such offences were heard in the Star Chamber in England, and could call before them all misdemeanours. The Court was empowered to punish "by fines to our use, ymprisonm^{t} & otherwise after their demeritts & according to your discreations"; but they never inflicted the capital penalty. They also were authorized "to taxe and cesse to our use

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[1] Egmont Papers, vol. i, pt. 1, p. 25 (Hist MSS. Com.).

americiam'ts fynes & penalties for defaults to be made for non-apparaunces, deptures from the Court withoute licence or other defaults." Their judgments were to have the like validity with those of the Star Chamber of England.[1]

The law officers of the Court were the Attorney-General, the Solicitor-General, and Serjeant-at-Law, who received £10 apiece every year for their services in the Court; but it is probable that there were emoluments derived from fees. The officials were the Clerk and Marshal, who each received £13 6*s.* 8*d.* per annum. The former also was Clerk of the Writs, Processes, and Commissions, and both of them received fees for the duties performed by them. There would appear also to have been an Usher, as in 1597 this officer was considered needless.

The procedure in the Court was as follows:—In a prosecution by the Crown, the Attorney-General would proceed by written information, as in the King's Bench, unless the defendant confessed the offences laid against him, when the Attorney-General proceeded "ore tenus" without a written information, and, in this case, counsel was not allowed to the defendant.[2] But if the case was one of an action between private individuals, the procedure followed closely the lines of equity suits, that is, the action was commenced by a bill of complaint in which the plaintiff set out the cause of action; to this, in ordinary course, the defendant filed his answer, which was followed by plaintiff's replication and defendant's rejoinder. When this had been done, the case was heard by the Court and judgment delivered. But if the defendant failed to file his answer, then a writ of attachment was issued against him to be followed by a writ of attachment with proclamation, and after that by a commission of rebellion, if he still remained obdurate. The various steps in this procedure, as also the different forms of writs, were all copied from that of the English Court, and all affidavits, commissions, orders, and decrees were to be registered and entered "in a faire booke called the book of Acts."[3]

Let us now turn to some of the most important cases which came before the Court. Of these the case of the recusants, in the reign of James I, may be said to have held the same position in the Court of Castle Chamber as did Ship Money in the Star Chamber of England. By the Statute of 2 Elizabeth, it was required that every one should attend the Protestant service in his parish church every Sunday and holy-day under pain of a fine of twelve pence for every breach of the Act. But during the reign of Elizabeth, as far as Ireland was concerned, it was nearly a dead letter. Only two or three prosecutions before the Ecclesiastical Commissioners under this Act are on record,

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[1] Pat. Rolls (Ireland), 1 Jas. I, pt. 2, No. 2, m. 6.

[2] Cal. State Papers (Ireland) 1611–14. p, 374.

[3] Pat. Roll (Ireland), 1 Jas. I, part 2, No. 2, m. 6.

and in one case—that of a man named Chamberlain—he was punished not only for not going to church himself, but also for not compelling his wife to go too. But James I, whose accession was hailed with joy by the Catholics, soon showed that he was no advocate of toleration. He was resolved to coerce the people into an acceptance of Protestant ceremonies, if not of dogmas. By two proclamations, one of the 4th July, 1605, and another of the 16th October in the same year, he ordered all Jesuits and priests to leave the kingdom and all people to attend divine service; and by the latter of these proclamations, he increased the penalty for non-compliance to "such further punishment as may be lawfully inflicted upon the wilful contemners of His Majesty's royal commands, proclamations, and prerogatives." Thus this latter proclamation extended the Statute of Elizabeth by bringing the recusant, if necessary, within the scope of the Castle Chamber jurisdiction. The humbler people who refused to attend their parish churches he left to be presented by the Grand Juries in the Court of King's Bench and at assizes. But the fines there imposed under the Statute were not sufficient to force into compliance the nobility and the more wealthy citizens. For them was reserved a special use of his royal prerogative, which he had not employed in England. Mandates or special King's Letters under the privy or broad seal were addressed to the recusants by name, commanding their particular attendance at church in the presence of the Deputy, or of the Presidents of the provinces of Munster and Connaught, or of their respective councils, under the penalty, in case of disobedience, of being punished by decree or censure of the Court of Castle Chamber with heavy fines and imprisonment. To mention one case, mandates were issued to sixteen chief aldermen and citizens of Dublin to attend the Mayor to Christ Church and to present themselves before the Lord Deputy and council there, and to hear divine service. They refused and were fined £100 each and imprisoned. To evade the fines, they made over their goods to their children, by deeds, but these were declared by the Court of Castle Chamber to be void to bar the King's execution. The same procedure was carried out in other cities, with this difference that in the provinces of Munster and Connaught, the fines were inflicted at the Council Table by the Lord President and Council. In the country districts the Act could not well be carried out because most of the churches were not habitable, and the New Testament and Book of Common Prayer in Irish had not yet been prepared.

Sir John Davys clearly showed the reason for this use of the prerogative. He wrote[1]: "But if the wealthier sort have no heavier punishment than to

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[1] Cal. State Papers (Ireland), 1603-6, p. 467.

pay twelve pence Irish for every Sunday or holiday, which amcunts not to three pounds sterling for a whole year, they would make a scorn both of the Statute and of the proclamation: so that law and prerogative must go together in this and other towns." He also, in a letter to Salisbury,[1] gave as an additional reason that they had not in Ireland the penal laws which they had in England, imposing a forfeiture of £20 a month and the like, and were therefore obliged to have recourse to the prerogative. In the case of the poorer class, who were left to the Grand Jurors, these latter frequently refused to present, and were prosecuted in the Court of Castle Chamber and heavily fined. The gentry of the English Pale, Lords Gormanston, Trimleston, Howth, and others, strongly protested against these mandates, and asserted that the Castle Chamber had never been used as a "Spiritual Consistory." Lord Gormanston, Sir P. Barnwell, and Christopher Flatisbury were imprisoned. Their resistance apparently dealt a fatal blow at the mandates, for we hear nothing more of this irregular procedure; and the Government were reduced to subjecting the juries who failed to present bills against the recusants to fines and imprisonment by the Castle Chamber. These were continued in the reign of Charles I; and Strafford, at his trial, justified his action against recusant jurors.

It will be sufficient to note briefly others of the more important cases which came before this Court. In 1577 Christopher Barnewell, Visct. Baltinglass, and others of the nobility and gentry of the Pale, strongly protested against the payment of cess, and were heavily fined.[2] In 1579 the Lord Baron of Howth was convicted in this Court of beating his wife without "lawful cause declared," but only, as appears, because she misliked his dissolute life and neglect of her, who had borne him fourteen children; the first beating causing her to keep her bed for a fortnight, and the second "ere she was well recovered of the former," being so cruel that two "sallye" rods, provided for the purpose, were both worn to the stumps and her skin so taken away that for many days she could not abide any clothes to touch her. His daughter Jane and the butler also received a severe beating at his hands, and he was fined £1000, which was afterwards reduced to £500.[3]

In 1581-2 the jury in the Court of Common Pleas, who, contrary to the evidence, acquitted Morishe Fitz James of aiding and assisting Viscount Baltinglass and other rebels, were fined £100 apiece and ordered to stand in the pillory. In 1586 Henry Ealand, late sheriff of Co. Roscommon, was found guilty of divers extortions and oppressions during his term of office;

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[1] Cal. State Papers (Ireland), 1603-6, p. 370.

[2] Egmont Papers (Hist. MSS. Com.), vol. i, pt. 1, pp. 5, 7.

[3] Egmont Papers (Hist. MSS. Com.), vol. i, pt. 1, pp. 11, 12.

and in the same year Henry Byrd, Register to the High Commission in Causes Ecclesiastical, was convicted of forging the Lord Deputy's hand to divers warrants.[1]

In 1587-8 Alex. Pluncket of the Bawne, Co. Louth, gent., was found guilty of declaring that " within two years of this spring or this spring itself," the Spaniards would return to Ireland and conquer it, and that all the Irish would join them against the Queen; after which the Spaniards, with the forces of Ireland, would go into England, and there crown a King and drive the Queen to flight[2]; while in 1593, Nicholas Whyte, of Maynane, Co. Kildare, was sentenced to imprisonment and the pillory for having " traitorously published that there was a prophecy in Ireland that O'Donnell shuld be King in Ireland, and that there was an old crown of the Kings of Ireland in Rome, and that the Catholic Bishops of this land did write to Rome for that crown."[3]

In 1594 the Bishop of Leighlin was fined £20 for undutiful speeches against the Lord Deputy; and Lord Inchiquin was ordered to pay 100 marks for assaulting Sir Tirloughe O'Bryen, Knight, on the Quay of Dublin as he was repairing to the Council Chamber.[4]

In 1608-9, in the case of Sir Robert Digby and Lady Lettice his wife *v.* Garrett, Earl of Kildare, dame Mable, Dowager Countess, and Henry Burnell, the latter was convicted of forging an Inquisition by which the late Queen was defrauded of the wardship of the Lady Lettice. This important case, upon which depended the lands of the whole earldom, gave considerable trouble to the Court.[5]

In 9 James I a case of legitimation and bastardy was tried in the Court of Castle Chamber, by which it was decided that the Ecclesiastical Court could not move in such a case without direction from a temporal Court. This case is reported at length by Sir John Davies, in his " Reports des cases & matters en Ley."

In 1611, in the case of Richard, Earl of Clanrickard *v.* Sir Thomas Brooke and others, the defendants asserted that the Earl was born out of wedlock, thereby conspiring to disinherit him; but the Court declared that he had been born after the marriage of his father and mother.[6]

In 1616 Lord Inchiquin was fined and imprisoned for receiving into his house one Nicholas Nugent, a Jesuit, who celebrated mass in his house. This

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[1] Egmont Papers (Hist. MSS. Com.), vol. i, pt. 1, pp. 17, 18.

[2] *Ibid.*, p. 20. [3] *Ibid.*, p. 25. [4] *Ibid.*, p. 26.

[5] Egmont Papers (Hist. MSS. Com.), vol. i, pt. 1, pp. 34-5, and Cal. State Papers (Ireland), 1607-9.

[6] Egmont Papers (Hist. MSS, Com.), vol. i, pt. 1, pp. 38-9.

is only one of several cases of harbouring or being in correspondence with priests.

In 1620, Christopher Draycott was summoned for behaving outrageously to Sir Francis Roe, Knight, Mayor of Drogheda, by spitting in his face, striking Lady Roe his wife, and throwing the Marshal of the prison, a man of seventy years of age, down the stairs, and also of uttering vile language. In the same year, we find the case of abduction of Margaret Cusack, which though under 3 Hen. VII was a felony, and properly ought to have been tried in the King's Bench, yet, on account of "the native disposition of this country in like cases," it was decided that the abductors be censured in the Court of Castle Chamber.[1]

In 1626 Sir Dominick Sarsfield, Visct. Kinsale, exhibited his bill against Lord Courcy touching the title; and Sir Thos. Crooke, bart., Baltimore Co. Cork, complained against Sir Walter Coppinger of the same county, and others, that, being Papists, they had endeavoured to supplant him and "return these places to superstition and barbarism."[2]

In 1630 Sir W. Power complained that the Earl of Cork had caused him to be arrested in England, and then came into the Court of Castle Chamber and moved the dismissal of a cause he had against him, on the ground of his absence; while, in 1639, the Lord Deputy exhibited an information against Sir Pierce Crosby, Lord Esmond, Lord Mountmorris, &c., in the Castle Chamber, for publishing a libel that he was the cause of the death of a man called Esmonde.[3]

These are only a few of the more important amongst the numerous cases with which this Court was engaged; but they will give some idea of the variety of actions which came within its jurisdiction.

The punishment meted out in these cases varied considerably. Sometimes the culprit was condemned to imprisonment, pillory, and fine, with forfeiture of goods; sometimes to a fine only, according to the heinousness of the offence. The fines varied from £10,000 to a few shillings; but many were heavy, as affecting wealthy people, and to strike terror into their hearts. Thus in the case of Sir A. Blundell *v.* Thos. L'Estrange and Robt. Smith (1638), the former of these defendants was fined the enormous sum of £10,000, while Smith was fined only £100. In the case of the nobility and gentry who refused to pay cess in Elizabeth's time, several were fined £500. Lord Howth, for his inhuman treatment of his wife and daughter, was condemned to pay £1,000, but this was reduced to £500 on his appeal. Some of the

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[1] Egmont Papers (Hist. MSS. Com.), vol. i, pt. 1, pp. 59, 60.

[2] Cal. State Papers (Ireland), 1647–60, p. 82.

[3] Cal. State Papers (Ireland), 1633–47, p. 215.

punishments seem to us, with our more humane ideas, to be too cruel and barbarous to be possible. Nicholas Terrell, in 1579, for perjury, was ordered to be delivered to the sheriff, to be by him set in the pillory for two hours, with a writing in great letters upon his head "for wilful perjury," and at the first time, his right ear, and at the second time, his left ear, to be nailed to the pillory, "and to deliver him a knife with the same, to cut or otherwise to tear off the same." However, the nailing in his case was to be omitted if he paid £40. A similar fate befell Alex. Pluncket, of the Bawne, Co. Louth, gent., in 1587–8 for seditious speech. In 1590 John Delahide of Bellantree was ordered to stand in the pillory on three market days, with one of his ears nailed to the pillory, "not to be unloosed until it be cut off, or himself do tear it off." In 1608 Jas. Sherlocke, Co. Tipperary, gent., convicted of forgery, was condemned to stand in the pillory in Waterford on a market day, to lose his ears, and to have his nose slit and seared. After these sufferings, the poor wretches were returned to gaol. Nor can we flatter ourselves that these punishments were not carried out, as in one case a sheriff was prosecuted for allowing a prisoner to escape, who, after having his ears cut off, had been sent down to him to be exhibited in the town where his crime had taken place.

It would appear that all those condemned to imprisonment by this Court were handed over either to the custody of the constable of Dublin Castle, or to that of the Marshal of the Court, who had a prison of his own. A dispute arose between these two as to the custody of the prisoners; and it was decided in 1604–5 by three Judges of the Court that "all Barons, and persons precedent unto Barons, Counsellors of Estate, Justices of the Benches, Barons of the Exchequer, Lords of Irish Counties, Sheriffs of Counties, Mayors, Knights, Deans of Cathedral Churches, and Justices of the Peace "committed by the Court, were to be in the custody of the Constable of the Castle, and other persons in the custody of the Marshal."

The fines received upon sentences of the Court formed, at least in the reigns of James I and Charles I, an important part of the casual revenue.[1] As we have seen, in some of the more important cases, the fines were very heavy. It is true that they were often reduced, even to the extent of two-thirds or more, in the case of the recusants who submitted; but they were large enough to be regarded with covetous eyes by the Government, and instructions were given to see that they really did come into the King's hands. Even the Lord Deputy was forbidden to reduce the fines; and such authority was given only to the Treasurer, Barons, and Chancellor of the

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[1] Letters of Thos., Earl of Strafford, vol. ii, p. 293.

Exchequer. In order to avoid payment of the fines, the parties sometimes made fraudulent conveyances of their goods. It is curious to note that the Government showed some reluctance about taking the fines produced by the prosecution of the recusants, for in some cases their fines or part of them were allocated to charitable purposes. Thus part of the fines imposed on the recalcitrant aldermen and citizens of Dublin who refused to attend divine service were ordered to be laid out partly in repairing the churches in Dublin which remained ruinous since the blast of gunpowder, part in the relief of poor scholars in the college, and in other necessary and charitable uses, that they might perceive it was not their goods but their conformity that was sought. The Mayor, burgesses, and commonalty of Drogheda (1607) petitioned to be paid some of the fines imposed on the townsmen by the Castle Chamber: and the dean and chapter of Christ Church also sought to be paid some of the fines imposed for building the Law Courts near Christ Church. Both these petitions were allowed.

We find that complaints against the Court were numerous. In 1582 the Clerk of the Court complained that in many of the cases depending, as well as in a far greater number not yet proceeded with, both plaintiffs and defendants had failed to appear and prosecute. It would appear that a prosecution in the Court was used as a species of blackmail, and that the parties arrived at an understanding without the intervention of the Court. In 1588 Sir Richard Bingham complained to Burghley that he had been convicted on the judgment of the Lord Deputy and two or three Irish Councillors, though the majority, including the Lord Chief Justice, the Treasurer, and Bishop of Meath, were in his favour. In 1613 the recusants complained to Lord Chichester against the action of the Castle Chamber, especially that jurors who refused to convict the recusants were not allowed counsel. To this it was answered that no counsel was allowed because the jurors proceeded "ore tenus" upon their own confession. About 1630–2, in a "Brief collection for his Highness' Court of Castle Chamber in Ireland," probably prepared by the law-officer, it was shown that the Court was now "abused for private ends," plaintiffs "wresting and terrifying the poor" or compounding with delinquents without licence from the Court. The king is thus deprived of £1,000 a year or more in revenue." This memorandum went on to state that there were about 1,200 cases in number pending in the Court, "most of them of great consequence and very foul, which are and have been discountenanced."[1] The Lord Viscount Dorchester was advised to ask the King to rectify the evils. In a memorial

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[1] Cal. State Papers (Ireland), Add., 1625–60, p. 172.

of Lord Dorchester on the subject, about the same time, which probably was prompted by this "Brief Collection" and written for the King's perusal, he stated that the reason so many causes were discontinued was the poverty of the litigants; that they were allowed to sue *in forma pauperis,* but were wearied out by delays. "Others of ability," he wrote, "are discouraged by the evil success of those that spend their whole estates in bringing some causes to censure, whereby His Majesty may causualy get a fine, but the plaintiff is awarded little or no damage, the ordinary course also being to reduce to a third or fourth part bills of costs presented by a clerk of the office not containing a tithe of the petitioner's expense. There is no means of recovering these costs without spending three times their sum." He added that wicked people often brought suits against the innocent to get compositions from them, on which they dropped the suit.[1] In 1641 the Committee of the Irish Parliament represented certain Irish grievances to the King, and, amongst others, they recommended that "an Act should be passed forbidding any juror to be bound to the Castle Chamber, or to be there in any sort questioned, except corruption be proved against them. Jurors shall not be compelled to respect the evidence of notoriously bad characters. The proceedings of the Court of Castle Chamber should be agreeable to the Statute 8 Henry VII, and no jurors should be proceeded against *ore tenus,* nor bound over to appear or called into the Star Chamber upon any pretence before the information be filed of Record. Only legal courses to be taken." The answer returned to this complaint was that "the Court of Castle Chamber shall be regulated on the English models." Indeed the frequency with which we meet with orders that the Court in Ireland should be made to conform in all respects with the Court in England shows that there was considerable laxity in the administration of the Court in this country.

Irish causes were tried not only in this Court, but, when the King thought fit, the parties were ordered to attend in the Star Chamber of England instead of the Irish Court. This was especially so in the case against the London Society for not properly carrying out the plantation. They were evicted from their possessions by a decision of the Star Chamber in 1635, though they recovered them later on in 1662. In 1630 Sir A. Savage and others were summoned to appear in the Court of Star Chamber at the instance of the Lord Deputy, Lord Falkland. This summons was issued by the Court itself; and it was contended that nobody in Ireland was bound to answer such a summons except issued by the King himself. It was even maintained by some that, as a Court of Castle Chamber had been erected in Ireland, even the King

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[1] Cal. State Papers (Ireland), Add., 1625–60, p. 158.

had no right to summon his Irish subjects to appear in the Court of Star Chamber, but there were several instances of his doing so. He even called into England cases which had been tried in the Court of Castle Chamber, e.g. Apsley *v.* Coppinger. On the other hand, he sometimes sent over petitions he had received to this Court to decide the issue there. He also in some cases ordered the Irish Court to alter its sentence or remit fines inflicted by it. In the case of Blundell *v.* L'Estrange and Smith in 1638, Wentworth complained bitterly at being ordered to pardon Smith, who, with L'Estrange, had been convicted in the Court of Castle Chamber; and from his letters to Secretary Windibank we gather that such a procedure was of rather frequent occurrence in his time. It is true that such interference was sometimes even requested at the King's hands. In the case of the Earl of Kildare *v.* Sir R. Digby, the Council, on account of the momentous importance of the issue, implored the King to take it into his own hands; but this was very different from altering the decision already arrived at by the Castle Chamber. Another case of interference—this time by Parliament—with the jurisdiction of the Irish Court occurred in the case of Stewart and others, being Scots holding land or houses in Ireland, who had refused to take the oath of allegiance, and were fined in the Court of Castle Chamber. Their fine was remitted by the King. Stewart appealed to the English Parliament, who ordered the members of the Court who had convicted Stewart to answer for their action. In a letter of 30th July, 1641, of the Lords Justices and Council to the English Privy Council, they asked the King to drop the matter, as they had confessed their mistake. They added: "It would be dangerous to admit the doctrine contained in the petition, for, if it were admitted, people would be afraid to become Privy Councillors, lest they should be liable to damages for not understanding a case so fully as God might have enabled them to do. The error in practice was bringing such suits before, and trying them in, the Castle Chamber; but this is an error which has been made continuously for a century." On a former occasion the Privy Council of England had been very careful not to lessen the prestige of the Irish Court. In 1588, when Henry Eyland, late Sheriff of Roscommon, petitioned the former against a decree of the Castle Chamber, it referred the matter back to the Council in Ireland for re-consideration, "which re-examynacion and that which was further thereuppon by them to be don, their Lordships thought meet should be don at the Councell Borde and not in the Starr Chamber, because y^t could not in their opinion stand with the honour and reputacion of any soche Court of Justice after a judgment given in the same Court to have y^t re-examyned and altered."

From the above account of this Court it will be seen that it was in effect a kind of Judicial Committee of the Privy Council (Burleigh called it a session of the Council), but considerably strengthened by outside assistance, for the Court had extensive powers of calling to its aid any Judges and members of the House of Lords whom it should deem necessary. The necessity for such a Court lay in the fact that such offences as riot, conspiracy, maintenance, &c., either could not be tried by the King's Courts, or that the procedure in such courts was not sufficiently effective. As we have seen, the Act of 10 Car. I made maintenance, embracery, champerty, &c., statutory offences. If it be asked why the Government could not have given in the reign of Elizabeth power to the ordinary Courts to deal with these cases instead of setting up a new Court, it must be remembered that, during the reign of the Tudors in Ireland, very few Parliaments were held, and the power was concentrated in the Privy Council; and it was to relieve the Privy Council of the labour of dealing with such cases that the special committee or sessions of that body was formed. Under the circumstances, the use of the King's prerogative does not appear objectionable; but it was the misuse of that prerogative in the issuing of mandates to enforce attendance at public worship, in the reign of James I, that calls for our condemnation, as the King's Bench was already authorized by statute to deal with these cases; and the trial of people for a breach of the statute before the Court of Castle Chamber was distinctly unconstitutional.

In writing this paper I have been much indebted to the first volume of the Egmont Papers published by the Historical MSS. Commission, and edited by Mrs. S. C. Lomas, as it contains a calendar of an entry-book of orders or decrees of the Court. This volume was apparently carried away from Ireland by one of the Percivals, who were Registrars of the Court of Wards in the time of James I and Charles I, and were ancestors of the Egmont family. This volume contains entries from c. 1573 to 1620. That there was a second volume in existence is proved by the volume in Trinity College Library (G. 3. 1), entitled "Star Chamber Tryalls," in which have been transcribed full entries of many of the decrees of the Court, probably as precedents; but whilst containing many of the decrees to be found in the volume in the Egmont collection, it also comprises other decrees up to the year 1630.

APPENDIX.

(1). *Clerks of the Court of Castle Chamber.*

1563. Thomas Walsche, clerk.
1565. John Bathe, gent.
1565–6. Edward Waterhouse, gent.
1569. John Harepennye, gent.
1572. Anthony Wilcocks, gent.
1575. Edmund Molyneux, esq.
1576. Robert Kendall, gent.
1581. Laurence Hollinshed, gent.
1586. Anthony Stoughton, gent.[1]
1607. Anthony and John Stoughton.
1625. John Stoughton, clerk.
1626. Anthony Stoughton, junior, on death of John.
1666–72. Sir George Lane.

(2) *Marshals and Ushers of the Court of Castle Chamber.*

—— T. Kinge.
—— John Mountaine.
—— William Maiore.
1578. William Kendall (marshal or usher).
1581. Daniel Brian, gent.
1583. Thomas Keere, writer.
1590–1. William Jones, thro' Keere's absence in England.
1592. Thomas Keere (re-appointed).
1597. Samuel Mullenex, gent. (marshall).[2]
1608. Master Philpott, dep. marshall.
1615. Richard Pemberton (marshall).
Henry Southey, ,,
1625. George Richard, ,,
1627. Rob. Newcomen & Rob. Richard (marshalls).
1666–71. Geo. Rutledge (marshall).
1671–72. Will. Robinson ,,

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[1] Dr. Elrington Ball has kindly brought to my notice the inscription on the monument of this officer in St. James's Church, which is noted in Thomas Dineley's Journal. In this inscription he is styled "sometimes clerk of his Ma$^{\text{ties}}$ High Court of Chancery Starr Chamber in this Kingdome." I would suggest, as a possible explanation of this manner of designating the Court, that, when the Law Courts were removed from the Castle to the new buildings at Christ Church Cathedral, in the time of James I, the Court of Castle Chamber was probably removed as well, and that the Court held its sittings in the Court of Chancery.

In 1597 it was considered that an usher was needless, so this office was discontinued.

XI.

FIND OF BRONZE OBJECTS AT ANNESBOROUGH, CO. ARMAGH.

By GEORGE COFFEY, M.R.I.A., and E. C. R. ARMSTRONG, F.S.A.

Plate XVIII.

Read February 23. Published May 15, 1914.

A very remarkable find of bronze objects was recently made in Co. Armagh, on a farm at Annesborough, which lies between Lurgan and Lough Neagh. Mr. H. C. Lawlor, of Belfast, a keen student of local antiquities, fortunately heard of the find, and at once proceeded to the spot, and we give the account of the find in his words as follows :—

" These were found by the proprietor of the above farm on 14th April, 1913, when sinking a hole to put in a gate-post. They were about 9 inches below the level of the surrounding surface. The torc and fibula were first found. A tree-root interfered with the work, and on its removal three bracelets were found about 30 inches from the torc and fibula, and a few inches further away was found the adze. One of the bracelets was given away by the finder before he brought the rest to me. The hole was filled in again, and the surplus soil spread over a potato plot. When I got the ornaments, I went to the place and excavated the filled-in soil, riddling it to try and find the missing inch or so of the torc, but was unsuccessful; it was probably among the soil spread over the potato plot."

After making further examination of the site, Mr. Lawlor wrote at a later date :—

" Assuming, from the relative positions in which the several articles lay, that they were the personal adornments of a man who lay as he died, with the adze in his hand, I decided to excavate where the body would have lain if this had been the case. Beginning with the spot where the torc and fibula lay, we carefully dug where the body would have lain if it had been face downwards. We then dug where the body would have lain if on its back, but our further searches were quite negative. Later on in the season, when the potato plot where the surplus soil from the hole had been spread came to be dug, the proprietor had a careful look-out kept to find the missing portion of the torc, but without success.

"Our want of success in finding more evidence hardly, I think, disproves the theory, formed from the positions in which the various articles lay, that they may have been the personal articles worn by one man at his death; the position in which they lay, and the nature of the articles themselves, seem, I think, to preclude the idea of this being a bronze-founder's hoard."

The find is of importance and interest not only on account of the juxtaposition of objects of very different dates, but from the nature of the objects themselves.

The bronze torc (Plate XVIII, fig. 1) measures 6 inches inside diameter, and is ¼ of an inch in thickness.

It is of the usual twisted pattern; it is broken in two near the centre; and about 3½ inches of one end are missing. Another twisted fragment, 2 inches in length, was also found, and was assumed to be portion of the large torc. Mr. Reginald A. Smith, F.S.A., to whom drawings of the objects had been submitted, and to whom we are indebted for some suggestions, thought this fragment was probably portion of another torc; and as the twisted pattern is slightly different from that of the larger torc, we quite concur with this view. (Plate XVIII, fig. 4.)

The torc, like the other objects comprising this find, is covered with a fine dark patina, relieved with patches of green where the metal has been oxidised. This patina is a rather unusual one with Irish bronzes, which more generally show a brownish colour, characteristic of objects found in bogs, and is in itself an additional piece of evidence for the associated deposition of the objects.

Gold torcs have been frequently discovered in Ireland, but up to the present no torc of bronze has been recorded as having been found. There is one bronze torc in the Academy's collection of exactly similar type to that we are describing (text-fig. 1). It was formerly in Dr. Petrie's collection, but unfortunately no details have been preserved as to its provenance, and its Irish origin has been considered doubtful. The discovery of the present example and fragment tends to establish the Irish provenance of the Petrie torc.

Montelius, in his chronology of the Bronze Age of Great Britain and Ireland, places torcs of this type in his third period of the Bronze Age, dated from the seventeenth to the end of the fifteenth century B.C. This date may be considered rather too early, and it might be safer to reduce it roughly by 500 years, and place the date for Ireland at from about 1200 to 1000 B.C.

The palstave belongs to a type common both in Ireland and Great Britain; the cutting edge is expanded, and it has a triangular pattern below the stop ridge. The seams of the casting can be seen on both sides. It had a loop at one side which has been broken. It measures 5¼ inches in length (Plate XVIII, figs. 2 and 3). The palstave very much resembles the three found with the celebrated Grunty Fen torc figured by Baron Von Hügel in the "Proceedings of the Cambridge Antiquarian Society," vol. xii, Plate III. The Grunty Fen find is placed by Montelius in his third period, and there is little doubt that the bronze torc and palstave from Annesborough may be considered as contemporary, and the palstave placed at about the same date which we have suggested for the torc, i.e. 1200–1000 B.C.

The two bracelets that have been recovered are very featureless, being merely rods of bronze, square in section, bent into circular form (Plate XVIII, figs. 6 and 7). It would be exceedingly difficult to form an estimate of their age. The bracelet that was not recovered was of the same type. It was sold by the farmer to a woman living in the neighbourhood.

The most interesting object, which at the same time presents the most difficulties, is the brooch. It belongs to the type of Roman provincial fibulae generally known as hinged-brooches, and may be assigned to the close of the first century A.D. It measures nearly 1⅝ inches in length, and the cross-piece is an inch long. The pin is hinged at the head, and its point rests in the groove of the catch-plate. The bow has a longitudinal rib, the catch that held the chord of the spiral spring having become merely ornamental, and the cross-piece has slight transverse grooves near the two ends, perhaps a survival of the bilateral spring with which earlier brooches of this type were provided (Plate XVIII, fig. 5).

It is almost impossible to differentiate the latest forms of the late La Tène brooches from the early provincial Roman types, as they pass so gradually from one form to the other; but the attachment of the pin by a hinge is generally considered to distinguish the provincial types from the La Tène brooches.[1] The example before us is certainly post-La Tène. The type is derived from the La Tène examples with bilateral springs, and eventually it evolved into the cruciform Teutonic brooch.

Forms of early Roman provincial brooches similar to the Annesborough brooch have been found in England—for example, at Polden Hill, Somerset.[2] They have also been found in central and south Europe.

While on the subject of hinged-brooches found in Ireland, we take this opportunity of illustrating four other specimens in the Academy's collection.

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[1] "Zeitschrift für Ethnologie," vol. xliii, pp. 689, 690.

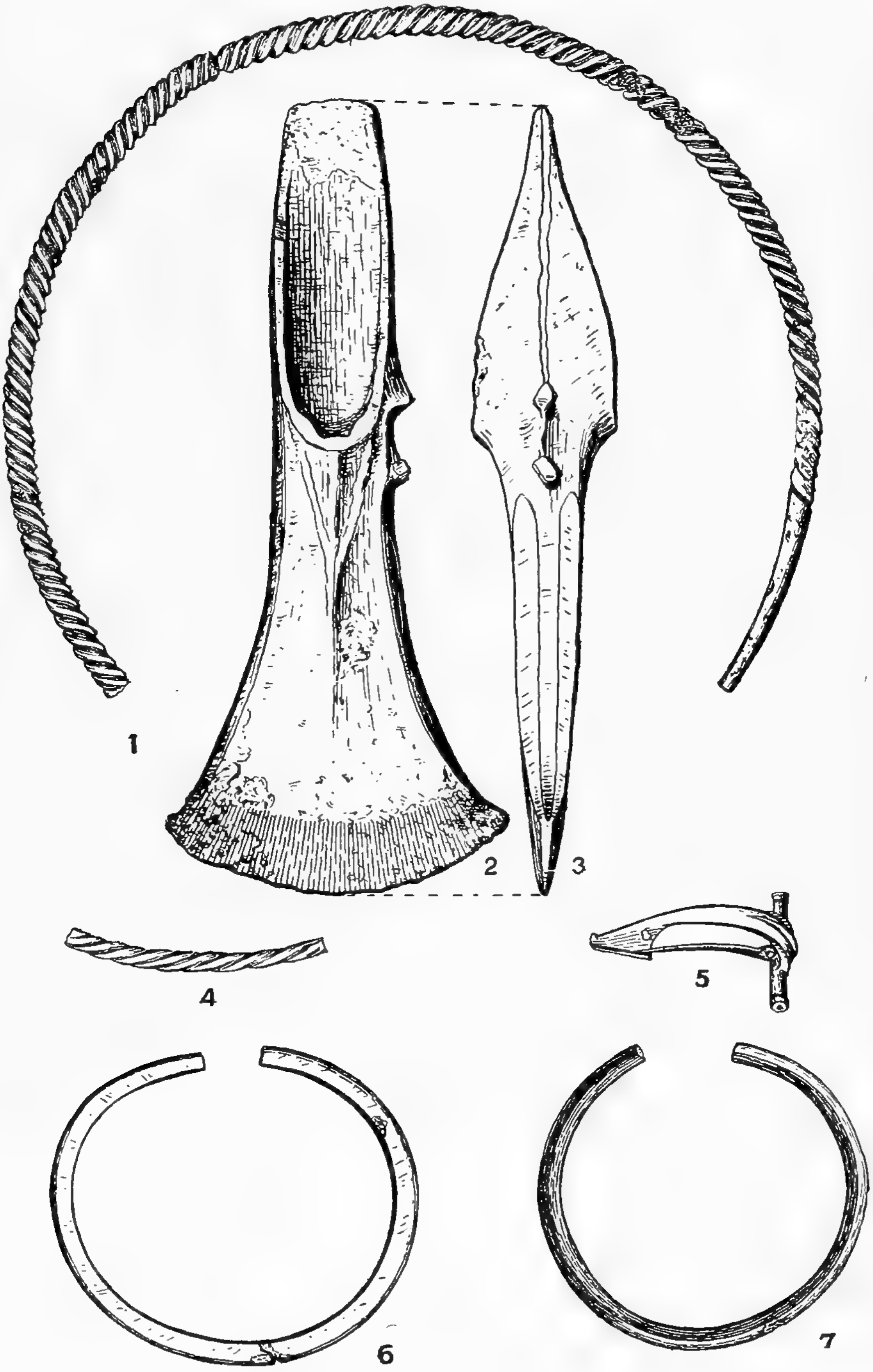
[2] "British Museum Iron Age Guide," p. 128, fig. 109.

The first, which is of exactly the same type as the Annesborough brooch, measures $1\frac{3}{4}$ inches in length, and the cross-piece measures $1\frac{3}{8}$ inches. The pin is missing, but a portion of the attachment remains (text-fig. 3). It was formerly in the Petrie collection, but no particulars as to its finding have been preserved. The second brooch is also of the same type, and a very fine specimen. It measures 3 inches in length, and the cross-piece is $\frac{15}{16}$ of an inch long. The bow is decorated, and also the cross-piece (text-fig. 5). Unfortunately no record of it can be traced; but on the analogy of the Annesborough brooch, there is a fair probability of its having been found in Ireland.

The next example is of a later type, belonging to the close of the third and commencement of the fourth century A.D. (text-fig. 4). It is of the ordinary Roman crossbow variety, which occurs very commonly in finds made in the Roman Wall. The type survived the fall of the Western Empire, and one was found in the tomb of the Frankish King Childeric I (d. 481). The brooch (text-fig. 4) measures 3 inches in length, and the cross-piece is $1\frac{3}{4}$ inches long; it is of the ordinary shape, with knobs at the top of the bow and ends of the cross-piece, the foot being ornamented on the front, and the pin missing. It was formerly in the Petrie collection, and is stated to have been found in Ireland. This type is a later stage of the provincial Roman brooches, and is related to the Teutonic cruciform brooch, but is not in the direct line of descent.

The last brooch is of a distinctly Celtic character. It is bronze, and unfortunately a good deal damaged. It measures some $3\frac{1}{4}$ inches in length; and the head, which had a ring attached, measures an inch across (text-fig. 2). It resembles the silver gilt specimen found at Backworth, Northumberland, figured in the "British Museum Iron Age Guide," p. 102, fig. 84, and is akin to the very remarkable fibulae found at Aesica, Great Chesters, and illustrated by Sir Arthur Evans, "Archaeologia," vol. lv, p. 181, fig. 4. The loop, of which only a fragment remains in the example we are describing, was to take one end of a chain, as these brooches were worn in pairs. The pin was attached by means of a spring. It is most unfortunate that the brooch is in such a damaged condition, as it appears to have been ornamented with enamel, and must have been a very interesting specimen of these Celtic fibulae. As regards date, it probably belongs to the end of the second century A.D.

Returning to the objects found at Annesborough, it only remains to make some suggestions as to the finding together of objects differing in date by some 1000 years. It must be recollected that no remains of burnt or unburnt bones were found with them; and although it is possible that all traces of the bones might have disappeared, this is unlikely, and we are inclined to dismiss the possibility of their having formed part of a grave-deposit.



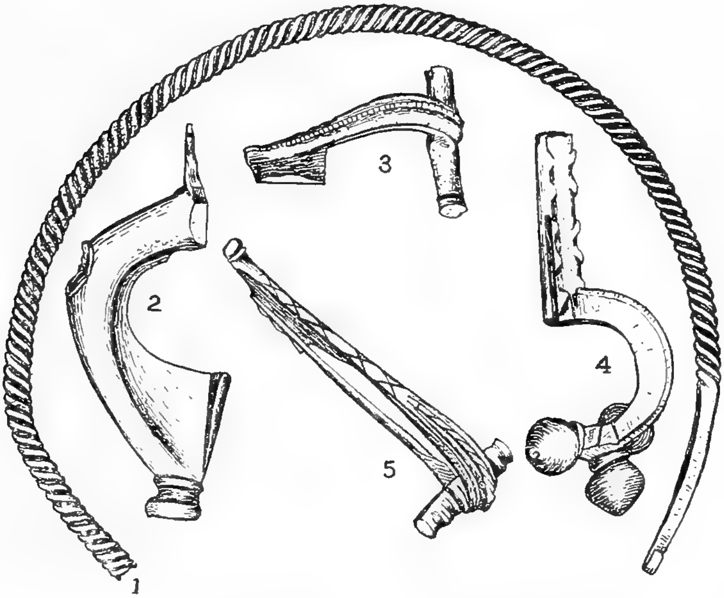
All × $\frac{1}{3}$.

Coffey and Armstrong.—Bronze Objects found at Annesborough, Co. Armagh.

Another possibility appears to be that these objects were a hoard which an individual in some period after the first century A.D. had collected for the purpose of melting down to convert the metal to some other purpose.

A third question might be raised as to whether the objects were all deposited at the same time, or if they were lost at separate periods, and by some fortuitous circumstances had got close to each other. The fact, however, that the torc and fibula undoubtedly appear to have been found adjoining one another, and are similarly oxidised, militates against this view.

On the whole, we are inclined to adopt a cautious attitude, and while leaning towards the supposition that the objects belong to a hoard, do not wish to press this view unduly, and are satisfied to record the circumstances of this remarkable find, on the acquisition of which the Academy is to be congratulated.



Bronze Torc and Brooches in the Academy's Collection (½).

XII.

ON A HOARD OF REMARKABLE GOLD OBJECTS RECENTLY FOUND IN IRELAND.

By R. A. S. MACALISTER, M.A.

Plate XIX.

Read June 22. Published July 29, 1914.

Through the public spirit of Lord Iveagh, the National Museum has become possessed of a series of gold objects of considerable importance, which were recently discovered in Ireland.

It is desirable to record the circumstances of the find and of its acquisition as fully as discretion permits, for it is a very serious indictment of the present state of the law affecting the discovery of important antiquities, especially of those that happen to be made of the precious metals.

The objects in question passed into the hands of a dealer in London, who offered them to the British Museum. Certain private collectors had, however, seen them before the British Museum authorities had been approached, and there is reason to believe that some of the series of objects had already been sold. It is feared also that others have been melted down.

The British Museum courteously communicated with the authorities of the Dublin Museum, and with the keepers of the Royal Irish Academy's collection, before making any arrangements with the dealer; and the objects, or rather some of them, were sent on approval to Dublin. While they were in the custody of our Museum I had an opportunity of seeing them, and I was much impressed by their extraordinary character, and by the extreme importance of acquiring them as monuments of early Irish culture. Knowing that the funds of the Royal Irish Academy would be insufficient to pay the necessary price, I took an opportunity of laying my views before Count Plunkett, which was, however, superfluous; for he was as fully conscious of the interest of the objects as I could be. Doubt had, however, been expressed in certain influential quarters as to the genuineness of the find, and in the face of this judgment it was difficult for Count Plunkett to move freely in the matter. But the generous patron above-named stepped in to play the part of *Deus ex machina*, and, thanks to him, the objects are now the property of the National Museum, and are permanently housed in the country to which they belong. Two or three other objects, said to belong to the group, were afterwards forwarded by the dealer, and have also been acquired through his public spirit.

As soon as the purchase was effected, Count Plunkett requested Mr. E. C. R. Armstrong and myself to carry the objects to England, and to submit them to the judgment of experts there, in order to have the question of their authenticity settled one way or another. We saw Sir Arthur Evans, whose life-long experience in collecting and studying antiquities of all kinds gives him a unique claim to authority in deciding such matters. We also saw Sir Hercules Read. Both of these gentlemen were emphatic in their opinion that the objects are genuine, and gave us the fullest permission to use their names in evidence of the character of the find. Some correspondence that I have had with Canon Greenwell, to which reference will presently be made, shows that that experienced collector also is assured that they are genuine. It is necessary to adduce this evidence for the authenticity of the objects for two reasons: first, that they are of so unusual a nature that a suspicion might be aroused (as has actually been the case) of their being forgeries; and secondly, to vindicate Count Plunkett for having, in the face of numerous difficulties, acquired the collection for the Museum under his charge.

The question of the genuineness of the objects being thus satisfactorily settled, the next question that arises is that of the place and circumstances of the find itself. Here, unfortunately, we are on less certain ground. The pernicious working of the antiquated law of treasure trove was never so completely demonstrated as by the present case; and I am obliged to confess that it has been impossible for me to obtain sufficient information as to the provenance of the objects and the circumstances of the discovery. It is lamentable that the value of the find, from a scientific point of view, is thus depreciated.

All I can tell is contained in two letters from Canon Greenwell, which I shall quote. It may be convenient to state first that the hoard, as received at the Museum, consists of a torque; a bracelet of gold which had been straightened out, and the ends of which have been looped and hooked into the ends of the torque to widen it; a long pin with cup-shaped head; a flat disc of gold, cut into the shape of a shield; and five small models of bronze flat flanged celts. There was also another pin, with the head coiled into the shape of a double spiral; but we are all agreed that this pin cannot be of the same period as the others; that it belongs to a much later date; and that its association with the rest of the objects submitted to the Museum is probably of no earlier period than their arrival in the shop of the dealer.

To discover the circumstances of the find, Count Plunkett first wrote for particulars to the dealer. That gentleman wrote back, merely stating that the circumstances were known to Canon Greenwell, from whom all particulars could no doubt be obtained.

Count Plunkett communicated this letter to me, as I had already undertaken to write a description of the hoard; and I accordingly wrote to Canon Greenwell, telling him that the objects had been acquired for the Museum, and that his name had been mentioned to us as one having information of the circumstances of the find. In answer the Canon wrote as follows:—

Durham, March 17, 1914.

DEAR SIR,

I am glad to give you all the information I possess about the hoard of gold articles, some of which have gone to the Kildare Street Museum. The find took place somewhere (I do not know the exact locality) near to the north-west of Strangford Lough, Co. Down. I am told that under a mound was a cist of stones set on edge, with a cover stone. In the cist was a large urn which contained burnt bones, and the gold articles in question. I may say I have no belief in the story so far as the statement that they were placed in the urn. If that was the case, they were associated with a burial of a cremated body. Such a large number of ornaments, &c., of gold to be found accompanying a burial would be quite unprecedented. It is possible, however, that they may have been found in the mound, placed there to secrete them. A burial-mound may have been selected with a view to their safe keeping, as such a place might be regarded as unlikely, from motives then current, to be disturbed.

So far as I have been able to ascertain, the hoard consisted of three collars (one in the Museum), eight or ten axes (one modelled after a stone axe, the others, some plain, others with circles with a central dot, facsimiles in form to a slightly flanged bronze axe), a shield, and some other things the nature of which I am ignorant of; and a piece of thin wire on which the axes were possibly hung.

Whether the six axes with a spiral pattern, now in the Museum, were part of the hoard, I do not know. I believe they were not; and I was told, I forget by whom, that they came from Co. Clare. If I have not made things clear, I shall be pleased to answer any question.

Yours faithfully,

W. GREENWELL.

This letter obviously referred to the find, but it puzzled us considerably. None of the axes acquired by the Museum were plain, and none of them are impressed with circles and dots. All of them, as will presently appear, are decorated with impressed spirals. If the informant of Canon Greenwell was to be believed, there must have been *two* finds of these unprecedented objects, one in Co. Down, the other in Co. Clare, made at about the same time. This was much harder to believe than that a mystification was being practised by someone trying to evade the pains and penalties of the law of treasure trove; and that Co. Clare was dragged into the complication through a reminiscence of the fatal find of gold ornaments in that county many years ago. The problem was not made easier by the information which the dealer supplied, in a further communication, that he believed that the shield was found in Co. Wexford, having been told so by the man from whom he had purchased it.

After consultation with Count Plunkett, I wrote again to Canon Greenwell asking if he could put us into communication with his informants. We thought that it might be possible to elicit some more definite information from them, now that the objects had been acquired for the Museum, and no further question of commercial interest could be involved. The Canon's answer was as follows:—

Durham, April 1, 1914.

DEAR SIR,

The person from whom I had the information will not tell me anything more, nor will he allow me to mention his name. I have, therefore, no more details than you already have.

My own strongly held opinion is that the gold articles were not found in association with a burial.

The difficulty in all these cases is the neglect of the good rule that finders should be keepers. Under the claims by the law of treasure trove, manorial rights, &c., I have personally known many objects of the greatest interest disappear, and have heard of any amount of other cases.

Yours faithfully,

W. GREENWELL.

Such, then, is the not very satisfactory information that is available as to the circumstances of this remarkable find. That the objects belong to one hoard is, I think, unquestionable; they are linked together by various points of resemblance. On the whole, I am inclined to accept the story that they came from somewhere in the neighbourhood of Strangford Loch. That they should be found with a cremated interment is, as Canon Greenwell says, unusual, though it does not appear to me impossible; I hardly believe, however, that they were deposited *in* the urn with the burnt bones. I have some difficulty in accepting the suggestion that they were hidden for simple concealment in a burial-mound; the same superstitious feelings that would restrain possible thieves from interfering with the *cache* would have restrained the lawful owner of the hoard from tampering with the mound in the first instance.

Having now laid before the Academy all the evidence that we have been able to gather as to the authenticity and the provenance and circumstances of the find, I come to a description of the objects themselves.

The Torque. (Plate XIX, 4.)

According to the information obtained by Canon Greenwell, there were three torques in the hoard. Of these, one only has been brought to our notice and acquired by the Museum.

It is a twist of a single flat ribbon of gold, that has been beaten out from a bar 1 foot $5\frac{1}{4}$ inches in length. The ends of the bar are recurved, and end in hemispherical knobs. The weight of the object is 2 oz. 14 dwt. 9·6 grs. It is of a quite ordinary pattern.

The Bracelet. (Plate XIX, 4.)

This object is a bar of gold, pointed at each end and swelling slightly in the middle. The body of the bar is twisted into a screw, not very regularly. There are several bracelets like this specimen in the Royal Irish Academy's collection. This example has been straightened, and the ends of the bar have been looped—one end slightly, the other end with a long loop recurved like the conventional shepherd's crook. These loops have been hooked into the ends of the torque, evidently to enlarge its diameter and to make it fit a neck thicker than that for which it was originally intended. Length, $5\frac{5}{8}$ inches; weight, 8 dwt. 8·5 grs.

The Larger Pin. (Plate XIX, 1.)

The larger of the two pins is a plain bar of gold $5\frac{5}{8}$ inches long, and pointed at both ends. At about $\frac{3}{8}$ inch from the upper end there are signs as though the shaft had been fractured and repaired in ancient times. Immediately above this fracture there is a disc of gold, turned up so as to form a conical cup-shaped head with the concavity upward; from the middle of the "cup" projects the sharp end of the pin, like a spike, after the fashion of the boss of a shield. There is no ornamentation on the pin except on the upper surface of this disc. Here there is the following decoration: At about $\frac{1}{5}$ inch inward from the margin is a circle of minute dots, concentric with the disc. Between these dots and the margin of the disc is a row of seventeen impressions of a small punch $\frac{1}{7}$ inch in diameter, which has borne the device of a spiral of two whorls traced from the eye outwards by a point moving clock-wise (counter-clockwise in the impression) and having a free end. The same punch has been impressed inside the circle of dots also; here there are eight spirals arranged to form an equal-armed cross, the punch being turned so that each pair of impressions join one another after the fashion of the two loops of the letter S. Weight, 1 oz. 4 dwt. 16 grs.

The Smaller Pin. (Plate XIX, 2.)

This pin has every appearance of being later than the other objects; it probably has no connexion with the hoard. It is a plain bar of metal, flattened into a triangle at the head; the shaft of the pin is an extension of the apex of the triangle, and the other angles are also prolonged, and are coiled into spirals, reminding one of the *antennae* of bronze-age swords. On each side of the triangle there is engraved a circle, filled with faint but roughly drawn radial lines and with a dot impressed at the centre and at the ends of the vertical and horizontal diameters. The length of the pin is $4\frac{3}{8}$ inches, but it seems to have lost its extreme tip, and to have been originally slightly longer. The weight is 13 dwt.

The Shield. (Plate XIX, 3.)

This curious object is a disc roughly cut out of a thin sheet of gold. The gold is of a rather deeper colour than the gold of the other objects, and seems to be slightly alloyed. The disc is slightly concavo-convex. It is $2\frac{7}{8}$ inches in diameter. A notch of oval shape has been cut out of the edge of the shield. Four rather irregular holes run in a line across the diameter, and represent the holes by which the handle of the shield was secured. A fifth hole, of smaller size, close beside one of these, might possibly represent the rivet-hole for securing the shoulder-strap. This, however, is doubtful; we should have a second hole for the other end of the strap, so that the hole existing may be merely accidental.

Though the object is roughly and carelessly made, there are distinct traces of three different attempts at ornamenting it.

First, a series of impressions of a circular punch was made on the concave surface. These do not appear to have been arranged in any order or pattern. After having been made, they were all hammered out again.

Secondly, eleven impressions of the same or of a similar punch were made, also on the concave surface. Eight of these form a roughly drawn circle concentric with the margin of the shield, and the other three form the diameter at right angles with the row of holes for the shield handle.

Thirdly, on the convex surface are to be traced seven very faint concentric circles, with a zigzag between each of the three outer pairs. Crossing this pattern is an arrangement of spirals, rudely drawn, apparently in imitation of the impressed spirals on the larger pin and the axe-heads. There are twenty-five of these spirals round the margin of the shield, and a cross of sixteen spirals running through the centre of the shield—four spirals in each arm of the cross. There is an additional spiral in each angle of the cross, and another additional spiral at the side of the outer spiral of each margin of the cross, so that the spirals are really disposed in the form of a swastika. The weight of this object is 10 dwt. 16 grs.

The Axe-heads. (Plate XIX, 5.)

The axe-heads are the most interesting objects in the collection. Those rescued by the Museum are five in number. They are all of the form of flat flanged axe-heads, with a straight stop-ridge running across the blade, and giving it a gable shape. The flanges are rather deep. There is a perforation at the end of the tail of each axe.

All the axe-heads obtained by the Museum are decorated with impressions of a spiral punch, similar to the punch with which the larger pin is decorated, if indeed it was not the identical instrument. The disposition of the spirals is the same on each face of every individual axe, though there is a slight variety in the number and disposition of the spirals on different axes. There is always one spiral between the stop-ridge and the tail of the axe; between the stop-ridge and the edge of the axe there are three spirals (arranged in a triangle with the apex towards the tail) on three of the axes; four, arranged in a lozenge, on one of the axes; and on the remaining axe five spirals in two rows, two and three in each row. The lengths and weights of the five axe-heads are as follows:—(1) $1\frac{3}{8}$ ins., 8 dwt. 14 grs., 3 spirals; (2) $1\frac{1}{4}$ ins., 11 dwt. 22 grs., 3 spirals; (3) $1\frac{1}{4}$ ins., 14 dwt. 4 grs., 3 spirals; (4) $1\frac{1}{4}$ ins., 13 dwt. 8 grs., 4 spirals; (5) $1\frac{1}{2}$ ins., 19 dwt. 10 grs., 5 spirals.

Such, then, is a description of what the Museum has been able to acquire of one of the most remarkable archaeological discoveries ever made in Ireland. The first and most obvious observation that is to be made about it, in reviewing the circumstances of its discovery, is that there is a crying need for a drastic revision of the law of treasure trove. As it stands it seems to have been drafted with the idea of securing the suppression and concealment of important finds. As I have shown, the circumstances of this discovery are very imperfectly known, nor have we any certainty that the whole find has been recorded; it has been lamentably scattered; and but for the courtesy of the authorities of the British Museum, which deserves the warmest acknowledgment, we in Ireland might never have heard of it at all. Besides the revision of this mediaeval law, the time has fully come to press for a largely increased grant for the purchase of antiquities. The inflated prices which antiquities have acquired in recent years make it difficult to secure them for the nation; and it is nothing short of a scandal that public bodies like the Royal Irish Academy and the National Museum should be unable to compete with the often ignorant and merely acquisitive private collector.

Passing this point over for the present, though expressing a hope that the circumstances of this discovery may lead to an improvement of the conditions under which objects can be acquired for the public benefit, we next turn to the find itself to see if anything further is to be made out regarding it.

The first question that presents itself is the date of the hoard. The evidence throwing light upon this problem is given us by the torque; the spiral patterns on the axe-heads, the cupped pin, and the shield; the form of the axe-heads; and the form of the cupped pin.

According to the scheme set forth by Montelius in his epoch-making paper on the *Chronology of the British Bronze Age* (*Archaeologia*, vol. lxi, part I), the torque comes into use in the third period, that is, about the middle of the Age of Bronze. It is distinctly later than the lunula, which is a characteristic ornament of the Bronze Age in Ireland during the earlier stages of that phase of civilization. The presence of the torque, therefore, forbids us to assign the find to the second period, though to that period the flat axe-head properly belongs. This is not a difficulty, for though the flat type of axe-head dates back to the second period, it by no means follows that all flat axe-heads are to be assigned to a date so remote; the type persisted and was also contemporary with the later developments. With this conclusion the spiral pattern also agrees, for the spiral is not found as an art-motive in the lunula period. The cupped pin is distinctly late in date; indeed, Montelius does not date it earlier than the fifth and last period of the Bronze Age, when, as a rule, the spiral had broken up into groups of concentric circles—as we can see illustrated by comparing the carvings at New Grange with the much later designs at Dowth or Lochcrew. The typical example of the cupped pin is one of bronze, of unknown provenance, in the Royal Irish Academy's Collection, and figured in Wilde's *Catalogue*, p. 558, fig. 450. Evans, in his *Bronze Implements*, p. 372, reproducing this cut, quotes other examples from the famous Heathery Burn cave, and from a peat-bog near the Point of Sleat in Skye. The last-named is the most important, for its associations are recorded. It was found with a fifth-period bronze sword and two socketed spear-heads (*Proc. Soc. Antiq. Scot.*, vol. iii, p. 102). Another Irish example, apparently from a crannog in a lake called Monalty, near Carrickmacross, is figured in the *Archaeological Journal*, vol. iii, p. 49.[1] All these pins are of bronze. The Skye specimen seems to be the only recorded example which resembles the pin before us in having a conical spike rising up in the centre of the cup.

The spiral ornament calls for a few words. It is extremely unusual to find a pattern consisting of plain open spirals in metal-work, though it is common enough in New Grange and allied stone monuments. The spirals have been made with a punch, and most likely this instrument was one of the tools of a goldsmith, and was intended to save the trouble of the freehand drawing of spirals which would form part of some more extended and complex pattern or diaper. The use of a punch to make groups of concentric circles *in relief* on gold ornaments is common enough; there are several examples in the R.I.A. collection; another was the well-known Comerford bowl, commonly but ridiculously called an old Irish crown. But the punched *incised* spirals of the objects now under discussion, so far as I know, are unique, in Ireland at least. The use of a punch is probably another indication of a late date. The roughly scratched spirals on the shield are obviously additions made by an amateur hand in imitation of the ornaments impressed on the pin and the axe-heads by the professional goldsmith.

Taking all the evidence together, we cannot be far wrong if we assign the hoard to about the end of the fourth or the beginning of the fifth of the five periods into which Montelius divides the British Bronze Age. Having thus arrived at a conclusion as to the dating of the find, the next question that arises is its purpose. Here there is wider room for conjecture.

We may, I think, take it for granted that we have to deal with a grave deposit. The difficulties raised by Canon Greenwell in the letters quoted above are real, but not, as it seems to me, insuperable: though I should certainly agree with Canon Greenwell in doubting that the deposit had been placed *inside* an urn. The torque, bracelet, and pin are then simply ornaments deposited with the dead, according to a universal custom that needs no

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[1] Two apparently early crannog groups are described together in this paper, and its author has not been careful to keep them apart.

comment; though so rich a grave deposit is excessively rare, if not unprecedented, in Ireland. The curious linking of the torque and bracelet together is perhaps evidence that the former was not originally made for the person in whose tomb it was found, but for a smaller individual who, perhaps, paid the normal penalty for his inferior physique. But the axes and the shield open up other questions.

The first point that strikes the eye is the contrast between the excellent workmanship of the axes and the extremely rough make of the shield. It would appear that the axes were the work of a practised goldsmith, but the shield was home-made; everything shows the tentative hand of the amateur; even the gold is inferior. The warrior had been provided with an armoury of imitation weapons of offence from the atelier of some goldsmith, and tried to make for himself a weapon of defence that would complete his equipment.

The next point is that the shield, rough though it be, is of very great value in illustrating the construction of early Bronze-age shields. The circular shape; the four holes for the strap-handle; the ornament of concentric circles *and zigzags*; and, above all, the notch in the edge for observation or for the passage of a spear-shaft, are all real contributions to knowledge. The Bronze-age shields which we possess are all assigned to the fifth Bronze-age period. They are circular, and have a *metal* handle riveted inside; the four holes, which obviously indicate a *strap*, distinctly suggest an earlier phase in the development of the shield, for which we have no extant illustrations. Then, the ornament of the extant shields consists for the greater part of concentric rings, with rows of punched bosses between them. The ornamentation of the shield before us, however, carries us back to the ornament of the earlier periods of the Bronze Age—the period of the lunulae, which likewise are decorated with patterns founded on the zigzag motive. To this ornament of an earlier type the roughly scratched spirals have been superadded; and the arrangement of these spirals in a swastika is surely a fact not without significance. Lastly, there is no existing parallel among the shields in our museums for the notch in the edge of the shield. It survives, as a rudimentary organ survives, in the curious form of irregularities in the ornamentation of the surface of certain shields. The leather shield from Clonbrin, described by Mr. Armstrong in the Academy's Proceedings (XXVII C, p. 259), and some other examples which he has illustrated in the same paper, may be referred to in this connexion. In short, just as the flat axes represent a survival of an earlier form of weapon, so does the shield; it probably illustrates for us the shield proper to the second period of the Bronze Age, of which no actual specimen has as yet come to light.

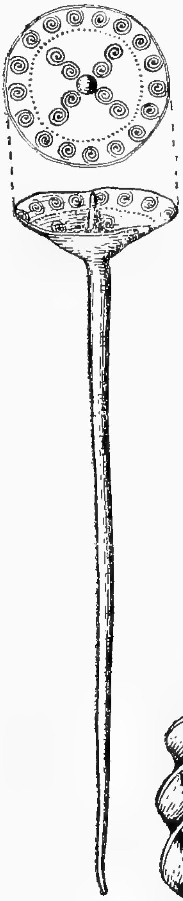
That the axe-heads and the shield are to be regarded as merely ornaments like the torque and the pin is scarcely credible. For those who deposited them where they were found, they must have had additional value as *amulets*. The use for such a purpose of forms of weapon which, though not superseded, were nevertheless archaic, would be just what we might expect. We are here in the presence of an almost world-wide cultus—that of the weapon with which primitive man subdued his human and animal foes. The worship of the double axe in civilized Crete is now one of the most familiar instances. In various parts of the Mediterranean Basin, amulets and pendants in the form of stone celts, often made of ornamental stones such as carnelian or crystal, have come to light. The modern superstitions that centre in "elf-shots" and the like ideas, or in the virtues of stone axes as protections against lightning, are but survivals of this ancient worship.

Evans (*Bronze Implements*, p. 134) quotes a minute *socketed* celt of Bronze found in the grave of a woman belonging to the La Tène period, discovered at Arras, near Market Weighton, Yorkshire. This was again evidently an amulet, and here again the older type of implement is used for the purpose. In the La Tène period the socketed celt was as antiquated as was the flat celt in the time of the Strangford Loch interment, which we are now considering. Evans further quotes certain minute socketed celts found in Ireland (which, however, may, as he says, have been chisels), and also from Brittany; the well-known small *leaden* celts found in that country can hardly have served any practical purpose. Further he quotes from the *Barrow-diggers*, 1839, p. 72, a reference to an object that was apparently exactly parallel to the axes before us—a golden celt, found in Cornwall, and once the property of a former Earl of Falmouth. Evans failed to trace this object, and seems to have doubted its existence; but the Strangford Loch discovery appears to confirm it.

Before leaving these interesting objects a possibility may be suggested—that the axes may form part of some rude system of currency, and that there may be a relation between the number of the spirals impressed upon them and their supposed value. I do not attach much importance at present to the facts now to be noted; but they are worth recording, and future discoveries may tell us if there is any value in them.

The three axe-heads with three spirals upon them weigh respectively 8 dwt. 14 grs.; 11 dwt. 22 grs.; and 14 dwt. 4 grs. The average of these three weights is 11 dwt. 13 grs.

Supposing that the axe-heads stamped with three spirals were meant to be three multiples of a certain unit, the unit thus indicated would be 3 dwt. 20 grs.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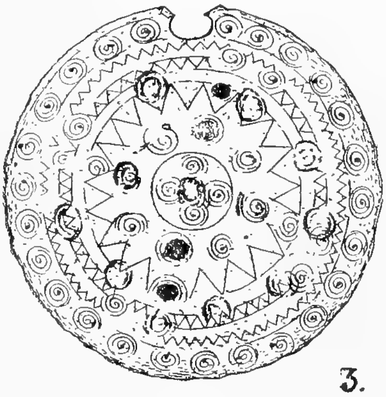
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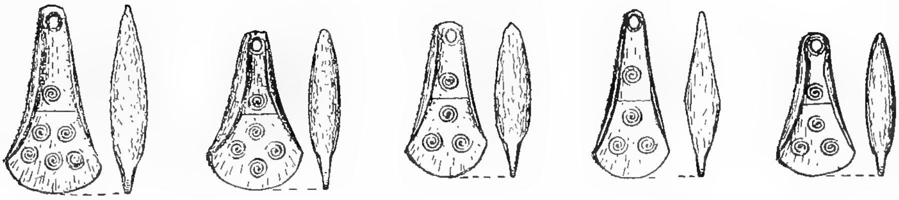
5.

Macalister.—Hoard of Gold Objects from Ireland.

Four times that unit would be 15 dwt. 8 grs., which is not very far from 13 dwt. 8 grs., the weight of the axe-head stamped with four spirals.

Five times the unit would be 19 dwt. 4 grs., which is practically identical with the weight of the axe-head stamped with five spirals, 19 dwt. 10 grs.

I am quite conscious of the obvious objections to this scheme; the unsatisfactory working from averages, the huge margin of error that must be allowed in the three-unit group, amounting to nearly 6 dwt., and, above all, the anomaly that the heaviest three-unit axe is so heavy, and the four-unit axe so light, that the former is actually larger than the latter. Still, the figures are not undeserving of notice. We cannot build much on observations of the weight of five objects; till we have five hundred at our disposal we cannot feel any certainty on points such as this.

XIII.

FORTIFIED HEADLANDS AND CASTLES ON THE SOUTH COAST OF MUNSTER.

Part II.—From Ardmore to Dunmore, Co. Waterford.

By THOMAS JOHNSON WESTROPP, M.A.

Plates XX–XXI.

Read June 22. Published August 27, 1914.

The coast of Co. Waterford must be studied along with that of Co. Cork to give us a wider view of the fortified headlands of Southern Ireland. Together they give us a typical collection of these antiquities. The coast which we now study is less broken than that of Cork, where the endless long creeks, so beautifully wooded and so sheltered, meet us at regular intervals and add so much to the distances and the difficulty of exploration of the cliffs between them. Here, the only considerable breaks are the creek of Dungarvan, with its great intake, behind the sandy spit of the warrens, and the wide sand-filled bay of Tramore. The coast, however, if more accessible, is even more troublesome to explore on foot, for its edge is cut through at close intervals by deep, and sometimes precipitous, stream-glens, between which the sections are often termed "islands." Though without the varied loveliness of Kerry and Cork, and the gloomy, rampart-like grandeur of Clare and Mayo, the cliffs are very picturesque. The bold headlands, with outlying stacks, reefs, and islets, assume every fantastic shape, resembling towers, oratories, rows of cruel fangs, and monsters, underarched by caves and bridges. The rocks, unlike those north of the Shannon, are very varied in colour—red, dark brown, lichened with grey or tawny-gold, draped with slopes of rich green velvet or purple and gold with gorse and heather-bells. Far-reaching, often for over thirty miles, are the views that we gain from the salient points, reaching from the silver sparks of light that are the towers of Hook and Tramore to the lighthouse of Mine Head. Inland, for many miles, run the long yellow lines of furze-clad fences, and, beyond, are the huge blue peaks and scalloped "cooms" of Knockmeildon and the Comeraghs. To the other side towards the sun, shimmers the frosted gold of the unbounded sea; peregrines, choughs, gulls, ravens, and cormorants enliven every "jutty, frieze, buttress, or coign of vantage" of the cliffs. Amid such scenes, as endlessly interesting for the artist as for the naturalist, lies a rich harvest of the time-worn defences of the ancient shore-dwellers to be gathered by the antiquary.

HISTORICAL NOTES.

In general terms, as we could sum up each district in our former researches as "Domnonian," "of the Corcavaskin," the "Ui Fearba," the "Corca Dhuibhne," or the "Corca Laidhe," we may call this group of forts after the Desi. The oldest legends and indications seem to show that the present Co. Waterford was connected with an Ivernian population; the map of Ptolemy, about A.D. 140, marks Iouernoi and Brigantes to either end of this district; Irish legend frequently coincides with this. Behind the "Nan Desi" tradition looms the name of Nia Segamon, a prehistoric king of Munster, whose chronology is doubtful even in the mythic history, but lay somewhere about a century before our era (B.C. 75 to 150). Again and again in the Decies we are met by ogham-inscribed pillars with epitaphs ending in the formula "Maqi mucoi Netta Segamonos" at Seskinan, at Ardmore, and at Island, close to one of the most remarkable forts noted in these pages.[1] The central legend, though possibly the most problematical, is certainly that of the flight of the Desi of Bregh from Meath to this coast.

Legend tells us how the Nan Desi lived near Tara in the third century, and were descendants of King Fedlimid Rechtmhar, the restorer of the Tara monarchy, after the great servile revolt in the middle of the previous century (164–174). Their nearer ancestor was Fiachadh, brother of King Conn "the hundred fighter"; his descendants were passed over, and their exclusion from the throne rankled in their minds. To the chronic trouble was added a new insult: Aenghus "dread (or poison) spear," Fiacha's grandson, found that his niece had been carried off by Cellach, son of King Cormac Mac Airt.[2] He found her drawing water from the well Nemnach (that, where all else is changed, bursts as cool and clear and sweet as ever, out of the east slope of Tara hill under Cathair Crofin fort); he carried her home and went to seek justice from the High King. He unfortunately met Cellach; there was a fierce quarrel in which Aenghus slew the prince and the steward, and by accident struck out one of Cormac's eyes. No mutilated man could reign at

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[1] See Journal Roy. Soc. Antt. Ir., vol. xxxiii, p. 381, and the Dublin Museum "Handbook for the Irish Ethnographical Collection," Part v, p. 10. For the curious history of the attempted reading of these epitaphs see the first, p. 373.

[2] Or, as in Keating, that Ceallach took prisoner and blinded a chief in violation of the security of Aonghus Gaoibuaibhtheach ("History," Book I, sec. xliv).

Tara; Cormac abdicated, retired to Skreen, and appealed against the Deisi. Sentence was passed, and Aenghus and his tribe ordered to submit and pay tribute; they refused indignantly, left their lands, and fled southwards, driven before their overwhelming adversaries; this is dated about A.D. 278.[1] The Nan Desi fled to the great Ailill Olam, King of Munster, and he took them in.[2] Aenghus married (or had already married) one of the Munster king's relatives, and he and his clansmen were settled south of the great mountains and the River Suir,[3] where we find them when their history begins. Readers of our antiquary-poet, Sir Samuel Ferguson, will recall his lines in "The Burial of King Cormac"—

> ". . . . Through angrier floods than these
> On linked shields once our king we bore
> From Dread Spear and the host of Deise."

The baronies of "Deece" in Meath and "Decies within and without Drum" in Co. Waterford recall the migration.

Professor MacNeill throws doubt on the whole tale, arguing that if the Deis had been of the royal race, they never could have been tributary; he regards them as Iberian chiefs for whom a Milesian pedigree was confected, perhaps as late as the twelfth century.[4] There are many openings for confusion, as the Deis of Bregh in Meath continue to appear in the Annals down at least to A.D. 757: the Dalcais of Thomond were called the "Northern Deis,"[5] which, if Dr. Joyce be right, and the word only means "south," is a hard saying.[6] Then there were the Deisbeg of eastern Co. Limerick, and last,

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[1] For ancient texts bearing on this, see Professor Kuno Meyer's edition of Laud, 610, and Rawlinson, B 502-512; also "Ogygia," p. 339; O'Curry's "Manuscript Materials," Lecture II, p. 326; Keating, "History of Ireland," Book I, sec. xliv (ed. Irish Texts Soc.), vol. ii, p. 313; and article by Professor MacNeill in "New Ireland Review."

[2] Keating notes that Sadbh, daughter of Conn (uncle of Aongus), had married Ailill Olam.

[3] The northern border of the Desi, 852, was Magh Tamhean, near Clonmel, in Co. Tipperary (Ann. F. M.).

[4] He regards *Deis* as meaning a vassal community under Milesian Lords—*Deisius* being "rent," *Aire Desa*, "chief of vassals." He gives a paper on the genealogy of the Deisi in the Book of Ballymote, Waterford and S. E. Ir. Journal, vol. xiii, p. 46. He regards the "Northern Deis" as having been with Aran and Corcomroe at one time subject to the Eoghanachts, the Killaloe princes rising to independence and importance after 700.

[5] "Book of Leinster," 319, c. 5, "Cormac Cass a quo Dal Cais, i.e. In Deis." "Book of Lecan," f. 455, adds: "From him descended the Eoghanacht of Munster and the Northern Deis"; and p. 174, b 10: "This is the covenant of the Dál Cais among themselves, i.e. the Northern Deis, and the Southern Deis."

[6] Dr. P. W. Joyce, "Irish Names of Places," Ser. ii, chap. xxv, following Dr. Todd, MS. Ser., R. I. A., vol. ii, p. 25, and Zeuss, "Gram. Celt," 57, note.

but not least, the people of Deis Mumhan or Desmond, who are at times confused with the Desi of Co. Waterford. Not content with the remote date assigned to the tribe, the so-called *Annals of Clonmacnoise* (p. 42) tell how "Owgany More," King of Ireland, circa. B.C. 460, gave "Fergus Knoy the land of Desyes in Munster" in a still remoter part. An Irish verse attributed to St. Benen by Ussher tells how St. Patrick when at Cashel in A.D. 449 gave Munster and all its raths to Ailbe the humble; to Declan, the Deisi for ever." It seems based on later conceptions, and is only valuable as showing the two southern saints as well established in Munster before Patrick's visit to their district.

To this tribe fled St. Mochuda (Carthage), and their chief Cobthach granted him the site of Lismore near Dunnasciath, before A.D. 638. Their chiefs are frequently recorded[1]—Branfinn, son of Maelechtrach (mortally wounded), 637–663 (664 Ann. Clon.); Connall, son of Suibhne, (695) 700; Dathgus son of Baeth, killed 731, and perhaps confused with Niallgus, son of Baeth, King of Desi Bregh, 757; Maelcrom, son of Muiredach, half-king of Desi Mumhan, was "left" (i.e. lost) 858, if the southern tribe is intended.

Lying on the coast, they suffered from the Norsemen, who settled on either flank at Waterford and Youghal. Every creek and bay must have been an open door, and the two great rivers convenient lines of invasion. The name of the bluff headland of Helvick outside Dungarvan is evidently Norse.[2] After the first shock, probably that in which the tribe was wasted in 836, the Desi rallied, destroyed the foreigners' fleet, and levelled their fort at Youghal in 850 (or the Four Masters give 865). Perhaps two victories are confused, for we hear of an invasion by a Viking, Colphinn, in 869, with the fleet of Dun Medhoin; he was checked at Carncurrane, whence the Desi and Rechtabhrat, son of Bran (who died in peace 874–876), pursued him with slaughter to Lismore, near which, perhaps, his ships awaited him in the Blackwater. In 876 again a victory was gained by Cearbhall, son of Doughal, and the Desi, over the men of Munster, near Clonmel. Some time before 877, Barith, a Norseman, and Amlaibh's son destroyed the churches of the Desi. The interesting fact is also recorded that they explored every burial cave. Amlaibh and his allies in 861 had done the same, opening the great tumuli at Brugh of the Boyne,

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[1] If O'Donovan, Hennessy, and MacCarthy be right in their classification—Ann. Four Masters and Ann. Ulster. The Ann. Clonmacnoise gives Cormac McCuilleannann, Bishop of Lismore and King of the Desies, killed by his own family in 915. I use the printed Annals named above and the Chronicon Scotorum.

[2] The name Carraig Bhaltair near it may refer to a Norman Walter, not to *Balder* as I have heard suggested.

Knowth,[1] Newgrange, Dowth, and their compeers. The searchers in the Desian territory got a vast quantity of plunder, and had the pleasure (that Norsemen loved) of glorying in having dared the spirits of the dead to do their worst in defence of their violated tombs.

What private quarrel brought on the Desi the slur of having slain Flann mac Lonain, "the Virgil of the Gaedhil," we do not know. He was killed by them (or by the Ui Cuirrbuidhe, or the Ui Fothach) in the Desi of Mumhan, at Loch Dacaech, or Waterford Harbour.

Unfortunately no foreign danger could unite the Irish tribes, and, among the rest, the Desi not only weakened themselves and the Osraighi by war and a slaughter of the latter, between 877 and 890, but later on got aid from the foreigners, and repeated the outrage, wasting Ossory as far as Gowran in 893. In 940 Murcheartach, son of Niall, with the men of the north and Breagh, fell equally on the oppressor and the oppressed, ravaging the Osraighi and the Desi. The latter submitted in terror, and were promptly punished for their weakness, for Cellachan, King of Cashel, slew 2,000 of them. Some place his raid earlier—the Annals of Clonmacnoise in 934, the Chronicum Scotorum in 940; he had raided them and taken hostages after he had stormed Waterford and expelled the Danes. The two tribes, tortured into friendship, united in desperation and defeated the army of Cashel.[2] This preceded, and perhaps brought about, the famous "circuit of Erin" by Murcheartach, who carried off Ceallachan, "with a chain of iron on his stout leg," in 941. The tribes recovered sufficiently to help Mathgamhain, son of Cenedid, the Dalcassian King of Munster, against Murchadh, son of Finn, King of Leinster, in 966 or 967, and compelled the latter to make a rapid retreat. Ossory was now closely bound up with Munster.

King Brian "of the cattle tribute," Mathgamhain's brother, avenged the latter's murder by slaying Maelmuadh at the battle of Bealach Lechta in 978; he defeated the Danes, not for the first time, the next year, and then was ready to deal with the unfortunate Desi. He ravaged their territory up to Port Lairgi, or Waterford Harbour, and banished Domhnal, son of Faelan,

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[1] Cnogbha was again opened and plundered by Amlaibh, grandson of Imar, in 935 (Ann. Ult.). For the great cemetery of Brugh see especially Mr. George Coffey's two monographs (Trans. R.I.A., vol. xxx, p. 1 (1891), and "Newgrange (Brugh na Boinne)," 1912. As I have pointed out, the name Brugh is traceable to the present day, e.g. Fiant, 254, Hen. VIII, 1541, Brows weir, Oldbridge, Newgrange, and Rossynry: Pat. R., 1619, Cal. p. 422, Brows weir and Brows Mill on the Boyne, Knowthe, Rossenry, &c. (See Journal R. Soc. Antt. Ir., vol. xxxvi, p. 82).

[2] "Cathreim Ceallachain Caisil" (ed. A. Bugge), sect. 31, tells of Aed, son of Domnall, the descendant of Faelan, and twenty men who slew twenty of the Norse, and only five of the victors escaped home. In sect. 39 Cellachan, who had been brought captive to Dublin, is shown the head of this Aed.

who had commenced the quarrel. Faolan was the son of Cormac and chief of the Desi, who died in 966, but he is called by some "Prince of Desmond," there being constant confusion between the two tribes of the Desmonians and Desi in southern Munster, and even, I think, between them and the northern Desi or Dalcais of Thomond. The tribe were thenceforth subordinate to Brian, and shared his crowning victory at Clontarf, just nine centuries ago. On the death list of the fatal Good Friday of 1014 appears their king, Mothla, son of Domhnall, son of Faolan, and, when the bodies of Brian and his son Murchadh, were brought for burial to Armagh, the heads of Mothla and Conaing were brought with them, and shared their new grave to the north of the altar of St. Patrick's Church.[1]

We soon after see two families standing out in the royal line of the Desi, the Ui Faolain and the Ui Bric; the name of the last attaches to one promontory fort and several other place-names down the coast, as we shall see. The son of Mael nam bo, of the Ui Ceinnselagh, carried off prisoners and cattle from the Desi in 1048; otherwise, so far as our records show, they had a long breathing-space after the losses of Clontarf. In 1068 the *Chronicon Scotorum* tells of the slaying of Muircertach Ua Bric, King of the Desi.

On 5th August, 1103, Domhnall Ua Lochlain, with the Cenel Eoghain and the northern Irish, attacked Leinster. The Laighin were supported by many southern tribes, the princes of Kerry and Corcaguiny, and the Desi; they met the northern invader at Magh Cobha, and among others fell the two Ui Bric, royal heirs of the Desi. The Cenel Eoghain carried off Ua Briain's tent and banner with much treasure. In 1137, King Diarmaid mac Murchadha, Conchobhar Ua Briain, King of the Dalcais, and the Danes of Dublin and Wexford, with 200 ships, blockaded Waterford by land and water and took hostages from it and the Desi. Donnchadh, son (or grandson) of Carthach, in that entry, attacked but was captured by the Desi in 1142; he was sent to Thoirdhealbhagh Ua Briain. Donchad Ua Feolain, the chief of the Desi, attended the Synod of Athboy in 1167, and immediately afterwards came the invasion of a new race, destined to rule the district and supersede the Desian chiefs.[2]

Norman Period.—After the landing of Raymund le Gros and his staggering blow dealt at the Irish and Danes of Waterford at the promontory fort of

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[1] Annals Loch Cé and Ulster.

[2] For these notes on the Desi I rely on the Annals of Clonmacnoise, Loch Cé, Ulster, Four Masters, Chronicon Scotorum, The Wars of the Gaedhill, and the Caithreim Ceallachain Caisil.

Dundomhnall at Baginbun (when he threw his prisoners over the cliffs), panic seized on the tribes near Waterford. Maelsechlainn Ua Faolain threw himself into Waterford to help the Danes against the terrible "Strongbow" of Strigul, into whose hands he fell on the capture of the town. Short had been his shrift but for the intercession of King Diarmaid, whom one is pleased to find engaged in any act of humanity. The first absolute reduction of the Desi by the Normans took place in 1173, when Raymund overran their country with great slaughter and plundered Lismore. The spoils were sent down the Blackwater on to Dungarvan, where the Normans took thirteen boats. After a long wait for favourable winds they sailed for Waterford. The Danes of Cork, under Gilbert, son of Turgeis, with thirty-five ships, intercepted them, but they were defeated and their leader slain. Diarmaid (MacCarthy), King of Cork, arrived at Dungarvan just too late to save the boats. Raymund attacked, defeated him, added 4000 cattle to his precious spoils, and returned to Waterford victor on land and sea. In about 1179 Robert le Poher settled in the county where his descendants played ever since so conspicuous a part.

Another Dessian chief rose against the Normans and destroyed their castle at Lismore, slaying its garrison of sixty or eighty men. His successor, Artcorb, died in 1203, and the tribe made terms with the "Franks," so that three years later their next prince, "Daniel," died at Cork, an avowed supporter of the justiciar, Meyler fitzHenry. In 1297–8, O'Faolan of the Desi slew David Walsh, Bishop of Waterford.

In some sort of submission to the English, with whose settlements they were now honeycombed, the Desi held their power, if in diminished pride. Ua Faolain, "Res O'Folan de Dessia," and another, Richard[1] mac Hermekan de Dessia, were of sufficient importance to be asked to join the Justiciary with all their forces[2] in 1244, for an expedition to Scotland. I do not intend to follow out the fortunes of the Desi; they may have made or occupied certain cliff-forts and raths, but hardly could have made any after this late date.

As to the Norman settlers, we do not touch on their colonies inland from Lismore to Waterford. It is held by some that every Norman grant of lands in Ireland implies effective occupation; this, I have shown, is most fallacious in Thomond and parts of Cork;[3] so it may be so elsewhere, but it is equally

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[1] Was this name a compliment to "Strongbow"?

[2] Cal. Documents relating to Ireland (under dates), vol. i.

[3] Also in Corcalaidhe, for in 1298 "Corkely, in Co. Cork, cannot be extended on account of the Irish" at the time of the death of Thomas fitzMaurice (Cal. Doc. Ir., vol. iv, p. 261).

mistaken to do (as some others have done) and regard all these documents as mere "paper grants," for the grantees as a rule soon turned them to realities. The chief coast settlement of the Normans among the Desi was at Dungarvan; it was an important harbour for the ancient type of ships,[1] and a "half-way house" between Youghal and Waterford. I propose to follow its main record for a century, and to note the substantial sums of money raised from "Dessia." John seems to have been the first Norman king to turn his attention to Dungarvan; he built its castle, probably where the round tower of the present fortress stands[2] beside the harbour, in 1204, and established a surrounding manor. At an early period he planted a Geraldine, Gerald, in Dungarvan.

In August, 1204, Donald Uffield made quit claim to "the king of the province of Dungarvan" of three cantreds, keeping the other two for himself.[3] Next year Meyler fitzHenry, who was founding the Abbey of Conall for a colony of monks from Llanthony, endowed it with five burgages at Dungarvan. A bridge was made (I suppose across the creek, near the present one and the railway), and King John made a direct grant of its tolls to help the burgesses in July, 1215, granting Thomas fitzAnthony the custody of the castle and the *prise* of wines at the port in the same month.[4] He also then, and in 1217, granted Dungarvan Castle to Maurice FitzGerald, a fine of sixty marks being paid. The grant recites that FitzGerald, having just "been girded with the belt of a knight," should have the lands in Des, of which Gerald, his father, died in possession.[5] Two years later we find an objection lodged by Thomas to anyone having "custody on the king's behalf of the forest of Des," because it had been granted to him. He was called on to produce the charter, but could not do so, and was also deprived, at least for a time, of the castle. An important survey of the mearings of Dessia was made about 1229, when John d'Evreux got the lands there, but (unless Killorzie be Killarisie or Kilfarrissy) no land at any of the forts is named. Numerous grants of lands and accounts of rents in Desi are on record, but superfluous to our study.

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[1] It appears on most of the portolan maps ('garva), 1339; ('garvein), 1351, 1360, 1367, 1436; (Dungalvani), 1450, 1513, 1544, 1569, 1593; (Dūgarvā), 1589. The *prise* of wines in 1276 was for 8 tuns.

[2] The "mote" is round-topped, and had chambers inside. It is too far from the ford and harbour to command them. The fact that it had once a fosse proves nothing, as this is not uncommon even with small sepulchral tumuli.

[3] Cal. Doc. Ir., vol. i, No. 223.

[4] Charter Roll, xvii John, pars 1, mem. 9. See also Irish Roll, "Antiquissimus," exemplifying John's Charter in anno xvii Ed. I. The castle is inseparable from the Crown.

[5] Cal. Doc. Ir., vol. i, No. 793, Close Roll, pars 1, m. 14.

The most important was the survey, 1234,[1] of the Honor of Dungarvan, giving the lands, dues from the Ostmen, warrens, &c. The king, to improve his manor of Dungarvan in Decies, established a fair there in 1244. Thomas fitzAnthony got compensation for lands in Des down to 1251.[2]

Prince Edward, the king's son, was put in possession of Dungarvan on his marriage with Eleanor of Castile,[3] and, in 1259, enfeoffed John fitzThomas, heir of Thomas fitzAnthony, in Desya, as held by Thomas fitzAnthony, John's father-in-law, and granted custody of the castle, with the proviso that if the prince should hereafter harbour any suspicion against John the fortress was to be surrendered. If the castle descended to the grantee's heirs female, it was to be held by the Crown till there was an heir male of full age.[4] In 1282 it had been found by a jury that this John held three cantreds in Decies, except Donnul (Dunhill) and the cantred of the Ostmen (Galtiere). He also held Dungarvan, with *prise* of fish and beer, *pannage* and greenwood in the forest of Decies.[5] Two years later King Edward granted the castle to Thomas fitzMaurice.[6] Like most of the Irish fortresses, Dungarvan was culpably neglected. On the death of the grantee in the Inquisition, June 4th, 1298, we read: "Dungarvan—The castle is in bad repair, unroofed and nearly levelled to the ground; a new tower unroofed, a stone house beyond the gate in ill condition and badly roofed."[7] The vulnerable heel of English martial power was the overgrown extent of lands (often far apart) held by the chief nobles and the constant mismanagement arising from the succession of minors and female heirs. For those working on the general topography of the Manor the Inquisition is of the first importance.

In 1300 the Ophelans of Decies slew 300 men who were plundering their

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[1] xix Hen. III, Pipe R., 35 Rep. D.K.R. Ir., p. 36.

[2] See generally Cal. Doc. Ir., vol. i, (1204) 223; (1215) 576; (1215) 584, 586, 598; (1217) 793, 892; (1223) 1108; (1225) 1292; 1229, 1680; (1231) 1864; (1251) 3146; (1238), 2009: 1242, fairs at Dungarvan, 2569; Close Roll, vii Hen. III, pars 1, mem. 9. Pipe Rolls, 35 Rep. D.K.R. Ir. Ann., xix and liii Hen. III; *ibid.*, xvii Hen. III, mem. 7, Pat., xxviii Hen. III, m. 4.

[3] 1255, Pat. R., xlii Hen. III, m. 9. Henry gave his nephew and namesake, son of the King of Almain, power to revoke all grants of land alienated without licence by Prince Edward contrary to the king's grant (Pat. R., lii Hen. III), save where the land is inseparable from the Crown of England.

[4] The lady's son or husband. See Pat. R., xliv Hen. III, No. 23, mem. 5. Roll, "Antiquissimus," xvii Ed. II. Cal. Doc. Ir., vol. ii, (1259) 629. For a later recital, see *ibid.*, vol. iii (1292).

[5] Cal. Doc. Ir., vol. ii, p. 425.

[6] Patent Roll, xxx Ed. III. Ireland.

[7] Quit Rolls Irish Exchequer, $\frac{325}{25}$. Cal. Doc. Ir. iv, pp. 261, 262. A similar but shorter Inquisition was made in 1300. *Ibid.*, No. 727.

lands.[1] Various constables of the castle frequently appear in the records[2]—Walter de la Haye, 1275, William de Londres, 1276, John de Baskervile till 1281, William FitzNicholas in 1324.[3] The mill was held in 1281 by Maurice Russell, Maurice MacKermegan, and Robert Stapleton, who, I presume, is the nefarious sheriff whose misdeeds I shall notice at Dunmore; a Jew was also a tenant. There were mills on the west side of the new water in 1298, and two on the east side on a branch of the sea; also a rabbit warren at Cosinche, I suppose on the long sand spit still given over to the "feeble folk." Baskervile's arrears of salary[4] gave much trouble to Joan, his widow; she procured a writ of mandamus in 1285 for his fees or forty marks, but Nicholas Clere would not execute it. She went to the king for redress, and the Lucca merchants were directed to pay, but Geffry le Brun intercepted the money and led to serious litigation in 1291. The corruption and open robbery of the lesser officials were very marked. The rents were (omitting shillings and pence) in 1272, £614 and £117; in 1276, £204, spent on work on the castle and in repairing a fishing weir wrecked by a sea storm; in 1280, £423 and £846; the weir again needed repair. The Dessia rents were in 1286, 500 marks; in 1287, £411; arrears, 1288–90, £1078; in 1291, 200 marks, arrears having risen to £1358; in 1303 they were £1158.[5]

I will not give further detail on Norman Dessia, but will briefly close its general history. Maurice, son of Thomas fitzMaurice and first Earl of Desmond, in 1342–3 entailed Decye and Desmond.[6] In 1359 Edward III granted le Dees and Dongarvan and the custody of the castle to John Moriz the seneschal; in 1363 he gave a grant for paving and walling Dungarvan, and in 1366 granted the castle on the Manor and the Black Castle to William de Windesore and his heirs.[7] In 1394 Richard II called on Gerald fitzMorice, Earl of Desmond, to show his title to the castle, manor, and honour. In 1444 James, 7th Earl of Desmond, was pardoned for his intrusion into the manors of Clonmell, Le Dees, and Dungarvan. Edward IV granted to Edmond Butler, Baron of Dunboyne, the *prise* of wines in

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[1] Cal. Doc. Ir., vol. iii, p. 261.

[2] Cal. Doc. Ir., vol. ii, constables, 996, 1242, 1249, 1839, p. 425.

[3] Plea R. No. 149, xviii Ed. II, m. 28.

[4] The 34th to 38th App. Report. Dep. Keeper Records Ir. Pipe Rolls, No. 2, Rep. 34, Hen. III; xvi, xix, Rep. 35, ann. liii, Rep. 36, Edw. I, ann. i, ii, iv, x, viii–x, Rep. 37, ann. xv–xvi, xiv, xvii–xix, Rep. 38, xxvii–xxx, xxxii Ed. II, ann. i.

[5] He also owed 28 hawks, due (at one hawk a year) for Cloncidan. In the next entry Edward II presses for aid, as he is going "to Scotland to destroy Robert le Bruys and his accomplices," but he could not extract the Co. Waterford arrears.

[6] Memoranda Roll, 6.

[7] Patent R., xliii Edw. III, m. 27, England.

Dungarvan in 1468. The earl was beheaded as a traitor at Drogheda, but the Crown was too unstable to dare to follow up the attainder. About 1480 Thomas, Earl of Desmond, settled Decies on his cousin-german Gerald fitzJames and his son John, from whom it descended to Sir John FitzGerald in 1619. Sir Maurice, descendant of the above Gerald, was in 1533 created Baron of Dromana and Viscount Decies; he died without issue in 1572. His father Gerald was son of John, son of the earlier Gerald.[1]

The only other family, besides the Desi and Geraldines, to have put its mark on the country history to any notable extent, on this coast, is that of Le Poer or Power. The Barony of Gaultiere probably coincides with the cantred of the Ostmen, who, as at Limerick and Dublin, were evidently transplanted out of the towns when the English settlers garrisoned the cities.

TRADITIONS.

The folk-lore of the coast and its ecclesiastical legends are of considerable interest. The latter centre largely in St. Declan of Ardmore; and it is most regrettable that no early "Life" is known to exist, for there is every indication that, like St. Ciaran of Clere Island and Saighir, he belonged to one of the earliest Christian settlements, "the Scots believing in Christ," which existed fifty or sixty years, if not earlier, before the mission of St. Patrick, perhaps about 340 to 390.[2] A curious relic of early Christianity at Ardmore exists in the "Bigo Esgobi" inscription—*vico episcopus*—or rural bishop[3]—on the ogham-stone of the descendant of Nia Segamon, "the servant or champion of Segomo," the war-god. Declan was born about 347; his parents, Erc and Dethain, had been converted by a pious priest Colman (Kilcolman still bears his name), who baptized their infant son. The existing late "Life," possibly of the twelfth century, is a mass of contradictions and anachronisms. St. Declan's miracles (the floating stone, the "petrification" of the farmer,

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[1] See Carew MSS. Cal. (Book of Howth, &c.), p. 438; see also Charter Roll, xx Ed. I, mem. 28, No. 34. The Castle was granted to William of Windsor (Pat R., Ed. III, pars 1, m. 27, Tower of London).

[2] It is at least noteworthy that at this very time, A.D. 387, St. Chrysostom says "the British Isles . . . . have felt the power of the Divine Word, churches having been founded" (Opp., tom. i, 508, ed. Bened. "Demonstratio"). This, however, may not allude to Ireland, though he is insisting on the extension to the farthest west.

[3] The last Bishop of Ardmore seems to have been Eugene, witness to a grant to St. Finbarr's, Cork, in 1174. In 1210 the Pope confirmed the Archbishop of Cashel in his control of the Cathedral of Ardmore (Cal. Papal letters, vol. i, p. 35); in 1217 the Bishop of Waterford held both Lismore and its appurtenance "Armor." (R. Litt. Claus. ann. ii Hen. III, m. 2, dorso). Eugene wrote a Life of St. Cuthbert, and after his death Ardmore was united to Lismore.

and Declan detecting the dog, cooked in insult for his dinner, and bringing it to life) are found in the old and the modern legends. The modern makes the revived dog rush up the Comeraghs through Barnawaddera, "the dog's pass."[1] In 1853 there was also a quaint tale of Declan cooping sparrows into a roofless barn, and so miraculously keeping them from the corn; and another of his turning the outflow of the Blackwater from Whiting Bay to its present bed at Youghal in order to punish some fishermen.[2]

The other chief legends belong to the interesting class connected with the long earthworks and entrenchments in Co. Waterford, evidently ancient roads.[3] The Rian bo Phadruig (from Ardmore by Lismore to Ardfinnan, and perhaps Cashel) is said (as the work of the same name at Ardpatrick, Co. Limerick) to have been ploughed by the horns of St. Patrick's cow.[4] Another early road is the *Cladh ruadh*, meeting the Rian and traceable westward; I found an interesting reference to it in a Chancery Inquisition,[5] giving the mearings of Co. Waterford, in 1625, naming "Mocholippe," the river Bryde and "south to the *Red dytch* called *Clyero*, and so at the said dytch runneth southward by West Tollagh (Tallow), and from the south end of the said *Red dytch* eastward." I know no legend of the *Cladh Ruadh*. The Glas Gaibhneach (a wonderful cow, whose legend is so minutely located on the plateaux round the great triple-ringed fort of Cahercommaun in Co. Clare[6]) is locally reputed to have cut *Glenn an earbail*[7] with her tail. When

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[1] "Place Names of the Decies," p. 138.

[2] See Journal Roy. Soc. Antt. Ir., vol. xxxiii, pp. 355–358. The rare "Antiquarian Rambles" of F. "O chille" (Fitzgerald), published 1853, pp. 18, 65, can be consulted.

[3] In my "Ancient Forts of Ireland," p. 139, sect. 56, a disastrous intended "correction" made in press after the paper left my hands turns this into "ancient forts," and a line: "The following are probably early roads" got omitted, altering the entire sense.

[4] See the Rev. P. Power's valuable paper on the *Rian Bo*, Journal Roy. Soc. Antt. Ir., vol. xxxv, p. 110, his "Place Names of the Decies," p. 369. For the Cladh Ruadh and Cladh Duff, from Kerry Head to Charleville, see Journal Roy. Soc. Antt. Ir., vol. xl, p. 123, sect. 149. For the great defensive "long earthworks," besides "Ancient Forts of Ireland," p. 139, see Mr. De Vismes Kane in Proc. R. I. Acad., vol. xxvii (c), p. 322; Canon Lett in the new Ulster Journal of Archæology, vol. iii, pp. 23, 67. Mr. Hubert T. Knox has recently added (Journal R. Soc. Antt. Ir., xliv, p. 28) a legend from near Rathcroghan, where a magical boar threw up the Mucklaghs, long parallel mounds, at Cashelmannanain, Co. Roscommon.

[5] No. 12 of Eliz. Chancery Series, P. R. O. I. It is of great topographical value as giving all the mearing of Co. Waterford in 1587. The curious form *Omore* is used for the "Awenmore," or Blackwater.

[6] Journal R. S. A. I., vol. xxv, p. 227; vol. xxvi, p. 154; Folk-Lore, vol. xxiii, p. 89; vol. xxiv, pp. 100–103. See original story in "Ordnance Survey Letters" (Clare), vol. i, p. 100.

[7] Peter Power (son of Robert fitz Piers Power, who died 1550) held Ballinerebell in 1587 (Inq. Exchr., No. 32).

the woman milked her into the sieve (which in Co. Clare made the "seven streams" and their waterfall at Teeskagh), it was said in Co. Waterford to have been at *Pairc an Iarla,* in the valley of the Mahon river.[1] Spirits abound; magic music is heard at Fail a geerane near the fort and ogham-stone in Island, and the "Gormog," an undefined spectre, haunts the sandhills of Tramore, where also the spirits of the military band, drowned in that most tragic wreck of the "Seahorse," play the "Reel na daibche," or "sandhill reel," at night.[2] I will give another shore legend near Ardmore at the end of this paper.

THE FORTIFIED HEADLANDS.

Two curious facts meet us when we come to study the promontory forts—that none of them, unless we allow Dunhill to be such, was strengthened by castles or gatehouses in later days (as is so usual in Cork and Kerry, and not uncommon elsewhere), and that Irish names of the forts are extremely rare; only two *dún* names and two *uamh* names being found—Dunabrattin, Dunmore, or Shanooan, and Technanooan. This, too, is on a coast where (as the Rev. Patrick Power has shown) nearly every reef, headland, and cavern has a native name. Even of these forts I have found none mentioned before the reign of Henry III, when "Dunmore" appears, and (as the charter probably dates as early) Garrarus and Dane's Island. The forts have high mounds and deep fosses in most cases, but their dry-stone walls have been nearly removed in every case for building purposes.

The name "island" is here applied to peninsulas, and therefore to promontory forts, as at Island Hubbock, Islandobric, Kilfarrasy Island, and Great Island. The usage is not unknown elsewhere; we have Dooneen "Island" promontory fort in Muntervara; the "Island" of Dunloch at Three Castle Head, Dunworley "Island," and other examples in Cork; in Co. Clare we have the peninsula and fort of Illaunadoon.

I may repeat the types here for reference—(*a*) The simple headland fort, with a single rampart and perhaps a fosse; (*b*) similar, but with several defences; (*c*) the entrenchment on the mainland, with a citadel behind it on a headland, of which there are three exceptionally fine examples here;

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[1] "Place Names of the Decies," p. 369.

[2] *Ibid.*, p. 158. I was told, when a child, that a black pig haunted the sandhills, but question if it was a genuine legend. For the "Seahorse" wreck see Waterford and S.E. Ir. Archæol. Soc., vol. xl, 151. The wreck took place in 1816. The towers on Newtown and Brownstown Heads to either side of Tramore are to distinguish that dangerous death-trap from Waterford Harbour.

(*d*) promontory fort with a subsidiary fenced headland, like Dunabrattin[1]; (*e*) and the platform with natural, or artificial, gangway; (*f* and *g*) are the simple rock platform and the shore rock, which do not occur.[2]

TYPE (*a*).

BALLYNAHARDA, RINANILLAUN (Ordnance Survey of 6 inches to the mile, No. 39). We pass through the long upland behind Helvick, with little of scenery or of interest, save a few ring-forts of the ordinary type, with fosses and furzed banks. Getting into lower ground near the village and graveyard of Ballymacart,[3] we pass down a stream-glen, and over a ridge sheeted with low furze and heather, and see before us a picturesque reach of cliffs and the Mine Head Lighthouse; most conspicuous and nearest to us is a long, dark headland, pierced by a square-headed natural arch, and known as Ringalaun, Ringanlaun, Rinanillaun, or *Rinn an oileán*, the point of the "Island." Though little suitable for habitation, it has been defended by a rock-cut fosse and strong rampart for, as we shall notice later on, every foothold on the cliffs (narrow shelves even have little clearings and fences) has been prepared for refuge in the two townlands next Cooshaneimma Cove. Mr. Richard Ussher, late of Cappagh (who was not only a leading authority on the birds of Ireland, but an antiquary), first noted this fort. Unlike many who only pursue their own special interest, his observant mind and clear memory made him an invaluable informant on geology and archæology. I had the privilege of his guidance all along the Waterford coast, save for the reach at Ardmore, though we visited its ecclesiastical remains, and to him I was indebted for much information and many notes, his knowledge of the places going back over sixty years. He first noted this fort, the little site in Ballykilmurry, the larger forts of Ballinamona, Kilfarrasy, and, at my suggestion, he found the large entrenchment at Dunabrattin. I believe I can claim to have found the Annestown fort and the trace at Dunhill. Those at Island Hubbock, Ballyvoony, Dane's Island, Island Ikane, Woodtown, Garrarus, Westown, Coolum, Rathmoylan, and Dunmore were marked on the Ordnance Survey maps from 1841.

Rinanillaun fort is unmarked; its site can be identified on the new maps

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[1] Compare with Kilmore and Gubadoon in the Achills, Doon near Ballybunnian, Dunsheane near Dingle, Baginbun, and Howth.

[2] Unless the Foillanean "Cashel" at Tankardstown, a detached shore-rock, was formerly fortified.

[3] Only a few feet of the church wall remain; an old man told Mr. Ussher: "Ah! there were some old arches standing, but we took them down to build the graveyard wall."

by the words "natural tunnell" in Ballynaharda, near the eastern mearing with Hacketstown, in the Barony of Decies within Drum, about a mile and a half west from the Mine Head Lighthouse. A zigzag road for bringing up seaweed for manure runs down its flank to the west side. Close to this is a low, weatherworn mound, thicker than the neighbouring fences, and perhaps ancient. Farther down the slope is a remarkable example of the rock-cut fosse. The makers took advantage (as so often) of a natural hollow, which they scarped, forming a trench 25 feet wide, and leaving a causeway 5 feet to 6 feet wide and high in the middle. The mound rises 7 feet above the gangway, and from 13 feet to over 15 feet above the fosse it is 24 feet thick. These dimensions very frequently recur in the promontory forts, as the diameter 102 feet does in the ring-garth. There are no hut sites inside, and it was probably a mere refuge, perhaps used, if not made, when the Danes were at Dungarvan.

Not far eastward from it a natural hollow and rocky platform resemble a fort, but were not walled.

BALLINAMONA, CARRIGPHILIP (O. S. 39). From the platform of Mine Head Lighthouse we gain a magnificent general view of the field of our studies. Westward lie Rinanillaun and the dark red cliffs on to Ram's Head at Ardmore; the houses and tall, slender round tower of the latter are visible; beyond these lie Capel Island and Knockadoon Head, the limit of the earlier part of this paper. Eastward, barely visible, is Hook Tower, with Tramore, and endless cliffs from it to Ballinvoyle and Helvick Head. Between the last and our lofty post we see a strongly fortified spur in Ballinamona. It, too, was found by Mr. Ussher, from whom I got my notes, as published in 1906,[1] in the Journal of the Royal Society of Antiquaries of Ireland. The preface to that volume calls my fort-plans *sketch-plans*: this is not the case; they were properly surveyed—Island Hubbock by myself and Mr. Ussher, the rest by working details of actual measurements on to the large plans made by the Ordnance Survey, tracings of which were most kindly lent me by Captain Hawkesley, R.E. I will hereafter notice a statement that this fort is in Ardoginna, not Ballinamona. This arises from confusion with the inland Ballinamona near Ardmore, the critic not having noticed that this latter place was not on the map-sheet given in my paper.[2]

The fort was a fine, well-preserved example before an "improving farmer" made a cartway into it, and removed some of the mound (I am told) for top-dressing. Fortunately, its bad, stony soil and the difficult approach soon stopped the vandalism, now so common and so unreproved. Two "shelves" of

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[1] Journal R. Soc. Antt. Ir., vol. xxxvi. p. 249.

[2] Waterford and S. E. of Ireland Archæological Society, vol. x, p. 150.

the bank were actually cut away inside the north end; but, as seen from the land, the damage is not apparent.

The earthwork is convex to the land, and is still 56 feet, once over 70 feet, long; the injured part is still 8 feet to 10 feet high and 12 feet thick. The mound is of two periods, marked by a dark curved layer 5 feet to 6 feet higher than the garth. The inner face, even where not cut, is very steep, sloping so much as 1 in 1 where not nearly perpendicular.[1] It rises 17 feet in 14 feet inside and 16 feet in 12 feet outside. The top was 12 feet and is now 7 feet wide, 5 feet having been dug away. There are heaps of very old limpet shells in the black layer. The garth is unfenced to the sides, and has no hut sites. The fosse is much filled, being only 3 feet to 4 feet below the garth, but 11 feet below the field it is 18 feet wide in the bottom and 46 feet at the field. Mr. Ussher, in my former note, gives the length from the inner summit to the field as 51 feet; there is no outer ring.

Opposite to the next headland, to the north, is a fine dolmen unmarked on the old maps. I presume it is the "*Tigh Caille Beara,*" or Calliagh Beirre's House, of Father Power's list.[2] Mr. Ussher first pointed it out to the surveyors, and got it marked on the new maps. As an undescribed

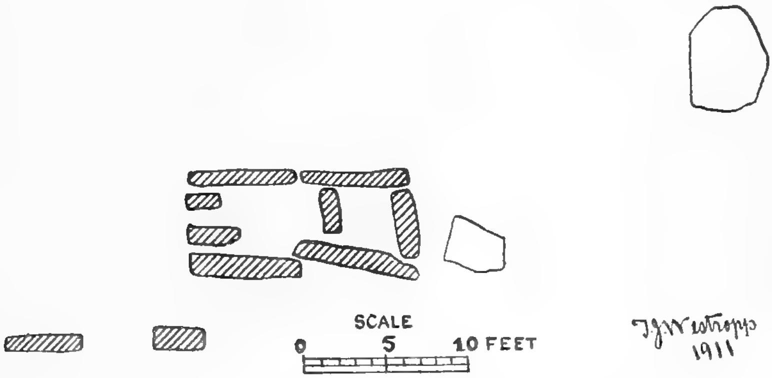

Fig. 1.—"Calliagh Beire's House," Ballinamona.

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[1] These fine steep mounds and deep rings are common south of the Shannon, even in small forts like Ballinamona. Fine specimens are found at Portadoon (in Scobaun), the back of whose wall has two stone-faced banquettes; Dunsorske; Doona (at Dunbeacon), and Dunkelly (near Dunmanus) in Co. Cork; Lissadocneen (at Beal), Faillnamná (at Ventry), and the Stack Fort (near Ballybunnian), Co. Kerry; and (besides Ballinamona), Coolum, and Rathmoylan. No such high mounds occur in the lesser forts of Co. Clare or Co. Mayo.

[2] "Place Names," p. 64. "Tigh caille Beara, an unmarked cromlech, standing close to the edge of the cliff."

monument. I give a plan. It has two chambers,[1] the eastern, 3 feet 1 inch long, tapering from 4 feet 8 inches to 4 feet 7 inches, the other, 5 feet long and 4 feet 4 inches wide to the east. At the west end are two stones, like a small gate. The cover measures 9 feet by 6 feet, and another slab at the west end, 4 feet by 3 feet, beyond which was an enclosure 17 feet 2 inches wide of set slabs, the west side removed.

BALLYVOONY (O. S. 32). About 10 miles across the bay, to the north-east of the last, we find a fortified headland, in the Barony of Decies without Drum, not far from the village of Stradbally.[2] It lies in the ancient tribe-land of the O'Brics, between their stronghold at Dane's Island and the fine little cliff-fort of Island Hubbock. Stradbally mill and Comeryth are mentioned in 1298 as part of the Manor of Dungarvan, and worth £6 15*s.* 5½*d.* per annum, and Stradbally was held by one Galfrid le Norragh in 1318.[3]

I know of no early entries relating to Ballyvoony; it derives its name, Baile Ui Mhughnaidh, from the O Meany or O Moony family, and was part of the estate of the attainted Mac Thomas (Richard), who had, in 1589, joined the Earl of Desmond in rebellion. It paid a head-rent of 6*s.* 8*d.* to the Crown.[4] Queen Elizabeth granted it after its forfeiture to Richard Beacon as "Ballyvonye" in 1590.[5] James Sherlock fitz John died in October, 1601, holding Ballymacdavid and Ballyvoony[6]; he was succeeded by his son James Sherlock fitz James, who held it under a mortgage to his father in 1615 as Ballyvoonye.[7] After the great civil war, Mary Beale was confirmed in Ballyvoony in Decies, under the Act of Settlement in 1667, and Sir Charles Wheeler in 1669.[8] The fort lies not far from the well of "Tubber cil Eilhe," notable for its ogham-stones inscribed "Qrit maqi Lobaton avi Nia-Gracolina" and "Netafroqi maqi t ——."[9] An ancient road, "Bothairin a chapaill," runs from Kilrossenty[10] to the coast, near Ballyvoony.

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[1] Unless the cist has been divided, idly or for some unknown reason, in later times.

[2] Journal R. Soc. Antt. Ir., vol. xxxvi, p. 251.

[3] Plea Rolls, No. 119, xi Ed. II, m. 3, and No. 123, m. 6, dorso. See also ann. xxvi, m. 38, Report Dep. K. R. Ir., p. 41.

[4] Inq. Chancery, Eliz., No. 1.

[5] Fiant No. 5536.

[6] Inq. Exchr., Jas. I, No, 8.

[7] Inq. Chancery, Jas. I, No. 11.

[8] Conf. Act Sett. Roll, anno xix, Car. II, pars 2, f. No. 114, and anno xxi, pars 5, f.

[9] See R. R. Brash, "Ogham-Inscribed Monuments of the Gaedhil," pp. 255–6; (Sir) S. Ferguson, "Ogham Inscriptions," p. 77, and (Professor) R. A. S. Macalister, "Irish Epigraphy," Part I, p. 8; Part II, p. 55.

[10] For Kilrossenty, see Papal Taxation, 1302. Kilrosnetyn, value £7 10*s.* 0*d.*, tenth 15 shillings; also Plea R., No. 125, anno xii Ed. II, m. 8; Kylrossynt, No. 133, xiv Ed. II, m. 13 dorso. Waterford and S. E. I. Arch. Soc., iii, p. 6; x, p. 200.

Not far from the large fort, opposite to Gull Island, a little spur, not 12 feet wide at the neck, bears marks of entrenchment, so slight that only for others of these minute cliff-dwellings I might hesitate to list it among the promontory forts.

The large fort is convex to the land; it has a slight outer mound, a fosse 6 feet to 8 feet deep, and 10 feet wide. It was cut through the drift, almost down to the looser rock, and is now filled up for some feet with dark washed earth.[1] The inner bank is (as so commonly) a low mound thrown up from the fosse and capped with a mass of stones thrown together (so far as I could see) with no trace of building or facing; the wall rises 10 feet above the fosse in the middle, and 12 to 16 feet high at the ends. It was about 100 feet long, and is 27 feet wide, with curious recurved ends like Dundahlin, Co. Clare. The faces of the drift bank to either end have fallen, and are wasting away.

Farther eastward in Ballinarid, near the great Dane's Island fort, at Cooneenagartan cove, is a headland with a trace of a fence, clearly not modern, across the neck. I saw no sign of a fosse and assert nothing of its age; there may have been a dry-stone wall, now removed.

CARRICKADURRISH, ANNESTOWN (O. S. 25).—To the east of Dunabrattin Head, in the baronyof Middlethird, I found a small, strong, unmarked cliff-fort, lying not far to the south-east of Annestown Church. The cliff is about 120 feet high; the ditch is 21 feet wide, 8 feet deep, and 30 feet long. The mound is 4 feet 6 inches higher than the garth, 14 feet to 20 feet above the fosse, and 21 feet thick. There is a slight gangway, 3 feet or 4 feet high; no hut sites remain in the enclosure. The neighbouring forts to either side, Dunabrattin and Green Island, are well seen from it.

DUNHILL (O. S. 25).—Up the stream valley (past Annestown village and the curious late monument on a low mound in the marshes), we approach a picturesque tower, on the edge of lofty, nearly perpendicular cliffs. It is the castle of the Poers, Lords of Donuil,[2] and recalls, more than our peel towers usually do, the "castled crags" of the Rhine Valley, though on a far lesser scale. I include it because the cliff-fenced spur on which it stands bears plain trace of the foundation of a strong wall of dry stone, convex to the land, doubtless "the *dun* of the cliff," or *wood* which gave the place its name. The castle is a fairly perfect tower, possibly of the late fourteenth or the fifteenth century; its ornamental features are defaced. The keep has two stories

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[1] See section, Plate XXI, No. 9.

[2] I find no early mention giving the now asserted form *Dun aill*; it is Dunoyle, Donnoil, Dunuile, and so forth, in early Norman documents.

under a pointed vault, over which (as so usual) is a large, well-lighted upper room, once roofed. The windows and the south-east angle are greatly wrecked. The door is to the east. A short, straight flight of steps leads to a spiral stair in the south-east corner, which weakened that part, and led to its collapse. A small building formed a porch, and has a garderobe on the edge of the precipice to the east; the southern wing, along a ridge of crag, has a large window looking down the valley to the sea. As noted, the foundation of a crescent wall encloses a small space to the west of the ruin. Farther back on the plateau is the parish church, called Dunuile in the Papal Taxation of 1302. It, too, is greatly defaced, and smothered by ivy and bushes: it had a nave and chancel, and at its north-west corner a vaulted belfry and priest's house which leans over in one mass with curious effect.

I must allude to the history of its owners, though as briefly as possible. Their name, usually Le Poher or Le Puhier, has been rendered le Pouvre, or "poor," and "de la Poer" from an assumed territorial division of Brittany. We hear of them as in Ireland in the earliest days of the Norman invasion. William le Puhier and Hugh Pincerna (Butler) lived in the honour of William de Curci. in Norfolk and Suffolk, 1171–2; they hired a ship to take Robert Puher into Ireland.[1] In 1230 William le Poer witnessed an agreement of Meyler fitz Henry and Fulk de Cantilupe, as to lands in Cork (Corkagh). In 1228 we hear of the marriage of John, son and heir of Robert le Poher. In December, 1244, we find them settled at Dunoyl; the Justiciar requested Sir John Maunsell to ask the king to grant him the lands held by Sir John le Poer at Dunoyle, now in the king's hands, I presume during a minority. I only know of one early charter of the Poers about that date that alludes to the sites of certain promontory forts. It is nearly identical in text with a De Burgo charter, *ante* 1247, in the Gormanston Register. I could get few side-lights owing to the destruction of nearly all the Irish enrolments of that reign. None of the existing Pipe Rolls help, nor do the Calendars. The Close Roll of 1318, however, mentions John, son of Piers le Poer of Dunoyl, and John, son of *Henry* le Poer.[2] The latter may be a son, or, more probably, son of a nephew and namesake of the Henry Poher of the charter. Two of the witnesses, William Chaudel and fitz Garett, may be identical with persons

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[1] Cal. Documents, Ir., vol. i, from Pipe R., xviii Hen. II, No. 3 m., 3 dorso. For other entries, see 1200, Chart. ii John, m. 22; Close R., xiii Hen. III, m. 20; Close R., xxviii Hen. III, m. 17 dorso; G. E. C. "Complete Peerage"; Waterford and S. E. Ir. Arch. Soc., vol. xi, p. 156; C. Smith's "Waterford," ed. 1774, p. 75; Pipe Roll, Ireland, No. 12, xv and xvi Ed. I; Rep. Dep. K.R. Ir., p. 38; also Roll I, anno ii Hen. III; Fiants, 100, 953, 1163, 1046, and Chancery Inq., Jas. I, No. 59; Car. I, No. 28. For a view of Dunhill Castle see Journal Waterford and S. E. I. A. Soc. i, 36.

[2] Cal. Chancery Rolls of Ireland. Pipe Roll an. ii Edw. I, names Henry le Poer.

of the names in Co. Cork and Co. Waterford, living later in King Henry's reign, about 1260, so it possibly dates in the middle of the thirteenth century. It runs thus, in the copy made for an Inquisition of James I[1]:—

> "SCIANT, tam presentes quam futuri, Frances (*sic*), Anglici, Valenses, et Hibernenses, quod ego, Henricus Poherus, dedi, concessi et, presente carta, mea, confirmavi, Johanni filio Walteri et heredibus suis Clunade, cum omnibus pertinenciis, Arddrasten, cum, &c., Garvros, cum &c., et duas carrucatas terrae de Ilanobrich, per servitium facientem quinte partes duorum militum. . . . . cum omnibus pertinenciis, suis, in bosco et plano, in castellis et fortelesciis, in pratis et pasturis, in viis et semitis, in aquis et molendinis, in stagnis et vivariis, in rivariis et piscariis, in mariscis et turbariis, in Ecclesiis et omnibus aliis locis et liberis consuetudinibus, bene, et in pura, libere et quiete, et integra, et plenarie, honorifice, et pacifice, per predictum servitium de militibus. Testantes—Stephanus Sandford, Willielmus Chaudel, Richardus Gross, Hugo Beg, Aluredde Coitrad, Hosbertus Grosse, Galfridus filius Garett, Richardus P. vus qui chartam scripsit et aliis multis, Apud Waterfordiam."

Arddrasten retained its name till superseded by its alias "Newtown," in the seventeenth century; it lay near Tramore. Garvros is Garrirus and Ilanobrich, Dane's Island; they continued to be held under the same deed down to Walter Power in 1606, and I presume later still.

As to the descent of the Poers; tradition seems honest but confused; it tells how Sir Roger, or Robert, came to Ireland with "Strongbow," and Robert was Governor of Waterford; this is confirmed by the English Pipe Rolls. As we saw, Sir John held Dunoyl in 1244. A later Sir John held numerous lands under Thomas fitz Maurice; in 1282 the manor of "Donnul" was, however, excluded from being part of the 3½ cantreds of the Decies held by Thomas fitz Thomas. John's "men," however, paid 7 shillings to it, and frequent mention of John's holding of Tylaghrath occurs. This (or a later) Sir John le Poer of Donnoill—for the succession of identical names has not yet been determined—is summoned on the Vascon Roll, 1326, and named in the Close Roll of 1302. Mention of the family is very frequent in Co. Waterford from that time to the present. In the reign of Edward II we find notice of Sir John, son of Sir William[2]; Peter (Pierce), Meiler, Philip, and William, all sons of Benedict. In a plea of 1308, Galfrid, son of Jo. le Poer, and Jo. fitz Robert de la Roche had a suit about lands at Ballydroghyd, Clonegh, and Ballykalligh, and 60 acres of woods in Co. Waterford; while

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[1] Exchequer Inquisition, P.R.O.I., No. 10 (11 new notation), James I.

[2] Cal. Doc. Ir., p. 262.

John (son of Piers le Poer), Baron of Donoyll, had another about Coulgarvyr,[1] Graneton, and Arddrastne, Co. Waterford, probably the Clunade, Garvrus, and Arddrasten of the early charter of Henry Puher. John le Poer, Baron of Donoil, also acknowledged a debt of 1000 silver marks to John Wogan.[2] Later on, in 1316, John was collector of a subsidy for the King's army at Greencastle under the Justiciar Edmund le Botiller, and again names his father, Piers le Poer. He received a pardon on account of his services to the Crown, and was one of the numerous debtors of the astute firm of money-lenders, "the Lucca merchants," to whom he owed £85 to be repaid in instalments of £10. In 1322, he was commissioned to inquire about felonies and the followers of Theobald fitz William le Botiller, in Co. Waterford.[3] It was probably a later John, Baron of Don Isle (as Smith calls it), who gave security for good behaviour to Bermingham, the Lord Justice, at Waterford, about 1350. In 1347, the King pardoned John fitz Peter le Poer, Baron de Donnoyle.[4] The grandson of John fitz Piers, Nicholas le Poer, was summoned to Parliament as a baron from 1375 to 1381. It was about this time (as I have noted in the earlier part of this paper in the history of Dunalong) that the bitter feud between the Poers and the city of Waterford came to a head by the former bringing in the O' hEidersceoils. Though the allies triumphed, and John Malpas, the brave Mayor of Waterford, fell, the allies also lost their leader, the Baron of Dunoill, his brother Bennet le Poer, and many others. The feud never ended till Baltimore and the two castles of Dunnishead and Dunalong were finally destroyed by the citizens of Waterford in 1537.[5] The territorial barony, as so often in Ireland, was becoming a personal one. Poer's son Walter was Baron of Dunoyl, 1393–1435. The successive Barons after that are John (1471), Walter (1529), Nicholas (1550), Robert (1587),[6] Nicholas (1635), and John le Poer the last Baron of Dunhill, whose wife defended the castle against the Parliament, and got terms of capitulation. John was transplanted to Connacht about 1652, and we hear of no descendant.[7] A collateral

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[1] Carew Calendar, vol. iv, p. 462.

[2] Plea R. No. 102, v Ed. II, m. 39.

[3] Pat. R., xiii Ed. II, No. 16, facie, 20 July, and dorso 74, and grant to same of Balicoyn and Killogheran.

[4] Aug. 8, at Cashel, Pat. R., xx Ed. III, m. 31.

[5] Miscellany of the Celtic Society.

[6] Inq. Exchr. Eliz., No. 30. In 1586, Robert Poore, of Kilmedon, who died July 4th, held the vill. and castle of Donhill with Killaryse, Ballinageeragh, &c. He is not described as Baron of Donhill.

[7] An Inquisition (Car. II. an. xx, Aug. 23, Exchr.) finds that Richard, Lord Power, held Kilcopp in Galtiyer. Tramore, in Dromcannane Parish, Middlethird, was held by Margaret Power, widow, and restored by the Court of Claims.

line sprang from David, great-grandson of Matthew, brother of Piers (father of John, Baron of Dunhill), 1280; David married a daughter of Nicholas le Poer, of Dunoyll; their son Richard was created Lord Coroghmore, and died 1483; the succession ran through Piers and Richard (Baron le Poer, 1535[1]), from the last descended Richard, the 6th Baron,[2] created Earl of Tyrone.

A number of documents, few of general interest, relate to Downyll, Downehill, and Donill, chiefly pardons dated 1559 and 1567 to Robert of Downhill and a commission to the same to execute martial law. In 1635, Nicholas Power held the advowsons of Kilmeadon and Downeoyle churches, the manor and millseat of Downeoyle, Ballynegeeragh (notable for its splendid dolmen), Newtowne de Downeoyle, Woodtowne de Downeoyle, Carrig de Downeoyle, Kilfarreise, and other lands. After the Restoration, Sir John Cole was confirmed in Donhill by the Act of Settlement, in May, 1666, a few months before the great fire of London.

WOODTOWN, GREEN ISLAND (O. S. 25).—To the east of the river mouth and shingle beach, just opposite to Annestown, in the townland called Woodtown or Woodstown (the old "Woodtown de Downeoyle), is a promontory fort.[3] It once defended a large headland, two portions of which have been successively cut off by the collapse of natural arches and form the Green Island; no Irish name for the fort was found by me, or, apparently, by Father Power. The sea is now cutting along a line of cleavage under the fosse and a deep drift cap. The mounds and fosse have been destroyed for 36 feet from the dangerous western edge,[3] the fosse and inner rampart, for 35 feet more. The chasm runs inside the fosse for 33 feet, curiously even dimensions. The rest of the works for 120 feet is fairly intact, but a chasm runs through the fosse for 15 feet at its east end. The outer mound is 18 feet wide and only a couple of feet at its highest. The fosse, though somewhat filled, is 5 feet 6 inches deep and 6 feet wide below. The inner mound rises up to 7 feet 4 inches above it and 3 feet 6 inches over the garth; it probably had a dry-stone wall, but no stones remain. The west section is of interest, a deep bed of yellow clay, over it a thin grey layer of splintered

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[1] I presume he is the "Lord Power" who served King Henry VIII at the siege of Bologne.

[2] Journal R. S. Antt. Ir., vol. xxxvi, p. 253.

[3] The early Irish (who were, as we see, practical geologists, as to stone and clay) avoided such spots as a rule. We find, however, the rath dug in light soil and so unstable (Trip. Life St. Patrick), and Bishop Dalam objecting to a site for burial on Iniscatha, Co. Clare. "The land is clay and brittle; the sea shall cut it away" ("Lives of the Saints from the Book of Lismore." ed. W. Stokes, p. 212). A similar legend is told of the fine double-crescent earthwork at Knockeen Castle, near Dunmanus, which I hope to give in the closing section of this paper on the forts of West Co. Cork.

stones, over that 2 feet of dark mould. When the fort was made the black layer was absent, the mounds being thrown up directly over the grey layer. The dark washed sward now covers all the works.[1]

Kilfarrasy (O. S. 25).—There was a Killorzhie in Dessys (Decies) in 1229,[2] which, as Decies then ran on to Galtiere, may have been this spot, the name of which is derived from a lost church of Cil Fheargusa (Killarrusa, Killfarrusa). Unless this be so, I have no records earlier than the reign of Charles I. when Nicholas Power of Downehill enfeoffed William Railebord and Darby FitzConnell with Killarisse and other lands in trust. Kilfarreise or Killarrisse (as we saw) formed part of Dunhill Manor in 1635[3]; it is marked as Kilfarrissee on Petty's map of 1656, and was confirmed to Sir John Cole, with Garrarusse and Dunbratton, in July, 1663.[4]

The Irish name of the fort is forgotten; the headland is called "the Island" of Kilfarrasy. In the middle of the last century Mr. Richard Ussher remembers its strong and lofty defensive works which he had often passed through when studying the birds of these cliffs. The works were dug away partly to make fences along the dangerously crumbling precipices, but the traces are well marked and can be planned.[5] They consist of a straight fosse 12 feet wide with a spring and stream in its eastern reach. It is crossed by a gangway 12 feet wide at 51 feet from the western and 75 feet from the eastern cliff, and is about 140 feet long; no recent rock falls have taken place near the ends. The inner mound is 10 feet to 12 feet wide, and was once 5 feet to 6 feet higher than the fosse into which heaps of it have been thrown in parts; the fosse was (and still is in places) 5 feet deep. On the west cliff, 60 feet south of the mound, is a natural recess, or terrace, fenced along the edge. I saw no hut sites, though a recent fire had cleared the garth. There is a very fine view of the endless reefs and the cliffs on to Islandikane fort and islets. One of the numerous early cooking-places[6] called *Fulacht Fiadh*, black with burned stones and charcoal, lies on the stream at the eastern limit of the townland.

Westtown, Great Island, Port (O. S. 26).—This is by some mistake while in Press called *Woodtown* in my former paper, and its length (which

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[1] See Section. Plate XXI, No 8.

[2] Cal. Documents Ir., No. 1680.

[3] Inq. Chan. Car. I., No. 59 & No. 28.

[4] Conf. Act Sett. under dates.

[5] Journal R. S. Antt. Ir., vol. xxxvi, pp. 254, 255.

[6] *Fulacht Fiadh*; see "Place Names," p. 381. Keating in his account of the *Fian* (Book I. sect. xlv) (Ir. Texts, p. 329) tells how the soldiers cooked, boiling by heated stones, "and these fires were so large that their sites are to-day in Ireland burned to blackness, and these are now called *Fulacht Fian* by the peasantry."

I wrote as 250 feet, as can be seen by the plan) appears as "200."[1] O'Donovan heard in 1841 that the old "entrenchment" had "been used in the last wars of Ireland," whatever he intended to express by this equivocal phrase. Such a structure could not be put to much use in modern warfare; it is locally called "Port."[2] It consists of a long, straight fosse 12 feet wide below, 5 feet to 6 feet deep, over 240 feet long, and fed by a little stream like the last. The inner mound (though greatly defaced by cattle, trampling and horning its slopes, when seeking the damp and shadow of the ditch) rises 11 feet to 13 feet over it, and 5 feet to 7 feet over the garth; it is 24 feet thick at the field and 15 feet on top.[3] The 1841 map also shows an oval mound, or hut site, in the garth, near the west end, but this seems obliterated. From the lightness of the soil and the comparative preservation, I cannot regard the work in its present condition as very ancient. It lies not far to the west of the three pillars, the central one crowned by the "Metal Man," on Newtown Head, beside Tramore Bay.

RATHMOYLAN, STONYCOVE (O. S. 27).—The name "Rathmoylan" is not that of the promontory-fort, but of a ring-fort further inland, from which the townland is named; it is in Gaultiere Barony. I have often found mention of the place, but nothing of connected history. I rest content in giving two entries. In 1301, Rathmolan, in Co. Waterford, was in the king's hands after the death of Ralph de Hamptoun, whose widow, Mabilla, had dower off it.[4] John Sherlock held it with Ballemacdavid[5] and other lands in 1562.[6] The headland is a low rounded mass of dark-brown stone; beside it is another headland beyond Stonycove, and from them runs back westward an impressive rampart of red, crumbling cliffs, the redder layers having weathered more than the rest with striking effect. Beyond are the two white towers and tamer cliffs of Brownstown Head, the eastern bound of Tramore Bay.

The fort[7] has steep grassy slopes on either flank. There is no outer ring;

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[1] Journal R. S. Antt. Ir., vol. xxxvi, p. 256. The length, though written 250 feet (see also plan there), was misprinted as 200 feet.

[2] "Place Names." It is there also called the "Embankment."

[3] For plan see Plate XXI, fig 3.

[4] Pipe R. No. 22, ann. xxxi.

[5] Ballymacadow, or Ballymacdavid. In 1566 David Browne, of Rathmollan and Brownestown, and John Sherlock, of Ballymacdavid, who died in 1562, are mentioned; the latter had a son, James, aged twenty-two (Inq. Exchr., No. 2). In 1587 Richard Classe was found to have alienated his lands in fee in Ballymacdavid to James Sherlock. (*Ib.* No. 32.)

[6] Inq. Exch., Eliz., No. 2.

[7] See plan on Plate XXI, fig. 5.

the fosse is convex, nearly 100 feet long, 9 feet wide, and 4 feet deep. The inner rampart is 87 feet long, rising steeply at a slope usually of 1 in 1, for 11 feet high. It is 21 feet thick at the garth, and 8 feet on the top, being about 5 feet higher than the garth, and up to 11 feet over the fosse. It, too, like Westtown and like Dunawealaun, near Ventry, has been much horned by cattle. There are no hut-sites.

DUNMORE, SHANOOAN (O. S. 27).—The last and most eastern of the simple forts is also in Gaultiere, the old Ostman "reserve" in early Norman days. It forms the shelter and overlooks the picturesque little harbour of Dunmore; the town, nestling among clustered trees, with a ring-tower of red stone, is at the opposite end. Beyond the harbour is the bold mass of Creadan Head, called Arkreadan in 1537,[1] and identified with the Cenn Crede, from whence a certain Thomas[2] Cinn Creite derived his name. He was slain when Haccon and "Cossa Nara" came in their fleet to Vedrifiord, or Waterford (on the Irish Loch Dacaech) in 916. when the Ciarraighe defeated the foreigners in battle at the beginning of the second great century of invasion.

Uamh, "ooan" is used in Co. Clare both for a souterrain and a ring-fort, so I think it very probable that here it has the pertinent sense of "old fort." It makes no figure in history till Norman times. After the raid of Raymund Le Gros into Decies in 1173 we lose sight of it again. Heverbricht, of Dunmore, in Co. Waterford, had been granted Culech, Fornach, and other lands by Henry II, whose son, King John, confirmed it in 1203, with service at Waterford. King Edward, in 1299, made a grant reciting his letters patent (Aug. 28, 1282) to Robert de Ufford, late Justiciar of Ireland, to hold a number of waste lands (with the assent of Stephen, Bishop of Waterford) and the villate of Dunnemore.[3] About the same period it was owned by Michael Le Flemeyng at £7 13*s.* $2\frac{1}{4}$*d.*; the lands were given to his son-in-law and daughter, Thomas Le Mareschal and Constance. The Manor of Dunmore is often named. John de la Rokell and Emelia, his wife, daughter of John Butler, had a suit with Robert Butler, who had disseised Gerald fitz William le Botiller of one messuage and half a carucate in Dunmor in 1322. Two parts of the manor had belonged to this William in 1303, and a third lay fallow. It, with the rents of the cottiers and free tenants, the perquisites of the court and the fishery, was delivered to William's son, John Le Buttyler, by a writ, August 26th, 1303.[4] There are other entries of rents which I omit; but one case gives so pertinent a tale and so striking a

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[1] Inq. Exchr., No. 1, of Sep. 18, xxviii Hen. VIII, P. R. O. I.

[2] Perhaps *Thomar.*

[3] Roll, "Antiquissimus," xxviii Ed. I.

[4] Charter Roll, John, an. v, m. 18; Cal. Doc. Ir., No. 190; Pipe R. xxiv–xxvii Ed. I; Plea Roll Ir., No. 136, an. xiv Ed. II, m. 12.

picture of what unchecked injustice and robbery could be done by an official that I give it here.[1]

When Michael Le Fleming died, he left, besides Constance, an infant son Hugh. Unfortunately for him, his father had leased Dunmore to a certain Robert de Stapleton, Sheriff of Co. Waterford, for twenty years at 100 marks a year, and, appointing an attorney to act for him at home, went to Dublin for a lawsuit. No sooner had Michael gone than the sheriff, taking advantage of the sessions, removed the attorney, produced the grant in court, and seized the Manor. Michael, on his return, sued for a writ of *novel disseisin*, but died the very day the case was to be tried, and Stapleton retained the lands. The friends of the unfortunate infant took him to England, and appealed to the King, who ordered the Escheator to take the Manor into the hands of the Crown. The writs, however, were got in vain, for the sheriff would not use them against himself. When, at last, the Crown again intervened, Stapleton pretended that he only wanted his lease, and returned the other documents.

Meanwhile several of his other victims took courage; Reginald Brun had lands at Dungarvan which the sheriff had coveted. Stapleton got a lease, and took possession, refusing rent. Not content, he arrested his creditor, imprisoned him in Dungarvan Castle, and, without calling a jury, produced him as a felon and homicide before the justices. Brun got his case stated to the Crown, and (though Stapleton again fell back on generalities) the case was ordered to be strictly investigated. Robert de Carreu had been treated exactly like Brun, but had weakly tried to make terms. Lastly, Stapleton had suppressed writs procured by the Bishop of Waterford, and seized the prelate's milch cows, but he had now filled up the measure of his iniquity, and he and the previous sheriff, Maurice Russell, an equally bad character, were brought to justice, though unfortunately we do not know the end of the story, for no record of redress or punishment (so far as I have seen) remains. The Botiller family long held their lands at "Donmore," for, so late as in 1434, Robert Lynse was granted charge of John Botiller's lands there, according to the Memoranda Rolls.

I find a Dungollem, held by a William Blam, in 1286.[2] There is nothing to identify it, but when we compare the name with that of the creek of the Oonagollum, within Dunmore fort, the coincidence is curious, so I mention it. "The Black Knob," as the headland is called, is a mass of red and purple sandstone conglomerate, looking across the broad estuary, the "Birgos" of

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[1] Abstracted from Cal. Doc. Ir., vol. iii, p. 311.

[2] Cal. Doc. Ir., vol. iii, p. 122.

Ptolemy, to the Tower of Hook,[1] oldest of Irish lighthouses. Some of the rock next the harbour has been quarried to make the pier along its flank.[2] The convex work is fairly preserved to the south, having a fosse about 4 feet deep and 15 feet wide, with a slight outer fence and a bold inner mound. It is formed by shaping the natural rise to the north of the entrance, and raising the southern part to equal height. Its slope in parts is again 1 in 1. I have rarely met such a batter in the forts of other counties. The mound, 12 feet high, 9 to 12 feet wide on top, and 24 feet at the base, nearly 6 feet higher than the inner field. It curves from Oonagollum, for 105 feet, to the large set stones in the entrance gap; behind it is an apparently early house site, 10 feet in diameter, the walls 6 feet thick. For 20 feet at the gap the mound is levelled; then its remains reappear. After 40 feet it is nearly perfect for 30 feet more to the quarry, being in all nearly 200 feet round its curve. There is a low enclosure, 160 feet across, in the north-west segment, and a mound, or traverse, of equally doubtful age, at 110 feet to the east. The high rock platform is 360 feet long, after which it falls into a slope of 60 feet more.

The Rev. G. H. Reade found a flint knife of very early type within the ambit.[3] I cannot too often warn against building any strong theory of the age of forts on such isolated finds. Systematic exploration is yet to be made, and in a poor country and unsettled period, with attempts to prejudice the public against scientific excavators in certain districts, we cannot afford to dogmatize. We have come to the most critical period in the existence of the forts. Since they passed out of use they were protected by superstitions; these are gone, and no enlightened interest has taken up their ward over our ancient strongholds. Even where safe from violence, "time and change happeneth to them all," and it is most important to try and get a safe and firm-based theory established before this branch of archaeology is choked, like others, by the parasites of unfounded assertion, prejudice, and absurd philology.

SECOND TYPE.

The type includes the normal forts with more than one series of defences. There are only two examples to be dealt with among the Co. Waterford cliff-forts.

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[1] The Rinn Dubhain, Dundoaban of the Portolan maps, from a saint's name, Dubhan, translated "hook." The tower was built by the citizens of New Ross in the middle of the thirteenth century. See Proc. R. I. Acad., vol. xxx, p. 420.

[2] See plan on Plate XXI, fig. 7.

[3] Journal Royal Soc. Antt. Ir. (R.H.A.A.I.), vol. x (consecutive), p. 227.

GARRARUS, OILEAN CHOITE (O. S. 26).—The townland name is derived from the "rough point," Garbh Ross, in which it ends. I have no record relating to it in early days, but it was part of the Manor of Dunoill, and was held by John Fitz Walter and his descendants under the charter, possibly about 1250–60, of Henry Poherus, granting to him and his heirs Clunade, Garvros, Arddrasten, and Ilanebrich.[1] It was held in 1558[2] by William Power Fitz Walter, on whose death his son, Nicholas, succeeded in 1582; Newtown was formerly Ardraston. His son, Edmond, held Newtown and Garryris, and died 1602, being succeeded by his son, Walter, aged eighteen, and already married.[3] The family still held it, and we find it in possession of Walter Power, of Castletown; he joined the Confederate Catholics in 1641, and lived unmolested "in the rebels' quarters" at Castletown (till his death in 1647) with his son, William Power, who was one of the commissioners for raising and applotting money to carry on the said rebellion. In later days it was remembered to his disadvantage that he had contributed arms and stripped Anne, wife of Edward Wade, of Passage, in 1641.[4] His lands were, of course, confiscated, among them Garrirus, Islandbecke (Islandobrick), and Tramore, in Middlethird. Garrarusse, along with Donhil and other property of the Poers, was confirmed to Sir John Cole, under the Act of Settlement, in 1666.[5]

In 1841 John O'Donovan says[6] that the fort was of stone and mortar; he probably meant clay mortar, but in any case the structure as it then stood must have been built (or at least rebuilt) in comparatively late times. It lies between Island Ikane and Westtown forts, on a little headland called Illanothy, Illaunacottia, or Oilean Choite. It has been greatly defaced, all the stonework having been removed beyond present memory; the fosses were probably filled at the same time to facilitate the work.[7] The northern, or outer, fosse is straight, 12 feet wide and 90 feet long, but now barely 2 feet deep. There are slight traces of the inner wall too defaced to be measured. At 51 feet further out on the headland is a similar work, equally shallow, 10 feet wide and 72 feet long; its inner wall is 13 feet thick.

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[1] See above, p. 207.

[2] Inq. Exchr. No. 5 (1574), Garreris and Donore in 1558, and Inq. Exch. James I, 1606.

[3] *Ib.* Jas. I, No. 8 and No. 10; part of Garreris was also held in 1574 by a William fitz Nicholas Power.

[4] Inq. Chancery, Car. II, No. 5.

[5] Act of Settlement Confirmations, Roll xviii, Car. II, July 3.

[6] "Ordnance Survey Letters," Co. Waterford MSS., R. I. Acad. Forts of stone with clay mortar are not uncommon from the Shannon southward.

[7] See plan, Plate XXI, fig. 6.

We then pass Tramore Bay and Brownestown Head,[1] and find, near Ballymacaw, a strong and fairly perfect fort at Coolum, in Gaultiere Barony.

COOLUM, ILLAUN'LIAMGOWL (O. S. 27).—The fort name, as usual, is forgotten, but the cove below it to the west is called Cloon-, Coon-, or Coos-liamgowl, and the headland Illaun'liamgowl, Oilean'liamgallda. Who "William the foreigner" may have been we have no means of knowing. Legend steps in with the absurd explanation that here King William of Orange and his army landed for the conquest of Ireland. The name Coolum has been alleged to be later than the seventeenth century, but it is found in the Down Survey map of about 1656, and was confirmed as Coolham, *alias* Coolum, along with Brownstown, Portallug, Raghmelan or Rathmelan, Credane, and Ballymacka, Ballym^c^David or Ballym^c^quaile, in Gaultiere, in June, 1667, under the Act of Settlement, to Col. Charles Wheeler and Sir Charles Wheeler, Baronet.[2]

Father Power says[3] that a farmer took away large quantities of stone from the rampart of Coolum, which thus evidently had a dry-stone wall on its inner mound, which, indeed, seems to have been usual all along the coast in Cos. Mayo, Clare, Kerry, and Cork.[4] It consists of a fosse of unusual depth and size, though I think mainly natural, for a continuation on a fault runs down the grassy slope of the west cliff to the bay. There is an outer fosse 3 to 4 feet deep and 9 feet wide, with a rampart 9 feet high (4 feet inside), and 15 feet thick; behind is a banquette, 30 feet wide at the main fosse. The inner ditch is 9 feet to 10 feet deep, 12 feet wide below, and 30 feet at the field level, deepening westward till over 16 feet deep at the edge. It is 66 feet long. The gangway is 9 feet wide, and about the same distance from the cliff. This lopsided arrangement occurs, not only in Ireland, but in Scotland[5] and in France. The main mound is again very steep, in parts 1 in 1, usually 16 feet to 23 feet above the fosse, 25 feet thick at the base, and 12 feet on top. Both flanks are grassy, though the maps give it the appearance of being deeply cut by the sea; in fact, there is no recent trace of such injury.[6] There are no visible hut-sites inside, nor much outlook, the fort being set back in the bay, the ground rising abruptly inland, while a

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[1] Brownestown in 1566 (Inq. Exchequer No. 2) was held with Rathmollan by David Browne; in 1620 it belonged to Sir John Fitz Gerald, Inq. Chancery, Jas. I, No. 43. The headland was called Horselep in the eighteenth century.

[2] Act Sett., confirmation anno xix Car. II, pars 1 *dorso*, No. 14.

[3] "Place Names," p. 193.

[4] Such as Port-conaghra, Bunafahy (Achill), Co. Mayo, Doonaunroe, George's Head, and Cloghansavaun, Co. Clare; Doonroe (Valencia) and Minard in Kerry; Doonah (Dunbeacon), Carrigillihy (Glandore), Port (Cape Clear), and Dunsorske, in Co. Cork.

[5] At Lud Castle.

[6] For plan see Plate XXI, fig. 4.

curving line of dark red cliffs, the eyrie of hawks and once of ospreys, runs out to the east.

Near the two reefs below, the last known capture of a living great auk in Ireland took place in August, 1834. The "Gair Fowl" was once very common round our coast, and the middens on the long sand-spit in Tramore Bay abound in its remains. Mr. Richard Ussher lent me his unpublished notes, which I may abstract here. A fisherman named Hardy saw a large bird swimming, just below the east face of the fort. It swam towards another man named Kirby, who lured it by throwing sprats (for the bird was very tame), and, getting near it, he caught it in his landing-net. It was a female, in its first year's plumage, and he gave it as a curiosity to Mr. Francis Davis. At first they had to feed it with potatoes and milk; then it got tamer and fed freely with the poultry, preferring fresh-water fish to sea fish. Lieutenant John Spence of the 89th Regiment, staying with Mr. Goff of Horetown, was shown the "penguin," and bespoke it for Dr. Burkitt, a Waterford naturalist. It died about ten days later, and reached Burkitt on September 7th, from whom it was procured by Dr. Ball, for the Museum of Trinity College, Dublin. The "Gair Fowl" was finally exterminated in its northern haunts about ten years later, so far as is known.

Third Type.

Some of the most picturesque and impressive of the cliff-forts are of the "citadel and entrenchment type." The platform is usually separated by a deep hollow in the neck and, without the landward entrenchment, is found on the four coasts of Ireland. The entrenchment of Island Ikane is the strongest of this type found by me, if we except the mighty Dún of Eask Hill near Dingle in Kerry. One fort of kindred type in France, at Cap Sizun, was proved to be of pre-Roman times. The great fort of the Baily on Howth is similar,[1] but its identity with the legendary *Dun Criomthann* is more than doubtful. Besides the three greater forts in Co. Waterford, within a range of twelve miles, certain small, but bold, rock platforms at Coolum, Brownstown, and Kilmurrin cove remain, but show no artificial works.

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[1] It took advantage of bold natural hollows to adapt them for fosses, fortifying the outer with 2 earthworks, and, I think, a stone wall. The inner fosse was left almost untouched, but was banked and perhaps walled; finally, on the nearly detached rock, now crowned with the Baily Lighthouse, was a ring-fort of dry stone with middens. Another shell layer is in the east bank of the middle garth.

Island Hubbock, Teach na nUamhain (O.S. 32).—This striking little citadel, a side tower of a cliff near Ballinvoyle Head, is of considerable interest and most picturesque, as may be seen by the illustration.[1] The place formed part of the Manor of Dungarvan, as held by King John, who, in 1217, granted it to Maurice FitzGerald, whose family held it down to the seventeenth century. It is probably the Inchenebacky, or Inchynbakye, named with Rathgarvyn and Crochany, in Co. Waterford, in 1297, as the subject of a lawsuit.[2] Local tradition only says that about the time of Cromwell it was inhabited by one MacThomas, a Geraldine;[3] if the tale be genuine old legend, the date is wrong, but the fact is right. In the reign of Elizabeth it was held by Thomas MacRichard of Pallace, Co. Limerick, usually called Mac Thomas; he mortgaged it to James Sherlock fitz Thomas of Waterford. Richard the "Mac Thomas" joined Gerald, Earl of Desmond, in his rebellion, and the lands in 1588 were found by inquisition to be forfeited to the Crown.[4] In February, 1591, Stradbally, Island Hubbock, and Ballyvonyne were granted in fee to Richard Beacon, to be called "Beacon's fee farm"; the owner was bound to build houses for himself, four freeholders, three farmers, and twenty-one copyholders.[5] Sherlock's rights under the mortgage passed to his son and heir, Paul (shortly before the grant), on paying a fine of £11 to the Queen on Illanhobuck. At the close of the year, under a letter of the English Privy Council, Gerald FitzGerald got the right of redemption of the mortgage as brother and heir to Thomas, whose attainted son, who had fallen in the rebellion, could not contradict the statement that he was illegitimate.[6] Nicholas Walsh of Pilltown, near Dungarvan, in 1597 (as found in 1604), claimed the *vill* and land of Illanhobocke and Ballinvalleen (Ballinvoyle) in soccage, as part of the King's Manor of Downgarvan. Beacon granted the lands to Thomas FitzGerald, who got a regrant (on surrender in the Court of Chancery) of the lands, including Illand Habugg.

The crescent-shaped enclosure on the mainland edge, shown in the map of 1841, is remembered, but no clear trace remains; it was over 100 feet across from the cliff, and nearly 6 feet high. The neck is lower than the field, but not so bold a dip as in other forts of the type. It is crossed by two deep fosses, or rather, perhaps, the natural hollow has been deepened to either side and a massive rampart made in the middle. A modern gangway was raised across the fosse and cut through the mound late in the

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[1] Plate XX; the plan and section are on Plate XXI, fig. 10.

[2] Plea Rolls, No. 16, xxv Ed. I, m. 7, No. 99; m. 27.

[3] The tradition is almost too exact to be real; could it only date from Rev. P. Power's investigations? I only heard it on my later visit.

[4] Inq. Chancery No. 1, Eliz.

[5] Fiants 5536, 4970.

[6] Fiant 5683.

last century, when the former tenant carted away the stone rampart of the inner fort.[1] The mound is curved, 14 feet thick at the gangway, and about 25 feet at the base, 6 feet to 7 feet high in the middle, but about 20 feet at the ends, for the fosses are saddle-backed, the outer 25 feet wide, the inner 28 feet, of varying depth. These works are entire at the ends, there being no traces even of fairly old cliff-falls save to the south-east of the inner part, which rises like a bastion turret from the cliff below. In the outer fosse, on my first visit with Mr. Ussher, we found a block of dark brown sandstone, with some ogmic-like scores that could be read "Amare,"[2] but were not a normal inscription.[3] On my later visit it had disappeared, possibly rolled over the cliff below by some idler, as so usual.

The dry-stone walls of the citadel are nearly gone. They embodied a low mound of clay and stones still 3 feet to 4 feet high; part of the wall with the east cliff fell *en masse* long ago, the break being quite weather-toned and grassed. The wall clings to the very edge of the platform, giving a very irregular plan. The platform is roughly 141 feet north and south, and 40 feet to 60 feet wide; there is a slight angle or rather dip inward to the west, whence a straight wall crossed the garth. Between this and the entrance is a circular hut, hollow, with a closed souterrain,[4] the *uamh* of the local name Teach an ooan. Such are rather rare in promontory forts; they are said to have been found in Dunmore near Slea Head, Co. Kerry, and one occurs in Dooneendermotmore near Toe Head, Co. Cork. A streamlet falls over the cliff from a little spring close beside the fort.

BALLYNARRID, ILLAUNOBRIC, OILEAN UI BHRIC OR DANE'S ISLAND (O.S. 32).—One of the most imposing fort-sites of the Irish coast is found at Illaunobric in Ballynarrid townland and Decies without Drum.[5] A huge dark tower of rock rises sheer from the shore, being nearly perpendicular,[6] even towards the

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[1] This has been so frequently done, even in human memory, that the only dry-stone enclosure in any sort of preservation seen by me in the district is beyond reach of carts at the summit of the pass of Barnawaddra above Kilrossanty Church, the Kilrosnety of the Taxation of 1302, and Kilrossynt of the Plea Rolls (No. 25, an. xii Edw. II, m. 6 *dorso* and No. 134, m. 13 *dorso*).

[2] Journal R. S. Antt. Ir., vol. xxxvi, p. 249.

[3] Perhaps meant for "—a maqi."

[4] "Tigh faoi thalamh" is given (in Waterford and South-East Ir. Arch. Soc. Journal, xi, p. 163) as a local name for another souterrain; another is "Poll talmhan" ("Place Names," p. 97). One recalls in the "Saga of Gisli the Outlaw" (12th-century tale about period A.D. 930-980) how Thorgerda and Gisli were in a subterranean chamber, one end opening into her hall, the other on the bank of a stream.

[5] Journal R. S. Antt. Ir., vol. xxxvi, p. 252; the view see Plate XX.

[6] "Place Names," p. 109, considers that this was separated from the mainland after the entrenchment was made; more likely its natural configuration led to its fortification, ages after nature had "roughed" it into shape.

grassy hollow of the neck, only accessible by a path like a goat track. A large entrenchment on the mainland formed a somewhat crescent-shaped enclosure, but was nearly swept away by 1841. I was unable to climb into the citadel, but the platform is (I am told) accessible to young cragsmen; it can be well seen from the cliff to the east. The names Oilean Ui Bhric and Templeobric are derived from an important branch of the Desi[1]; what name the fort possessed in pre-Christian or even Norse times, I do not find; but later writers put it back to the period before A.D. 400, and traditionally after A.D. 260, when the five-fold division of Munster took place between the descendants of Ailill Olom.[2] One of the mearings was a line from Bearnán Eile ("The Devil's Bit") to Oileán Ui Bhríc. The name, more probably, is late mediæval, after A.D. 1050, and has been superseded probably in the eighteenth or early nineteenth century, by the name "Dane's Island," based on the revival of the "Danish Fort" theory of Giraldus Cambrensis. I again have no early Irish document; the first record is the early charter, perhaps 1250–60. Henricus Poherus grants to John fitz Walter and his heirs, as we noted under Dunhill, "the land of Ilanobrich by making service of five parts of two knights' fees."[3] The next notice is a lawsuit, in 1317, of Johan, wife of the late Stephen le Poer, with Richard his son for dower off 1 messuage and 4 carucates of land, besides 40 shillings off Ilanybryk or Ilanhybrik, Co. Waterford.[4] It remained in possession of that family to the reign of Elizabeth at least, for William Power, of Imokyll, temp. Henry VIII, and then John, his son, held it. Next I find that Sir Thomas Butler, Earl of Ormond, alienated Hyllanyvriec to James Sherlock, fitzJohn[5] Thomas, FitzJohn, fitz Edmond, Poer of Illanyvrik, kerne; John fitz Edmond Poer, *alias* "Mac Eustace," horseman, and John Duff Flyn, of Tamplevrik, were pardoned in 1566.[6] As to the O'Bric family, we first find it in the "Annals of Ulster" in 1057, when Finnguine Ua Finnguine, royal heir of Munster, was slain by Maelsechlainn Ua Bric, who, two years later, was smothered in a cave by Maelsechlainn Ua Faelain. In 1103, the two O Bric were "royal heirs" of the Desi in the great battle of Magh Cobha, while, seven years later, Bran Ua Bruic, the senior of west Munster, i.e. the *south*, was the monk who used

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[1] The names Templeobric townland and rock, Illaunobric and Tobar Uibhric in Monksland Parish, remain on our maps. Templeyvrick church site lies among a number of disused mine shafts; the building has been entirely removed. Tamplabric is shown in Petty's map, 1655. Karriggyvrick was owned by David Condon in 1584 (Inq. Exchr., No. 24, Eliz.).

[2] Keating (ed. Irish Texts Soc.), vol. i, p. 127.

[3] Plea Rolls No. 121, xi Ed. II, m. 18 and No. 122, m. 19.

[4] Cited in Inq. Exchr. Jas. I, No. 10.

[5] Inq. Exchr. No. 5 Eliz.

[6] Fiant 977.

to act as spiritual adviser to the Abbots of the district.[1] In the following century Murgholt was held by Cormok Obrik and others in 1252, and in 1280 John Brike was fined 2 marks for not producing Richard O Kelekan, for whom he gave mainprise in Co. Waterford. The family, though fallen from its estate, is found down to modern times, and it is said that some of its members, under the impression that they were called from some "Broc" (badger), took the name "Badger."[2] The map of 1841 shows three house sites on the platform; Mr. Ussher saw foundations of (I believe he said several) stone huts, and traces are said to exist, though not visible across the chasm. The garth is about 170 feet to 150 feet across in each direction, being of irregular outline and fenced towards the neck by a low mound, about 3 feet high inside, and 5 feet outside. The neck rises to almost a knife edge, and the refuge must have been almost impregnable to ancient warfare. It is hard to believe the fact that its well-established name is not given on the Ordnance Survey maps.

Island Ikane (O. S. 26).—The name is found at least as early as 1296, and again, in 1319, in the Plea Rolls as Ilanyken, in Co. Waterford. Disona, widow of William fitz Philip, had in 1296–7 a lawsuit with John fitz Philip, her husband's grandson, claiming dower off a messuage and 2 carucates of land, 40 acres (of tillage ?) and 60 acres of pasture in Illanyken, Co. Waterford, for which the said William, with consent of his grandfather John, had dowered her.[3] The same name occurs down to 1601. It belonged to the Poers, but William Wyse held Illanykeen and land at Dungarvan at his death in April, 1596, being succeeded by his son, Henry, then aged 40.[4] Pardons were granted at various times to Edmond fitz Robert Power of Elanykene, horseman, in 1567; Peter Evann Power, of Illanyken, in 1569, and Walter fitz Richard in 1601.[5] John Wyse held Illanyken at his death in 1596; his son John owned it about the year 1601.[6] It is Island Icane in Petty's map, 1656. The name is an adaptation of *Oileán Ui Chein* from one of the lesser branches of the Desi. Father Power attributes the splitting of the headland into Oileán na gcaorach, or Sheep Island, and Oileán na bhFranncagh, or Rat Island, to about 1841; but both appear in the map dated in that year.[7]

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[1] See the Annals (especially of Ulster), under the years; also Cal. Documents Ireland, No. 135, and p. 360.

[2] Waterford and South-East Ir. Journal, vol. x, p. 145.

[3] Plea Roll No. 25, xxiv Ed. I, m. 11; and No. 96, iii Ed. II, m. 14; it is only "Insula" in the 1302 Taxation. See also Cal. Justiciary Rolls, 1305, m. 690, and p. 139.

[4] Inq. Exchr. Nos. 2 and 3, anno iv-v Philip and Mary, March 11th.

[5] Fiants 1046, 1304, 6476.

[6] Inq. Exchr. No. 47. The date is defaced; it is probably anno xliv.

[7] Perhaps also in Dr. Smith's map, 1745 (three shown), and on James Wyld's map, 1837–8.

The remains are of no slight interest[1]; the portion on the land has two straight sections meeting in a rounded corner: the western 268 feet, the eastern 320 feet long. There are slight traces of an outer mound 9 feet thick, then a fosse, 3 feet to 6 feet deep and 18 feet wide; there is a spring near the east end of it. The rampart is about 18 feet thick, and 9 feet to 11 feet high; parts have been repaired, but it is so steep that it must have been stone-faced till recent times. The garth is thickly sheeted with heather in which we failed to find the house-site marked on the 1841 map. The cliff-edge has a slight modern fence and is rapidly crumbling away. The trace of a long narrow neck remains at the south-east corner. It originally was 300 feet long and led to the present island in a deep dip. It got pierced by two natural arches which fell in, apparently in fairly recent times. Three narrow ones run under the island, and a larger one fell in, cutting off another islet. Beyond the present breaks the neck rose up to the Island; just at the top of its slope are slight traces of a fence and a well-marked hut-foundation, apparently oblong. Father Power[2] notes others, and says they were "primitive stone houses of the beehive type." The island is still joined to the land by a strand, bare at low water. It recalls in the general shape and cutting off of the neck the bolder but similar natural fortress of Bishop's Island, Co. Clare.[3]

In the second field, to the west of the earthwork, is a great ditch running north and south, 16 feet 8 inches wide and 4 feet to 5 feet deep, with a fence 11 feet high and nearly 10 feet thick. It is evidently ancient, far larger than the other field fences, and is not on the present bounds of the townland; it may, however, be an ancient mearing.[4] The fort seems to have been left undescribed till 1906, and I regret that my former paper has not led to its excavation or further elucidation.

FOURTH TYPE.

DUNABRATTIN (O.S. 25).—Attracted by the name, distant view, and general plan of the headland, though then unable to visit it, I noted it as a promontory fort.[5] Later on I asked Mr. Ussher to examine, and had the satisfaction

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[1] For Plan see Plate XXI, fig. 1.

[2] "Place Names," p. 379.

[3] Journal, R. S. Antt. Ir., vol. xliii, pp. 335–6.

[4] Mearing is provided for in the Senchus Mór (Rolls edit.), vol. iv, pp. 143–5. Mears could be a rath, *ditch*, mound, stone wall, flat stone, water, &c.; where no such mark existed two comharbs could divide it. Provisions are also made for local defence against wolves.

[5] See "Ancient Forts of Ireland," sect. 120.

soon after of hearing that I was right in my conjecture that a large entrenchment existed there. He subsequently got it marked on the new Ordnance Survey Maps. From a later visit I may describe it more fully.[1] It is of the fourth type of such structures where a subsidiary entrenched headland is found inside the main defence, as at Baginbun in Wexford, and Dunsheane in Kerry. The most complicated example known to me is at Dun Kilmore, on Achillbeg, where a ring-fort and two fortified heads lie within the outer wall. Ferriter's Castle, on Doon Point, in Kerry, and the Great Baily of Howth are closely similar. The Head lies on the edge of the barony of Decies, half way between Knockmahon and Annestown, and is rather low, but with some picturesque coves and arches. The name is the same as Dunbarton, meaning the Briton's (Welshman's) fort[2]: I failed to find any early record. In later days it appears as belonging to the Powers. In 1566 and 1567 Nicholas and Walter fitz Geffry Poer of Donbretayne, Donbrettan, or Donoretayne were pardoned.[3] Nicholas fitz Geffry Power died in 1602; at that time he owned 60 acres in Downebrattin[4]; his son Geffry succeeded. Robert fitz Morris Power of Ballyscanlan, on his death in 1605, held the same, and another Nicholas Power in 1622. The Bishops of Waterford in right of the see got 10*s.* head rent in 1578 from the vill and lands of Downbrattin; this fell to 7*s.* 6*d.* chief rent of Domnebrattin down at least to the time of Bishop Nicholas in 1635. Nicholas Power died at Downratten, September 10th, 1636, and his son Geffry succeeded.[5] It is marked as Dunbrattin in the 1655 map, and confirmed to Sir John Cole in May and July, 1666.

The main entrenchment is a fosse from 15 feet to 18 feet wide, 3 feet to 5 feet deep; on the inner side is a mound (much defaced by a modern fence), rising 10 feet over the ditch, and 3 feet to 5 feet over the field; it also is 18 feet wide. The west end is uninjured, with a fine view out to Kilfarrasy, Helvick, and Mine Head; the east end has been cut off by a cliff fall. From it we find, at from 81 feet to 102 feet, that the fosse is filled up;

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[1] Plan on Plate XXI, fig. 2.

[2] Not of the Welsh family, Bretnach. There were of course Welsh settlers in Norman times, such as William the Welshman, a tenant of Thomas fitz Maurice in 1298 (Cal. Doc. Ir., iv, p. 262). From such the fort may have been called. The custom of naming an early fort after a modern tenant is still very common, notably in Kerry, where the fort names sometimes have changed three or four times in a half century.

[3] Fiants 936 and 1046.

[4] Inq. Exchr., No. 5, App. 26, xxi Eliz.

[5] Inq. Exchr. Jas. I, Nos. 7, 10, and 39; a deed of 1593 granting Downemrattin to Garret Wall in trust for Nicholas Power and his wife Margaret Wall on their marriage, is copied. In the last Geffrey, son of Nicholas, was one of the jurors who found the inquisition as to William Power fitz Walter (so often cited); the place is there called "Downe Brattin."

at 257 feet the mound is greatly levelled, and turns a little northwards off the straight line (off for 15 feet at the west end). The works are still over 350 feet, and were once at least 370 feet long. Behind the mound are three greatly defaced house-sites, one with a large white quartz block; the rampart there is 15 feet wide; at the west the ends of the fosse are neatly rounded off like those of Dunnagappul on Clare Island, and are evidently intact.

The lesser fortified head is on the west flank. There is first a very slight ditch with low weatherworn mounds. At 96 feet on from this is a natural hollow, 46 feet long, at a well-marked fault. It has been scarped and deepened into a fosse 9 feet wide below, and 18 feet at the field, 10 feet deep in the middle, and nearly twice as much at the ends. The platform has traces of the usual thin fences, scarcely rising above the garth, and probably once capped with dry-stone walls. It is 60 feet long east and west, and 36 feet across near the fosse. Across the southern cove, "Trawnamurraoge," the natural fosse reappears, being there only a few feet deep, and getting more shallow till it is lost in the field. There is no trace of its being used for entrenchment or of any foundation of another wall, and the other little headlands to the south-east side have no old fences.

OTHER SITES.

The other types are not represented, so far as I know, unless the shore rock of "Foillaneen Cashel," in Tankardstown, near Knockmahon, was once fortified. There are some suggestive sites like the little rock platform (near Droghideen and the "Tea Rock," south of Ardmore, near Ram's head), a miniature replica of the Duns at Kinure, near Kinsale. Other rocks, small equivalents to Dane's Island, are found as I said at Coosliamgowel, near Coolum, and at a cove west from Dunabrattin. I saw no walling or fences on them.

BALLYKILMURRY (O. S. 40).—It is a larger but similar little platform, connected to the main cliff by a long natural "dyke" a few feet wide, in parts even narrower. It lies in Ballykilmurry[2] and near Cooshanimma (*Cabhas an Ime*), Causeway (or cove) of the butter, in Decies within Drum, and to the west of Rinanillaun. It recalls the cliff-forts of Dun Mucaig, or Muicinis, on the Island of Seil in Argyllshire.[3] The platform was levelled up and scooped out, leaving a bank to the west and north-west, the other

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[1] Inq. Chancery, Car. I, No. 51, and Inq. Exchr. of same, No. 1 Domnebrattin, &c.

[2] Baile mhic Giolla Mhuire, from a reputed Norse family of note in the history of Co. Waterford. See Journal R. S. Antt. Ir., vol. xxxi, p. 302.

[3] "Early Forts of Scotland" (Dr. David Christison), fig. 33.

side being sheltered by a neighbouring high cliff. It is only about 40 feet across. Not far away eastward of the stream from Ballymacart[1] is a terrace, or shelf, along the cliff with stone-walled little enclosures. It is hard to imagine so insecure a condition of life as to have made it necessary to fence and use such small and barren spots; perhaps (being near the Danish settlement of Dungarvan and Helvick) they were used for temporary refuge during raids. The fort, doubtless, had a single hut, like the small fort at Dunaneanir, Co. Mayo.

ARDOGINNA,[2] GORT AN DUININ (O. S. 40).—The "Journal" of the Waterford and South-East Ireland Society, in 1907, made a criticism on a statement in my former paper in 1906, which for the correction of archaeological notes it is important that I should here meet. "The first fort in his list Mr. Westropp places in the wrong townland, as it ought to be Ardoginna, not Ballynamona," adding that there are two townlands of the latter name. Strange to say, the critic fell into the very confusion that he deprecated. Had he verified the sheet of the Ordnance Survey given by me, he would have seen that I placed the fort in the Ballynamona near Mine Head on sheet 39, not in Ballymona near Ardmore on sheet 40. Rev. P. Power in his "Place Names" refers in a foot-note to the Ardoginna fort as the "Ballynamona" in the 1906 paper.[3] He adds that there is a promontory fort there, giving its name to Gortaduinín field. Now I examined the coast of Ardoginna townland, and found nothing resembling a promontory fort unless a fenced knoll at the mouth of the stream valley south-west from Ardoginna House be intended, and I do not think that it is an ancient fort or, if so, the trace is very slight and defaced. May not Gortaduinín be called after some little levelled housering—there being at least one between the modern house and the cliffs? Unfortunately Father Power could not find his original notes to reply to my queries, and of the long and interesting list of shore names collected by him, only one, "Knocknanvaddera" (for *Fail a mhadraidh*), appears on the maps. He tells[4] of a cliff site called *Cloch* (or *Croch*) *an oighre*, the heir's rock (or gallows) with a typical "Leap" legend. The heir of a large property had a rival in love who slipped a golden goblet

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[1] Charter Roll ix Ed. I, m 10, grant of Balimaicort et Baliabrain, 1281; Archbishop Miler MacGrath's visitation, 1588, Ardmore Deanery, "Ballymacart et Balyabran, vacat, vasat; ult. incumbens ignoramus."

[2] This is probably the "Minard," high mountain-flat, of the portolan maps. Minard 1360 and 1436, Minart 1375, 1497, 1513, and 1593, Proc. R. I. Acad., xxx, p. 419. Maurice Fitzgerald of Ballyogertye held Ardogena 1376 (Inq. Chancery, No. 39, Car. I). The name is probably Ard o gCineadh: "Place Names," p. 61.

[3] "Place Names," p. 62.

[4] "Place Names," p. 62.

into the youth's dress and denounced him as a thief. The victim sprang on his horse and galloped it to the cliff, hoping that he might fail to cross the chasm, but, contrary to all probability the charger sprang on to a grassy ledge unhurt, where the unfortunate lover was found by bulldogs, taken, and hanged on the spot. The cliffs should be re-examined from the "Tea Rock" to Ardoginna House; and if a fort exists, a description should be published.

ISLAND, TIGH NA SGANSA[1] (O. S. 32).—The same work mentions "an entrenched headland of the same general character as the Ballyvoony entrenchment." I found no trace of this in Island[2] townland. Is it a mistake for Island Hubbock fort, a little to the west? No site or indeed any suitable headland for one, appears on even the new maps, and Mr. Ussher certainly knew of none there.

RATHNAMENEENAGH (O. S. 36).—Near Helvick Head, in Rathnameneenagh and Killinooreen, two apparently suitable headlands are marked on the maps. I am told they are not entrenched, but only saw them in the distance. They, too, should be examined, and, if fortified, should be described.

PORTALAUN (O. S. 26A).—Father Power notes a cliff-fort at Portalaun, between Coolum and Brownstown Head, but could not give me any note. The maps do not mark any headland or entrenchment at the site. My walk along those cliffs was hurried and in the dusk after a long day at Dunmore, Stonycove, and Coolum, so I may have failed to see it.

I have striven to make this list complete, but, though several times along the coast, the possibilities of oversight remain, though fortified by the valuable opinion and experience of the late Mr. Richard Ussher. In publishing the notes thus fully I hope to induce antiquaries in Co. Waterford to examine the sites and fill up any omission made by me in noting the fortified headlands of this interesting coast.

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[1] P. 176, Tigh na sgansa, House of the "Sconce," or fortress.

[2] In this townland is a fine ring-mound once stone-faced, 4 feet 6 inches to 8 feet high, and 8 feet thick, in which lay a broken pillar with the ogmic epitaph "Cunet(a)s ma(q)i muc(oi) Netasegamo(n)as." The gateway of the ring was of large blocks, and faced the west; a bullaun or basin-stone lay to the east in the garth.

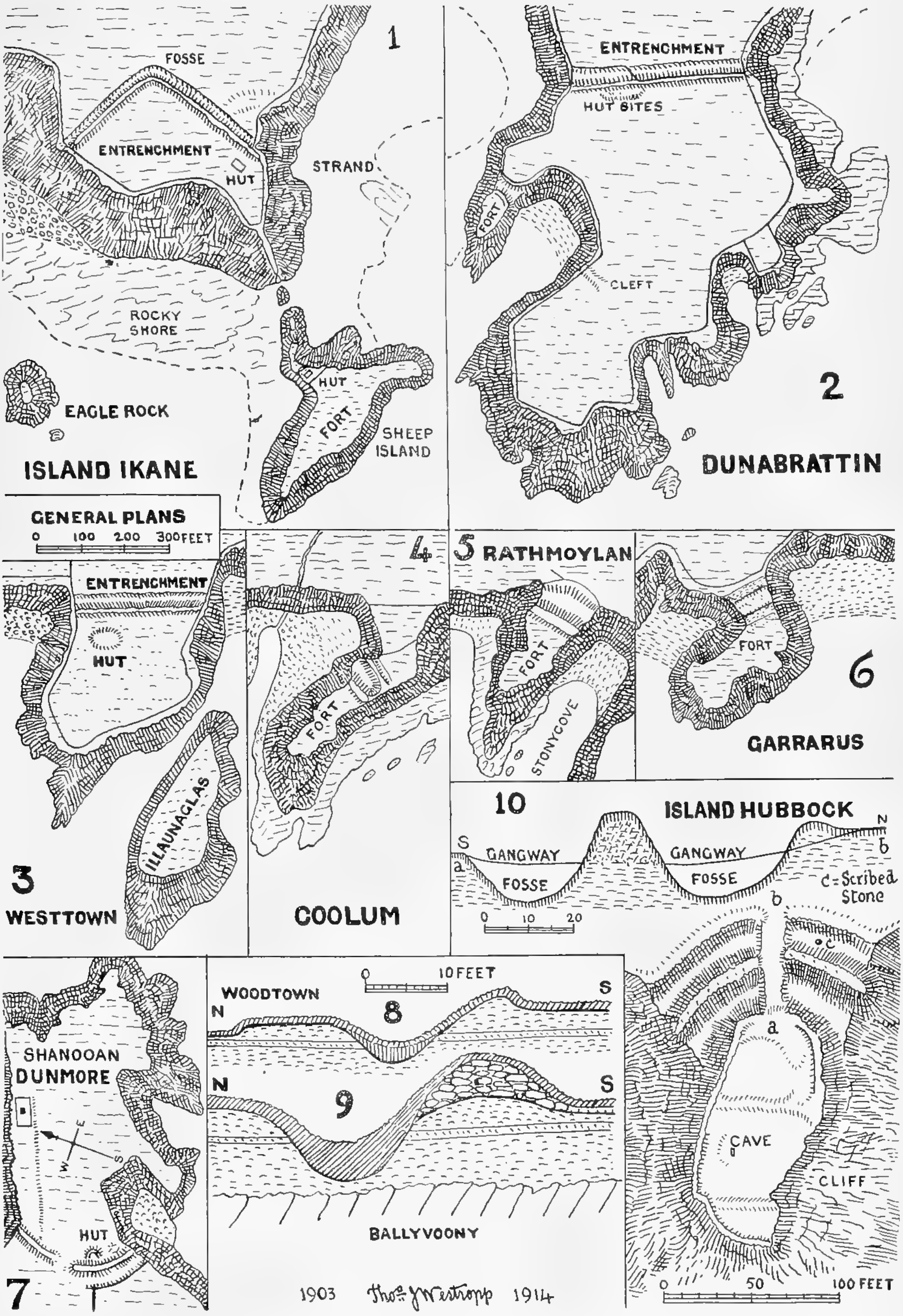
NOTE IN PRESS.

The succession of the Lords of Dunhill (*supra*, p. 206) seems to be—1273, John; Peter, drowned, 1283; John, 1290, 1310; summoned to Parliament, 1310; Peter, slain, 1328; John, 1337–1351; his son John succeeded, but left an only daughter; John (son of Eustace, brother of the last John) had a son John, Baron of Donill, 1373. Mr. G. D. Burtchaell kindly gave me these notes.

Fig. 1.—Cliff Fort, Illaunobric, Dane's Island.

Fig. 2.—Cliff Fort, Island Hubbock.

Westropp.—Fortified Headlands and Castles of South Munster.



Westropp.—Fortified Headlands and Castles of South Munster.

XIV.

THE "DRUUIDES" INSCRIPTION AT KILLEEN CORMAC, COUNTY KILDARE.

By R. A. S. MACALISTER, M.A.

PLATE XXII.

Read NOVEMBER 9. Published DECEMBER 30, 1914.

THE purpose of this paper is, primarily, to offer for the criticism of scholars a novel attempt at interpreting the well-known "Druuides" inscription; and, secondarily, to indicate in outline certain deductions which it appears to the author may be legitimately drawn from this remarkable monument.

I.

Since its discovery some fifty years ago, the two-fold inscription lying in the ancient cemetery called Killeen Cormac has been the subject of numerous disquisitions, and of almost as many theories. So far as the inscription in Ogham letters is concerned, it is unnecessary to recapitulate these. The exposition of this part of the writing on the stone may be said to be closed by the discussion to which Sir John Rhys has submitted it, in his paper entitled *Studies in Early Irish History*, published in the first volume of the *Proceedings* of the British Academy. The only question still open is, whether we are to read the first letter as an O or a U; there are the three marks requisite for U; but one of these is fainter than the rest, and may be a small accidental fracture on the edge of the stone, and not intended by the engraver of the inscription. Sir John Rhys inclines to read O; and though I thought that the letter was U, I have recently examined the stone twice, and have come round to the conclusion that in this he is probably right. It is likely that this point will never be settled with complete certainty; fortunately it is of minor importance, for whether we read the inscription OVANOS or UVANOS AVI IVACATTOS the identification or analysis of the names will not be affected.

The case is, however, very different with the associated epitaph, in Roman letters. We are here in the presence of an inscription that has severely taxed the ingenuity of two generations of scholars. It consists of one line of letters, fourteen in number. Except one of these—the fifth—all these letters are perfectly clear, though worn, and there is not the least possibility of doubt as to the way in which they should be read. The first four letters are IVVE. Then comes a character which is slightly broken at the top. What is left is an upright line, with an oblique line to the right of it—like an R which has lost its top loop, or an N which has lost its right hand upright. After this ambiguous letter the inscription continues EDRVVIDES: the R is so written as to overtop the rest of the letters, which in other respects are well cut and carefully aligned. The final S is reversed.

The Rev. J. Shearman, the discoverer of the monument, in his communication to the Royal Irish Academy (*Proceedings*, vol. ix (1864-6), p. 253), read the fifth letter as an R, and spaced and translated the whole inscription thus: IV VERE DRVVIDES, "Four true druids." It is perhaps needless to point out the improbability of this interpretation, ingenious though it undoubtedly is. There is precedent for the commemoration of groups of men numerically; at Iniscealtra we have a stone inscribed ILAD IN DECHENBOIR, "the grave of the ten men"; at Onaght in Aranmore we have OROIT AR II CANOIN, "a prayer for the two canons." The well-known stone in the same cemetery inscribed VII ROMANI is not in point, however, as this is probably a dedication to the seven martyr sons of Felicitas,[1] rather than a memorial to seven Romans who by some chance found their way to the Islands of Aran. But in any case the practice is rare, and I do not think that anyone would now venture to express his agreement with Father Shearman's rendering—especially as it was suggested in the interests of an impossible identification of the persons supposed to be commemorated by the monument.

It was probably in unconscious revolt from this unconvincing interpretation that Stokes and other scholars preferred to read the letter as N. It was noticed that the small fracture at the top of the character was not large enough for the loop of an R, especially in view of the large size with which the engraver endowed the other R in the inscription. To complete the N it is necessary to borrow the upright stroke of the following E. Such a ligature is of course common enough, and need not cause any difficulty; but it is questionable whether we were much better off, with regard to the interpretation of the inscription, with an N than with an R. The inscription would naturally divide itself into IVVENE DRVVIDES. Some interpreted this

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[1] Compare *Cesad sund secht mbrathar ir-Róimh nar-ros rígsaer*, Martyrology of Gorman, 10 July.

as "the druid youths," others as "Juvan the druid," equating the name somehow to the Uvanos or Ovanos of the Ogham. Though I always was suspicious of the "druid," the latter was the interpretation that I favoured before I hit on the idea set forth in this paper; but how, in defiance of all the relevant laws of phonology, IVVENE was to be equated to OVANOS, and how DRVVIDES was to be parsed, no one arose to tell us.

In his British Academy paper above referred to, Sir John Rhys, who had previously read the letter as N, announced his reversion to the older view, that it is an R. He pointed out that if the letter were to be read as an N in monogram with the following E, the lower point of the oblique stroke should come in contact with the lower angle of the E. But there is no such contact, as will be seen from the accompanying facsimile, reduced from a good rubbing kindly placed at my disposal by Lord Walter FitzGerald. Further, Sir John thought that he could detect faint traces of the missing loop of the R; and he spaced the whole IVVERE DRVVIDES, translating it "the druid of Ireland": an interpretation which he supported with his well-known opulence of learning and ingenuity.

In the course of the present year I have had two opportunities of examining this stone afresh. The first time I went specially for the purpose of examining the ambiguous letter, and of trying to come to some conclusion about it. The second time was on the occasion of the annual excursion of the National Literary Society, which under my guidance visited the cemetery last June. The first visit was unfortunately marred by heavy rain; yet this was not wholly a disadvantage, as the water lying in the grooves of the letters brought them into a prominence that on fine days (except under special conditions of lighting) they do not possess. The visit, in spite of the rain, was by no means lost; I was able to make certain observations which on the second visit, when the weather conditions were favourable, I confirmed, and have now no hesitation in bringing forward.

Sir John Rhys is most certainly right in saying that the letter cannot be N, and all interpretations which assume that value for the letter are wrong. On the other hand, I cannot agree that the letter is R. The small fracture is too small to have contained the most exiguous loop, and I cannot trace the faint marks in which Sir John Rhys sees the loop of the R. In my opinion the letter is neither N nor R; and I do not believe that it ever was any more than the two strokes that we see; all that is lost is the apex in which they met. The letter thus resembled a Greek *lambda* with one stroke vertical; or a Greek *gamma* with the horizontal stroke made oblique. And, for reasons presently to be adduced, I now believe that the latter is what it actually is, and that we are to read the line of letters IVVEGEDRVVIDES.

At first sight this is not any more promising than the other readings. But one day, when, in what I might almost describe as an idle moment, I was meditating on this inscription, it occurred to me to write it out in Ogham letters and to turn it upside down; with the surprising result that I found it would invert into the perfectly intelligible sequence CELI TURLEGETTI, "tenant, or follower, of Turlegettios." The word CELI is found on a number of stones inscribed in Ogham; thus at Whitefield, Co. Kerry, we have ALATTO CELI BATTIGNI. On a damaged stone from Glounagloch, Co. Cork, now in the British Museum, we have MAQI-BRIL . . . CELI ALACENG . . . .; the ends of the lines being broken, the names are here imperfect. A stone still hidden away in a rath-cave near Donoughmore, Co. Cork, reads, so far as the inscription is exposed, UDDMENSA CE-(li . . . .). And at Drumloghan, Co. Waterford, we have a long inscription that reads CUNALEGEA MAQI C . . . . SALAR CELI AVE-QVECEA. The formula of the last is practically identical with the complete Killeen Cormac inscription as now interpreted: OVANOS AVI IVACATTOS CELI TURLEGETTI—translated in both cases as "A, son (or grandson) of B, follower of C."

The name TURLEGETTI, thus recovered, is remarkable, and I have not hit upon anything exactly comparable with it; but the same is true of the apparently cognate and equally enigmatical name GLUNLEGGET, which undoubtedly occurs on one of the Monataggart stones: here the *-i* of the genitive case is omitted. This comparison confirms the reading of the ambiguous letter as a G.

II.

In the Drumloghan inscription just cited, which affords the closest parallel to the Killeen Cormac stone as thus interpreted, the inscription is written on three angles of the stone, in Ogham throughout. There does not seem to be any very obvious reason why this should not have been done also at Killeen Cormac. No one, I venture to think, can question that the interpretation of the inscription now suggested has the advantage over previous renderings in being simple, grammatical, unstrained, and in full accordance with the formulae of analogous monuments elsewhere in Ireland. But a critic has the right to demand an answer to the following questions:—

(1) Why is the inscription inverted?

(2) Why is the Roman character used?

(3) Why is one of the letters to be assumed as Greek?

In what follows I endeavour to answer these questions, and to indicate others which their answer raises. It is impossible to go fully into the points which will be alluded to, within the limits of a single paper; I can for the present only draw the outlines and await another opportunity for the filling-in of the details.

III.

The first point that I shall refer to is this: that some form of the Roman alphabet was in use in Ireland from an early time, anterior to the development of the existing manuscript literature. There are several indications pointing to this conclusion. The Gauls of Caesar's time were well acquainted with letters; the chief druidical schools in his time were in Britain; and, as Professor Mac Neill has pointed out in his masterly analysis of the Irish Ogham Inscriptions, published by this Academy,[1] the orthography and accidence of those inscriptions represent a grammatical tradition entirely independent of the tradition established by the Christian Old-Irish literature. Such a tradition cannot possibly have been preserved in the clumsy Ogham script, which is indeed more of a literary accident than anything else; nor can it have been preserved in the so-called Irish alphabet of the manuscripts, for there are several letters lacking in the Irish alphabet present in the Ogham, and *vice versa*. The spelling and grammatical forms on the Ogham monuments constrain us to the belief in a certain amount of literary culture before the coming of the Christian missionaries with their new ideas and their new letters. The groundwork of this literary culture was, no doubt, the poems which, according to Caesar, were committed to the memory of the pupils in the druidic schools—most likely Veda-like sacred and semi-magical hymns and formulae of various kinds. There are various side-issues at this point which for the present I reserve, as these would lead me too far away from the inscription under discussion.

The Ogham character is a cypher, based on some other alphabet. This has long been admitted, and need not here be enlarged upon. It is also admitted that the Roman is the only alphabet on which it could have been founded. But no one has attempted, I think, to give a reconstruction of the steps which the inventor followed in devising his scheme.[2] This I shall now endeavour to do, as it has a bearing on the question of the form of the Roman alphabet in use in Ireland at the period of the invention of Ogham, whenever that may exactly have been.

Let us think for a moment what the inventor of Ogham was trying to

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[1] Proceedings, vol. xxvii, p. 329.

[2] Except Bishop Graves, who in *Hermathena*, vol. ii, p. 460, suggests a process in which even he himself expresses no confidence.

do. Assuredly it was not an alphabet for literary purposes which he was inventing; as such it would have been abandoned within a week, as being totally impracticable. You have only to write a short sentence or a line of poetry in Ogham to be convinced of this. The grouping of the scores from one to five shows that he was inventing a system of finger signs, whereby secret communications could be made, after the manner of the deaf and dumb alphabet, by those initiated. For this purpose he wanted an alphabet the number of whose signs was a multiple of five. Now the form of the Roman alphabet at his disposal contained eighteen signs. This we infer from the omissions in the Ogham. These eighteen signs were

A B C D E G H I L M N O Q R S T V Z

—the V having of course both a vocalic and a consonantal value, as we assume in the inscription before us, where the second VV, taken as = UV, inverts into TU.

To make his alphabet an even multiple of five he first added two signs, for consonant V and for NG. Thus he had

A B C D E G H I L M N O Q R S T U Z V NG.

He then separated out the vowels; and this, together with the subsequent distinction which he observed of broad and slender vowels, shows that we have to do with the work of a grammarian—

ᚐ ᚑ ᚒ ᚓ ᚔ
A O U E I: B C D G H L M N Q R S T Z V NG.

He next, as was long ago noticed by the late Rev. E. Barry, took as one of his groups the initials of the first five numerals, as they would have been in the Irish of his time. These were H, D, T, C, Q. Of course, the numeral "four" should begin with Q as well as "five," but in the latter it is followed by a strongly emphasized 'u,' which perhaps enhances its quality. At any rate, the alphabet now stood thus—

ᚆ ᚇ ᚈ ᚉ ᚊ
AOUEI: HD T C Q : B G L M N R S Z V NG.

Of the remaining letters he began at the beginning, and took every second—

ᚁ ᚂ ᚃ ᚄ ᚅ
AOUEI : HDTCQ : B L N S V: G M R Z NG.

Next he rearranged the remaining group, beginning with M (probably because it was about the middle of the alphabet), and going backwards cyclically—

ᚋ ᚌ ᚍ ᚎ ᚏ
AOUEI : HDTCQ : BLNSV : MG NG Z R.

The last stage, so far as the first inventor was concerned, was to rearrange the groups with the vowels last, and the rest in the alphabetical order of their first letters—

BLNSV : HDTCQ : MGngZR : AOUEI.

At a later stage, but before the date of our earliest inscription, the first group was rearranged, and the N and V changed places; doubtless because it was found convenient to represent vowel V and consonant V by the same number of fingers, as they were represented in the normal Roman letters in use by the same character. This change was not, however, effected till after the Ogham character had received its name *Beith-Luis-Nion*, which persisted even after the third letter was no longer N.

The most striking point about this alphabet is the absence of P and its cognate spirant F, and the presence of Z. The former is not difficult to understand; they were not required in writing the proto-Goidelic of the druidic hymns, and so, if ever introduced with the rest of the borrowed Roman alphabet, speedily became obsolete. The latter is more difficult to account for; it likely is to be explained by the use of magical formulae, borrowed probably from Greek, and perhaps through them ultimately from Egyptian sources. Such meaningless words as were used by Gnostics and other mystical sects, inside and outside of Christianity, travel far, and reappear unexpectedly from time to time. There is one such word in Ogham on the amber bead from Ennis, now in the British Museum, and a similar formula on the slab in our Museum found at Glenfahan, in Co. Kerry. For such formulae both Z and NG might well be required, even though the former sound, at least, has no legitimate place in the language that also rejected P.

If then by some such reasoning as this we may suppose that the use of the Roman alphabet preceded the use of Ogham in this country, we need not feel surprise at finding an epitaph in Roman letters in an Irish cemetery. Nor need we feel surprise if there is only one; for I think there is some reason to believe that the reason why the missionaries introduced new methods of writing and orthography was exactly on account of the Pagan associations, among their Irish converts, of the Roman character and of documents written in that character. Pagan monuments in Roman letters might then well become the victims of iconoclastic zeal, and it may be that this stone is the only inscription in Roman letters in Ireland, simply because it is the only one that by some fortunate accident escaped notice.

But we have not yet answered the question why the inscription is inverted; or indeed why the engraver of the inscription having begun in Ogham did not finish in the same character. To answer these questions we must endeavour to reconstruct the most probable means whereby such an inscription was obtained when it happened to be required. I need hardly say that the arts of reading and writing were confined to a very small section of the community, and that in the majority of cases recourse would have to be made to one of these privileged and dignified persons when an inscription was to be drawn up. This would be still more necessary, inasmuch as not only were the mere letters generally unknown; but also what I may call the literary language had long parted company with the colloquial dialect, and was almost, if not quite, as distinct from it as Latin is from French. The druid (if only for convenience we may so call the functionary applied to) would naturally not take the trouble to write himself on the stone; the most he would do would be to give a model, cut on a rod of wood, to a stonecutter, and leave him to copy it on to the stone as well as he could. The stonecutter being himself in the majority of cases illiterate, it was inevitable that mistakes should occasionally be made. Such mistakes are not infrequent; scores are wrongly grouped; there is sometimes an excess, sometimes a loss of a score in a letter; and scores that ought to be on one side of the stem-line are sometimes cut on the other, the mistake being more than once carried through a whole inscription, to the confusion and bewilderment of decipherers.

Now I take it that the carver of the stone of Ovan was just such a blunderer—and, what is worse, a blunderer with original ideas. His literary attainments were precisely those of an Arab servant whom I once had, who knew but little English, and who used to complain that though he knew the English letters he could not understand how they came together to make words. Our stone-cutter knew the Roman letters in current use among the *literati*; he also knew their equivalents in Ogham. But given a line of writing, he could not see how they came together to make words. That was not his business; his duty was not to read inscriptions, but to copy them by rote from a model supplied. And, incidentally, we must remark in passing that his skill in *drawing* the Roman letters shows a practised hand. They are far better cut, on this stone, than they are on the majority of the Christian inscriptions in Wales, or than the Irish letters on many of the slabs at Clonmacnois. This was certainly not the only stone, by a very long way, on which our stone-cutter had made Roman letters in the course of his life.

Having got his model from the "druid," cut in Ogham on two rods, our workman copied the first of them exactly as we see it to-day, occupying parts of two angles and the top of the stone. He should then have gone round to the back of the stone, and copied the other rod on the remaining angles; but for one of many reasons that might be suggested, he took it into his head to write the rest of the inscription in Roman letters on the face of the stone. Possibly he thought that he would thereby save the reader the trouble of walking round the stone to decipher the whole inscription; possibly the other angles did not appear suitable for receiving the scores; possibly he wanted to show off his attainments in the Roman alphabet; possibly he was weary of the monotonous task of cutting scores and keeping count of their number and position. Any of these reasons are sufficient and satisfactory. Whatever may have been the determining cause, the fact remains that, in the theory I am endeavouring to develop, the stone-cutter transliterated the latter half of the inscription, but in doing so unfortunately held his rod upside-down.

It is perhaps less easy to understand how the blunder was allowed to pass when submitted to inspection. Perhaps the mysterious result appealed to the druidic love of mystery! This is not so far-fetched an idea as might appear at first sight. For I think we may fairly hold that there was something more than mere commemoration intended by the setting up of an inscription. It had a magical meaning of some kind as well. This is shown, among other things, by the pathetic attempts that we see to have been sometimes made to *imitate* Ogham letters by persons unfamiliar with the construction of the alphabet. At Hawkinstown, in Meath, for instance, on a stone to which Professor MacNeill called my attention, one edge is covered with scores which it is impossible to group into intelligible signs. Such "pseudo-Oghams" are fairly common over the whole country. And who knows but that this mistake may not have been the salvation of our stone, when all other writings in the heathenish Roman letters were destroyed? the would-be iconoclasts, not yet emancipated from their ancient superstitions, might have been restrained by fear from effacing the unknown "word of power" which they supposed it to bear, and which had been produced by this simple accident.

IV.

We have now indicated the lines on which answers to two of the questions set before us are to be sought. The inscription is in the Roman letters because the Roman letters were current, so far as any letters may be said to have been current, in the country at the time of its being carved; and though the inscription is now unique, that is only because all other inscriptions in the same character have perished. And the inscription is inverted because it was unintelligently copied by an illiterate scribe, who, though he knew his letters as separate pictures, so to speak, was unable to read them. He was like the scribe of the Newton stone in Aberdeenshire, who in copying by rote a model written for him—itself, probably, not over legible—succeeded in creating a sphinx that is likely to wait a very long time yet before it meets with its Oedipus. But we have still to consider why it is necessary to call in the aid of the Greek alphabet to help out our interpretation of an inscription which, however blundered in sense, is technically written with care and skill.

To answer this question fully is impossible, as the materials at our disposal are very imperfect. But we may say at the outset that the Celtic tribes, and indeed the inhabitants of Northern Europe generally, were at least as much open to the influence of Greek culture as of Roman, before the invasions of Caesar. The Greek colonies of Marseilles imparted a knowledge of the Greek alphabet to the Gauls in Southern France, and accordingly the Gaulish inscriptions of that region are in Greek letters, just as those of Gallia Cisalpina are in Etruscan. Caesar himself tells us of intercepted letters written by Gauls in Greek characters. The Macedonian coins, which (as everyone knows) are the patterns on which the Gaulish and British coinage was modelled, had their legends in Greek; and the occasional intrusion of a Greek letter into a writing otherwise in Roman characters need not cause us surprise. The letter G, which first appears at Rome in the epitaph of Scipio Barbatus, is common enough in the Gaulish inscriptions of the Continent written in Roman letters; but the Greek *gamma* might well have had, so to speak, the start of this comparatively late Roman invention, and have found its way, in advance of its rival, to a remote country like Ireland, whenever writing came there. It might, indeed, have been deliberately chosen, as it is obviously easier to cut than the curved G.

Be these conjectures as they may, the possibility of a mixture of Greek and Latin forms of the letters being current is much enhanced by the result of an analysis of the Runic alphabet. The letters of this alphabet are a valuable testimony, first, to the forms of writing which served as a model for the northern nations, and, secondly, to the nature of their writing materials. Most of the Runic letters are evidently Roman, modified by the simple process of eliminating all horizontal strokes. Thus the first letter, F, has its horizontal strokes made oblique, pointing upward. The reason is obvious. The Runic alphabet was primarily meant for cutting on wood, and it was necessary to avoid lines that would lie in the line of the grain of the wood.

Such wooden messages as are alluded to by Saxo Grammaticus (iii, 92) were the media for which the Runic alphabet was first invented.

According to the theory here put forward, the *gamma* at Killeen Cormac has been subjected to a precisely similar modification, and for the same reason.

This meets the objection so often urged against the suggestion that writing was in use in this country before the Christian missionaries—that all the words connected with writing, as the words for parchment, book, pen, &c., are loan-words from Latin. This proves no more than that vellum manuscripts were introduced with a knowledge of the Latin tongue: it does not preclude the use of wooden tablets, with or without a coating of wax, and similar primitive materials.

But all the letters of the Runic alphabet are not Roman. There is an admixture of Greek letters among them, so evident that some scholars have derived the Runic alphabet from Greek rather than from Roman, notwithstanding the clear traces of Roman origin afforded by, for instance, the form of the R. The letter G is represented by X, which certainly cannot be derived from the Roman G; it may either be an ornamentally modified *gamma* (derived from Γ through an intermediate form Λ), or a *chi* arbitrarily chosen on account of its simplicity. Probably the former is the more likely. The sign for NG ($\substack{X\\X}$) is certainly a modification of the doubled *gamma* that in Greek stands for that sound. And thus we see that among the Greek contributions to the Runic alphabet is the very letter in which the Irish form of the Roman alphabet seems to have a similar indebtedness.

On the ancient inscription at Inchagoill, Loch Corrib, the letter G is represented by a reversed Z, which may possibly be a reminiscence of the *gamma*.

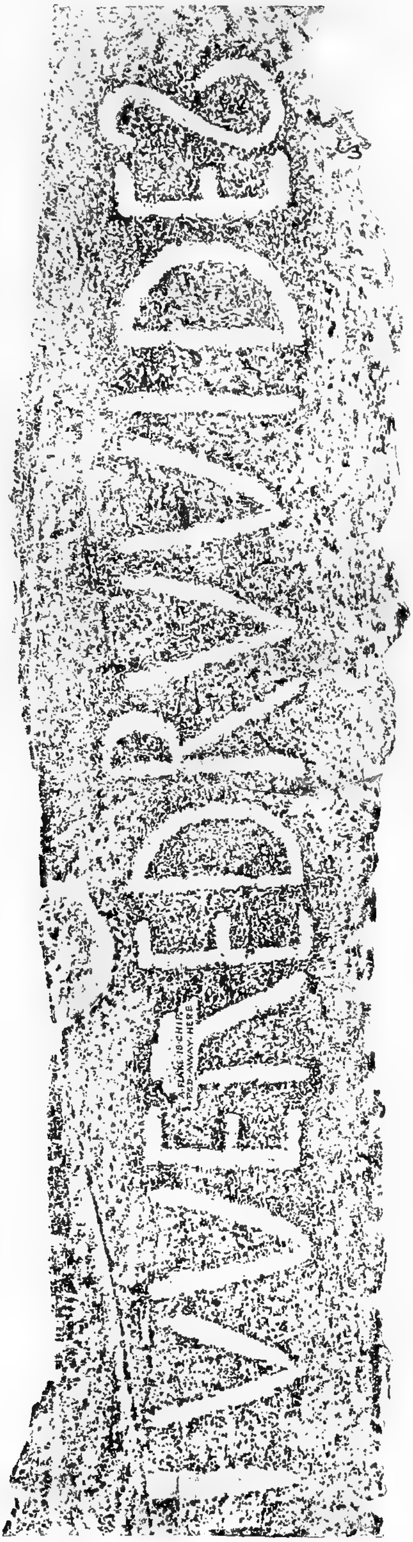
V.

Whether the suggestions that have been put forward in the foregoing paper command acceptance or not, I think all will agree that the stone which has suggested these remarks is one of singular interest and value. It lies neglected and subject to maltreatment of all kinds. Local idlers frequent the enclosure, and sit upon it playing cards, or walk over it with hob-nailed boots. I first saw it twenty years ago, and my impression is that it was certainly more legible then than it is now. Beside it lies another stone, bearing a strange figure carrying a cross—probably a representation of our Lord. This curious and unique figure has had the misfortune to attract the attention of a local "Old Mortality," who has recut and spoilt it. The removal of both these monuments, which are lying loose in the enclosure, and do not now mark any grave, to a place where they will be properly cared for and housed, protected from weather and from mischief-makers, is imperative, if the country is not ultimately to lose them altogether. I appea to the Academy to make representations to the responsible local officials, and to secure that these ancient monuments be deposited, if only on loan, in the Museum. One Ogham stone which formerly stood in the cemetery of Killeen Cormac has been smashed to supply materials for the wall that surrounds it. At any moment the valuable monuments that remain may meet the same fate.

NOTE ADDED IN PRESS.

P. 229, line 7 from end; after "I cannot trace . . . the loop of the R" add the following:—

It is true that the reduction of the facsimile brings into prominence a very faint curved line, not unlike the loop of the perfect R in the inscription. This, however, is scarcely visible in the full-size rubbing, and not at all in the stone. It resembles the oblique scratch above the last E, in being a mere flaw. The letters are boldly cut, and the stone is nowhere so badly worn that any part of the writing could have thus become almost evanescent.



Macalister.—The "Druuides" Inscription at Killeen Cormac, County Kildare.

XV.

INVESTIGATION OF THE CAIRNE GRANNIA CROMLECH NEAR MALLUSK, CO. ANTRIM.

BY H. C. LAWLOR.

Read NOVEMBER 30, 1914. Published JANUARY 29, 1915.

ABOUT 300 yards from the ancient mound or rath known as the Rough Fort in the Grange of Mallusk, lies a probably unique prehistoric monument known as the Cairne Grannia, locally called the Granny's Grave (Ordnance Survey Map No. 56). It consists of an ordinary cromlech, or so-called Druid's Altar, to which are attached in a straight row from south-west to north-east eight smaller cromlechs, measuring in all about 45 feet in length, the whole standing on an oval plot of ground raised about 9 inches above the level of the surrounding field. Tradition, referred to in Lewis' *Topographical Dictionary,* published about 1830, says that in former times the Cairne Grannia was surrounded by a stone circle about 60 feet in diameter, and that these stones were removed during agricultural improvements, and that in removing them several cinerary urns were found. But there seems to be no actual evidence confirming this tradition, although possibly quite correct. The late Bishop Reeves in his *Ecclesiastical Antiquities,* p. 66, describes the Cairne Grannia, or Carnegrany, the Cairne of the Sun, as "consisting of a series of ten chambers, or large slabs raised on side supporters like a series of cromlechs forming steps commencing at the north-east, and ascending gradually for a length of 40 feet towards the south-west. The largest stone is raised 7 or 8 feet. It is 6 feet 9 inches by 5 feet broad by 2 feet thick. The smallest, which is on the ground, is 5 feet long by 3 feet 3 inches broad."

FIG. 1.

Bishop Reeves wrote this nearly seventy years ago. At the present time the measurements and some details of description do not quite correspond with Dr. Reeves' description. The height of the chief or south-west cromlech is barely 6 feet above the surrounding ground. The length of the series is quite 45 feet. The top stones of the last two or north-east cromlechs are lying on the ground, but, counting these, the total number of chambers is nine, not ten as stated by Dr. Reeves. The ascent from the north-east to the south-west end of the series is very gradual, and cannot be accurately described as in steps. Bishop Reeves was undoubtedly one of the most accurate of writers, but one is inclined to believe that this description of the Cairne Grannia was second-hand.

Recently, with the assistance of the Rev. W. P. Carmody and Lieut. J. H. C. Lawlor, leave having been obtained from the landlord and tenant of the land, I made a careful examination of the cairne.

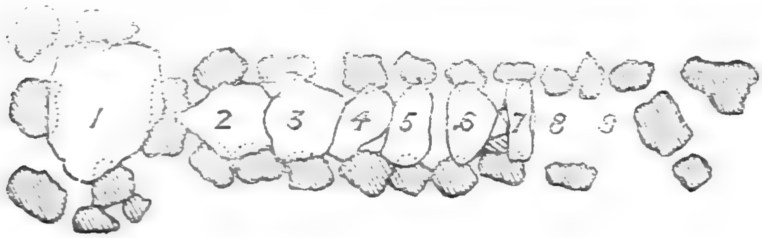


Fig. 2.

We commenced with the main cromlech, which I shall call No. 1. This can be entered by a narrow entrance on the south-east side. An excavation was made about 3 feet deep. From the soil extracted, showing fragments of modern bricks and glass, it became evident that this had already been excavated. No objects of antiquarian interest were discovered.

Chambers 2 to 7 are filled up to the level of the top stone with earth and stones. Nos. 2 and 3 presented no opening for excavating, but between the upright stones on the north-west side of numbers 3 and 4 is a space, through which a narrow trench was sunk leading into the centre of No. 4. On removing the soil and stones filling up the chamber, a layer of calcined human bone fragments and charcoal came to view at a level on a plane with the surrounding field. No remains of earthenware or flints were found. The layer of bones was rather thin, and spread over an area of about 2 feet in diameter. The bone fragments were very small: too small for any guess to be made as to the sex of the person. The enamel casing of an animal's (probably an ox's) tooth was found among the human bones. This was probably a case of cremation *in situ* without a cinerary urn, and with the addition of one or more non-human teeth. Having taken specimens of the bones, the soil was replaced as originally found.

Chambers Nos. 5, 6, and 7 were inaccessible from either side, so excavations were resumed at the north-east end. What is apparently the top stone of No. 8 chamber is lying prone on the site of No. 9, while that of No. 9 is lying several feet away.

The excavation of No. 9 soon produced interesting results. At about the same level as in the chambers first examined calcined bones and charcoal fragments became very numerous. They were not spread out so much as in the other chambers, but in a compact mass, indicating the probability that they had been deposited in the soil in an urn, which had through time and damp been absorbed into the ordinary soil, though examination showed no actual sign of pottery. This probability soon had confirmation, for just beside the place where the mass of bones lay a large urn was found. It was inverted and filled with calcined bones and a few small fragments of charcoal. The urn, being buried in soil, was extremely fragile, and the soil around it having been carefully removed, it fell to pieces. Every piece, however, was carefully packed in soft moss, and preserved for restoration if that should prove possible. The bones from the urn filled to overflowing a two-gallon bucket.

Nothing more was found in No. 9 chamber, and excavations were then proceeded with in No. 8, and by tunnelling into Nos. 7 and 6, so as to avoid disturbing the stones. In each of these chambers excavation displayed the same layer of calcined bone fragments and charcoal spread over a thin level on a plane with the surrounding field.

To sum up, chambers 1, 4, 6, 7, 8, and 9 were examined. Chambers 2, 3, and 5 were inaccessible without disturbing the stones, to do which, of course, would be vandalism. All the chambers entered, except Nos. 1 and 9, displayed examples of cremation and burial in the soil without urns. No. 1, having previously been investigated, showed nothing. No. 9 gave evidence of two interments, one or both being urn burials in the soil, without cist, after cremation. One urn, if it ever existed, had disappeared; the other was intact. The bone fragments in the mass without existing urn were replaced. Those in the urn were retained. The bone fragments were forwarded to Professor Arthur Keith, F.R.S., M.D., of the Royal College of Surgeons (England), an eminent anatomist and a keen archaeologist. He expresses the opinion that all the bones are those of one human being, probably a woman, of, at most, early middle age.

The urn has been perfectly restored by Mr. F. W. Cox, of India Street, Belfast—a feat which, considering its fragile and apparently hopelessly broken state, was little short of marvellous. It

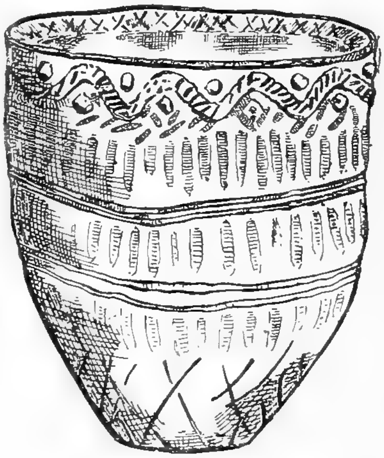


FIG. 3.

measures 13 inches in height, and no less than 40 inches in circumference, and is thus one of the largest cinerary urns preserved in Ireland. The decoration is elaborate, and although two examples of urns with a rope-and-dot scroll ornamentation on the outside of the rim are preserved in the R.I.A. collection, none appear in the large collection of urns in the Belfast Museum, nor in the British Museum. The art of rope-twisting must evidently have been known at the uncertain period when these urns were made. An interesting question therefore arises: Is there any evidence tending to show what textile material for rope-making was available? Flax was not a native plant; were the textile properties of nettles, now little known, familiar to the early Irish, and if not of what did they make their ropes?

So far as I can see we found nothing in our investigation from which it could be at all inferred that the urn is of the same period as the cromlech itself. I think the probability is that the urn interment is of much more recent date than the other interments in the cromlech.

The urn and its contents have been deposited in the Belfast City Museum, and will prove well worthy of inspection.

XVI.

FOUR BROOCHES PRESERVED IN THE LIBRARY OF TRINITY COLLEGE, DUBLIN.

By E. C. R. ARMSTRONG.

Read November 30, 1914. Published January 29, 1915.

Four interesting brooches are preserved with other antiquities in the Library of Trinity College, Dublin, and inquiries from England concerning these having reached the writer, he asked the Provost and Librarian for permission to publish them. This was at once granted. The writer is under special obligations to Mr. Alfred De Burgh, Assistant-Librarian, who took a most kindly interest in the writing of this paper, and gave every facility for examining and drawing the brooches.[1]

It is unfortunate that, except in one case, nothing appears to be known as to the date when the brooches were acquired by the Library, or the localities in which they were found.

The exception is the thistle brooch, which is described in *Collectanea de Rebus Hibernicis,* second edition, vol. i, p. 211, as " a silver instrument lately turned up by the plough in a field near the cathedral of Cashel in the county of Tipperary." An engraving of it is given on Plate I. It is also mentioned in the first edition of the same work, which bears the date 1770, so that the object must have been discovered before that year. Curiously enough, this brooch is the only one of the four mentioned in the *Book of Trinity College, Dublin,* where it is referred to as being in the same case as the celebrated harp of Brian Boroimhe. The only other of the four which appears to be known is the remarkable brooch which has a cresting round the hoop. There is a sketch of this, as restored by the artist's imagination, in the *Illustrated Catalogue of Ancient Irish Art,* issued by Messrs. Edmund Johnson, Ltd. The illustration will be found on page 19, No. 42, and is entitled the " University Brooch."

As will be seen later, two of the brooches belong to well known types, and

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[1] The penannular and annular brooch was a characteristic part of Irish costume for some four centuries previous to the Anglo-Norman Invasion; and the Brehon Laws refer to a brooch as portion of the insignia of a chief. (*Ancient Laws of Ireland,* vol. iv, p. 323. Translated by O'Donovan and O'Curry.)

can be dated with some degree of certainty. The remaining two present more difficulty, as their dating has to be based upon stylistic grounds, and the dates suggested for them must only be considered as tentative. It may be mentioned that Mr. Reginald A. Smith, of the British Museum, is publishing a comprehensive memoir on the dating of Scotch and Irish brooches; and it is much to be regretted that this was not printed in time to be of use in writing the present paper. The writer has, however, had some correspondence with, and received some suggestions from, Mr. Smith on the subject.

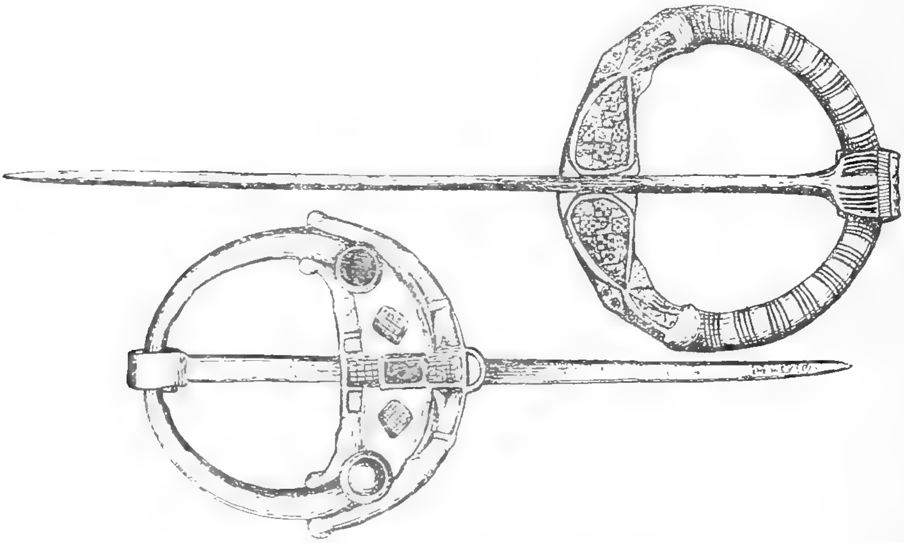

Fig. 1 (upper).—Brooch with La Tène survivals ($\frac{2}{3}$).
,, (lower).—Brooch with terminals fused together ($\frac{2}{3}$).

The description of the brooches may commence with that of the earliest in date, which is made of bronze, and is a good example of a well-known type of Celtic penannular brooches, which are earlier than the general use of the interlaced style, and show the influence of the pre-Christian (La Tène) period. In the present example the cusps on the hoop above the expanded ends, which are characteristically La Tène, are strongly marked. The ring itself is round in section, and ornamented with fine lines in groups of four. The terminals still retain traces of enamel below the cusps, and the enamel settings of the expanded portions are in exceptionally good preservation. These appear to have been composed of six small squares of variegated coloured glass (blue and yellow, and blue, white, and red, the white centre-pieces having a four-leaved design upon them), set in the form of a cross into a ground of red enamel. The small squares or cubes are made up of very thin rods of glass, fused together in the manner so common in Roman glass-

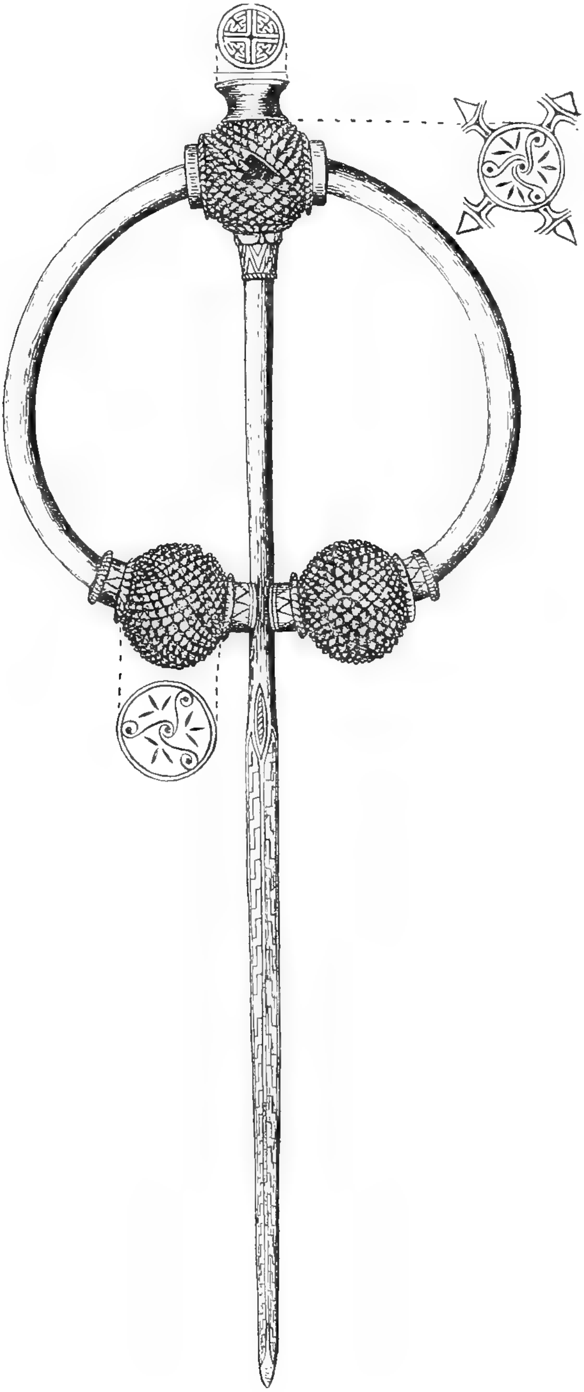

Fig. 2.—Thistle Brooch ($\frac{1}{2}$).

work. Examples of this process may be seen on other ornaments in the

Academy's collection—notably a brooch,[1] of exactly the same type as that under discussion, and a bronze pin[2] found at Clonmacnois. It has been pointed out by the author of a work on enamelling[3] that if such glass-work had been true enamelling it would have indicated a development of the art nowhere else to have been found in the seventh or eighth century; while, on the other hand, any bronze-worker would have been capable of making use of pieces of patterned glass, if not of fusing them together. The pin of the Trinity College brooch measures 7 inches in length, and the greatest diameter of the hoop is 2·7 inches. It may be provisionally dated at about 600 A.D. (fig. 1, (upper), p. 244).

The thistle brooch, which, as mentioned above, was found at Cashel, County Tipperary, belongs to a type that is also well known, and can be dated to the early part of the tenth century. Similar brooches have been found in hoards of silver objects discovered in Lancashire, Yorkshire, the Isle of Man, and Orkney, in association with coins dated from 910 A.D. to 975 A.D. The brooch is in admirable preservation; the pin measures 13·8 inches, and the greatest external diameter of the hoop is 5·4 inches. The round bosses on the pin-head and terminals are ornamented with numerous small spikes, and resemble a thistle, from which these brooches have acquired the name of "thistle brooches." The backs of the pin-head and terminals are ornamented with a triskele encircled by a ring, the spaces between the figure being filled in each case with three leaf-like forms; the flat top of the pin-head has a cross in a circle engraved upon it with the spaces between the arms filled with a kind of key-pattern. The shank of the pin is engraved on the front with a species of imperfect fret pattern, and has a slight ornament at the back. The neckings of the pin-head and terminals are decorated with a plain chevron ornament (fig. 2, p. 245). The Academy's collection contains four perfect specimens of these brooches, including the one found with the Ardagh Chalice, and three detached pin-heads. One of these latter found in County Kilkenny is very large, and if the rest of the brooch was in proportion, the hoop would have had a diameter of some 10 inches and the pin a length of 2 feet. A brooch of this type found at Cloneen, County Longford, is in the British Museum, and another found at Ballymoney, County Antrim, is in the collection of the Society of Antiquaries of London, while another is stated to have been found at Ballinrobe, County Mayo;[4] but the present habitat of this is unknown to the writer. Therefore, at least eleven thistle brooches, or portions of them, have been found in Ireland.

The most interesting and remarkable of the four brooches is the one

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[1] *Royal Irish Academy's Guide to the Celtic Christian Antiquities*, 1910, p. 22, fig. 28.

[2] *Early Christian Art in Ireland.* Stokes (revised by Count Plunkett), 1911, p. 68.

[3] *Enamelling.* Lewis Day, p. 27.

[4] *Proceedings Society of Antiquaries of London*, 2nd ser., vol. xxi, pp. 69, 71.

mentioned as having been illustrated in Messrs. Johnson's *Catalogue* (No. 42), and there called the "University Brooch." Owing to this being much sulphurised and discoloured, it was not quite apparent of what metal it was composed, so it was thought well to consult Dr. Sydney Young, F.R.S., who kindly analyzed the metal, and reported that the material was silver, free from lead, but containing a small amount of gold. It is probable that the presence of gold in the silver is due to natural rather than artificial causes.

FIG. 3.—Silver Brooch with crested hoop ($\frac{2}{3}$).

The pin is missing, and the hoop and terminals are broken into six separate pieces; the hoop measures 4·8 ins. in its greatest diameter. The most remarkable feature of the brooch is the cresting which encircles the hoop, no other example of this being known to the writer. It recalls the cresting which surrounds the heads of many of the Celtic crosiers in the Academy's collection. The expanded terminals are composed of a central panel, following their outline, surrounded by pierced interlaced zoomorphic patterns. These panels are ornamented with filigree work, and from them rises a boss, also decorated with spiral and other patterns in filigree. As will be seen in the illustration, only the boss in the right terminal remains. It will be noticed that there is a head and beak on each side of the edge below the junction of the hoop and terminal, and a head and beak can also be distinguished between these pairs. The animal forms at the straight edge of the terminals are clear; in the other parts they have the appearance of ordinary interlacements. All the limbs are divided by a centre line into a double band, characteristic of Irish ornament. The small animal heads at the lower angles of the terminals may be remarked (fig. 3).

A comparison may be instituted between this brooch and one of silver in the Academy's collection, the terminals of which show a similar arrangement of a plate and boss surrounded by pierced zoomorphic ornament, which is, however, so degraded in character as to be hardly recognizable as such.[1] There are two other silver brooches in the same collection in which the central boss is retained, but the open-work terminal has been replaced by a closed plate ornamented with dots.

The brooch must also be compared with a series of silver brooches, of which there are six in the Academy's collection, the best-known being the celebrated example found at Ballyspellan, inscribed on the back in ogham characters. In the usual form of this type the expanded terminals are decorated with four bosses, with an edging of filigree work, joined together by strap-work, the intervening panels being filled with zoomorphic patterns. Fragments of such brooches have been found in the great hoard of silver objects discovered at Cuerdale, Lancashire, dated by associated coins to the early tenth century.[2] The Trinity College example differs in several particulars from these brooches, but comparison will show that the types are related. It is probably a little earlier than these, and may be provisionally placed in the first half of the ninth century.

The fourth brooch is made of bronze, and the terminals are fused together so that it is of the nature of a ring-headed pin, and belongs to the type of which the Tara brooch is the best-known example. The pin measures 5·6 inches and the ring 2·6 inches in diameter at the widest part. The expanded portion is divided in the centre by an oblong setting, now empty, with an oblong space filled with cross-hatched lines at each end. On either side of this is a panel, with a diamond-shaped space in the centre filled with cross-hatched lines, and having at its end a circular setting, one of which still retains its filling of amber. An edging of degraded zoomorphic work borders the plate on each side up to its junction with the ring (fig. 1, (lower), p. 244). At the back in the centre of the plate is attached a small loop, which is a common feature in this type of brooch. In the writer's opinion the end of the ninth century may be suggested as a probable date for this example.

It may be added that the so-called "University Brooch" has undergone an expert process of cleaning at the hands of Dr. Young with most excellent results, and that all the four brooches have been arranged in a small desk-case, where they can be well seen by any visitor to the Library.

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[1] This brooch is figured by Salin, *Die Altgermanische Thierornamentik,* p. 334, fig. 715, who remarks that certain portions of the animal forms in its ornamentation must be ascribed to his Stile II (i.e., seventh century).

[2] *Archaeological Journal,* vol. iv, pp. 111–130 and pp. 189-199.

XVII.

FORTIFIED HEADLANDS AND CASTLES IN WESTERN COUNTY CORK.

By THOMAS JOHNSON WESTROPP, M.A.

Part I.—From Cape Clear to Dunmanus Bay.

Plates XXIII–XXIV.

[Read January 25. Published May 20, 1915.]

Having laid before the Royal Irish Academy[1] a survey of the fortified headlands from Skerkin Island to the estuary of the Barrow and Suir, I venture to continue the notes by extending them along the west coast of Cork, up to the Kenmare River. When this section is done, I hope to complete the subject by a survey giving brief notes and bibliography for each of the similar remains in the three southern provinces of Ireland. It was a slow and difficult task to carry out, but I may claim it to be a necessary work for the completion of the study of the Irish forts, and may hope from the welcome accorded to its different sections that it has proved acceptable not only to British, but to French, and even American, antiquaries. I have, as before, to thank Dr. George Fogerty, R.N., for much kind help.[2]

The types under which Irish promontory forts are best classified we must repeat for reference here—(*a*) simple fort with a wall, or mound, and fosse, like Oughtminnee, Dunlough, Dunleen, Dunkelly, and Doonah; (*b*) complex, with several earthworks and fosses, like Knockeen; (*d*) multiple fort; (*e*) platform with natural gangway, Lemcon; (*f*) headland with deep natural hollow; (*g*) shore rock, probably Doonlea. Since publishing my paper

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[1] Proc. R.I.A., vol. xxxii, p. 89. As the survey stands at present it is—Co. Mayo, Proc. R.I. Acad., xxix, p. 11; xxx (Part 2), pp. 19, 63, 73; R. Soc. Antt. Ir., vol. xlii, pp. 51, 101, 185; xliv, p. 67. Achill, the southern islands of Co. Mayo, and the Galway Islands, xliv, p. 297. Aran, Proc. R.I. Acad., vol. xxviii, p. 178. Co. Clare, R. Soc. Antt. Ir. (North part), xli, p. 135; (Irrus), xxxviii, pp. 28, 221. Kerry (Iraghticonnor), xl, p. 6; (Clanmaurice), p. 99; (Corcaguiny), pp. 179, 265; (Iveragh), xlii, p. 293. Co. Cork, Proc. R.I. Acad., xxxii, p 89. Co. Waterford, R. Soc. Antt. Ir. xxvi, p. 239. Proc. R.I. Acad., xxxii, p. 188.

[2] I heard of his unexpected death while revising these pages. The loss of so sympathetic and unselfish a helper is a heavy one to me and many other workers.

on the fortified headlands of South Co. Cork, Mr. Robert Lloyd Praeger very kindly gives me notes on a most singular case of the walled island. The more eastern of the west group of the Sovereign Rocks, nearly a mile off shore, before Kinsale Harbour, was fortified by a strong wall of large, well-laid blocks, clinging to the present edge of the summit. What could have led anyone to fortify, or even use, as a refuge, a rock without drinking-water, and so far from the shore is, perhaps, one of the most inexplicable mysteries among the many problems, increasing as the subject of shore-forts gets better studied. Like the minute defences of small spurs, and even rock-shelves (such as occur in Co. Waterford, and at Oughtminnee), it must imply a harrowing fear besetting the early fort-builders, and originating inland. Evidently, too, the fear must have prevailed in summer, for the Sovereign Rocks and other shore-forts must have been almost uninhabitable save in the more genial months of the year.

The work falls into four groups—the forts on Cape Clear Island, on the Ivagha peninsula, on the Muintervary peninsula, and those of the Barony of Beare. The first section is concerned with the first two groups. We are still on the O Driscolls' territory, but, unlike the islands in Corca Laidhe, they were deprived of the district of Ui Eacach, or Ivagha, many centuries ago; Clear Island, however, was theirs down to the seventeenth century, and the name is not extinct therein to our day.

CAPE CLEAR ISLAND (Ordnance Survey Map No. 153).

The most southern of the inhabited portions of Ireland, Cape Clear, is not only possessed of noble cliff scenery and interesting ruins, but of a further interest as a very early centre of Christianity. Despite the vagueness of records, it is sufficiently clear that a probable claim on behalf of Clear and Ardmore existed in early times, and maintained its cause against the dead weight of prejudice that asserted St. Patrick to be the first successful evangelist, and almost the sole source of Irish Christianity. Two names stand out before the mission of the son of Calphurn—Declan, of Ardmore, and Ciaran, of Clere and Saighir. Declan is said to have been born of Christian parents, and baptized by a local priest, Colman, about A.D. 347, yet no earlier date than A.D. 416 is claimed for Ardmore. All the chronology is doubtful, and the clearest fact is that Ardmore claimed a rule earlier than, and coequal with, that of Cashel and the Patrician churches. About A.D. 350 Ciaran was born, also of Christian parents, on Clear Island,[1] being of the Corca Laidhe;

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[1] Contradictory accounts of his parentage are given, but his mother, at least, was of the Corca Laidhe. See *Miscellany of the Celtic Society* (1849), xxi, p. 384.

his life is of course late, and throws little light on the topography of the Island. One tale of his boyhood[1] is characteristic of that lovely tenderness for animals that so often appears in the *Lives of the Saints*,[2] like the stag and blackbird of Kevin, the deer and bull of Mochulla, and the old horse of Columba. Ciaran as a very young boy on *Cleire* found a bird sitting on her young. As he stood looking admiringly at the pretty sight, a kite swooped and carried the mother away in its claws. The boy wept, and lo, the kite dropped its prey. "Arise! and be made whole," cried Ciaran, on a sudden impulse, and the bird returned to its nest. The Irish saints did not need the bitter lesson of the Ancient Mariner; and to one who has startled a hawk, and made it drop a young pheasant uninjured, the story seems very credible. Ciaran is, however, more closely connected in history with the great monastic centre of Ṡaighir Ciarain, in King's Co.[3] At *Cleire*, however, his memory is green; the little, far later, church at the north harbour, the strand Traghciarain, near it, and the rounded pillar scribed with two plain Latin crosses, bear his name; the latter may well date from his day. The island continued in possession of his kindred, the O hEidersceoil, or O Driscolls. I have given some details of their history in connexion with their castle of Dunalong on the neighbouring island of Sherkin and elsewhere in the first section of this survey,[4] so need not repeat it; the poem of O Huidhrin, before 1418, tells how "O hEidersceoil assumed possession of the Harbour of Cler." It was of some importance to the foreign traders in wine and spices, and so figures in all the early portolan maps. Angelino Dulcert, in 1339, calls it *Cap de Clar*; the subsequent portolans, *Cauo de Clara,* 1375 and 1426; *Clarros,* 1436; *C. d'Clara* or *Claro,* 1450 and 1552, and, to give no more, *Cauo de Chlaram,* in 1490.[5] The O Driscolls' Castle probably dates between 1450 and the last date. It was probably on an earlier headland fort, as it is called Dunanore. In 1602 it surrendered without resistance to the English, who burned it.[6] Six years later the place is described as "Cap Clyre, upon the mayne sea, one of the mearings of O Driscolls' country." It had twelve ploughlands and dues upon trading ships from the Stagges of Castlehaven westward. Fynan O Driscoll, *alias* Caragh, late of Dunalong (Sherkin), held the castle, vill, and three carucates of land, with a half carucate

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[1] Corca Laidhe (*Miscellany Celtic Society*, 1849), pp. 384 sqq. and p. 21.

[2] See his Life in Colgan, "Acta Sanctorum Hiberniae" (1614), March 5, sect. 3.

[3] "Dublin Penny Journal," vol. iii, p. 113, gives a rough sketch and brief description of the place.

[4] Proc. R.I. Acad., vol. xxxii, pp. 92, 109.

[5] Kretschmer, *Die Italienischen Portolane Mittelalters* (1909), pp. 427, 568.

[6] Cal. State Papers of Ireland, 1601-3, p. 237.

at Glanirogy, all on the Island of Cape Clear.[1] He died April 10th, 1600, having, by a deed of November 25th, 1594, enfeoffed David Hurley with the said castle, in trust, for More ny Rannell, the grantor's wife. Their son Conoghor succeeded, and died September 20th, 1606, leaving a son Donagh O'Dryscoll, of full age, holding from the king by military service.[2] In 1655 the survey of "The Parish and Island of Cape Cleare" gives Teige O Driscoll, *alias* Carragh, as holding Dununore, 114A.; Donogh O Driscoll, *alias* Carragh, Glonnoe; Donogh Carragh O Driscoll, 3 gneeves; m^{c}Connor mac Donnogh Driscoll 6 gneeves & m^{c}Gilladuffe 3 gneeves; Gortnavohanane; Dermod m^{c}Knogher 6 gneeves & Donagh m^{c}Dermod 6 gn. Keenline and Killvickadary 42 ac. 1.10; ffynne oge m^{c}Connor Driscoll, Knockanakehig 26A; ffynne m^{c}Connor Driscoll, Lisomonin, 10 gn. 38 ac. (To Sir Algernon May and his wife); m^{c}Connor m^{c}Donogh Driscoll, Killuicka fon-roane 40A 1. 0, Lohasty Donnell 6; Erevan oge Driscoll, Gortagolane 4. 2. 0; Hugh m^{c}Erevan Driscoll, 8 gn.; ffinne oge na Parke Driscoll 2 gn.; Ardgort and Parke; Knoghr m^{c}ffynne Driscoll, Carhoone 6 gn. 38; Knogher m^{c}Erevan, Killmorowne, 5½ gn. 24. 1. 0; Knogher oge m^{c}Gulliduffe, Camullane 5½ gn.; Knogher O Driscoll als. Crone, Trahauke 1 pl. ld., 6 gn. 138A; Glebe land of Cape-leere 2 gn. 10A; Knogher oge m^{c}Erevan Driscoll, Reheloge 1 gn. 3A. (To Sir Algernon May and his wife.)[3] The contemporary map marks Cape Clere, the Castle, and Trahaud, but puts "Dununore" at the wrong end of the island. Dr. O'Donovan, in his "Sketches of Carbery," gives a few notes on the later history. He says there was a garrison at the Castle in Queen Anne's time, and mentions the huge iron ring-bolt, set in the rock, to which the O Driscolls formerly moored their galleys in the creek. The last is improbable, even to impossibility: no one could moor galleys in the dangerous wave-trap, open to the most stormy and unsheltered points. The islanders regard the ruin as haunted, and tell of the singing of ships' crews in its vaults. One "Croohoor" (Conor) O'Careavaun (Heremon's grandson) lived as a hermit there in the eighteenth century. Another legend tells how, in 1798, the inhabitants painted the Farbreag Rocks and pillars so as to

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[1] Inq. Chancery, 1608.

[2] Inq. Chancery, Car. I, No. 185, 1630.

[3] Book of Distribution and Survey, Co. Cork, p. 238. Many of the present names are absent; Dunanore is obvious. Gortagolane was evidently at one of the gallans, perhaps at Gortalassa; Killmorowne is Kilvroon in Comillane (Camullane, 1655); Keenline is Keenleen; Knockaneakehige is Knockauncohig; Lisomonin, is Lissamona; Kilurickafonroane is Killickaforavane; and Carhoone is Carhoona. Trahauke appears as Trahaud in the Down Survey map.

resemble soldiers in uniform to keep away the French! If any truth underlies this, it is probably based on the idle act of some revenue or other officers, in the endless leisure of their island station.

DOONTHOMAIS. Crossing, past the west side of the south harbour, on by the old road between two little lakes, we ascend to the cliffs. Soon the tall, white tower on the distant Fastnet Rock rises over the moor and guides us to the headland south from the Bill of Cape Clear called Dunthomais. I have rarely seen so appalling a wall of such wrecked and loose-looking rock, with such dangerous, crumbling edges, apparently ready to fall at a touch. Much of the southern side has been cut away, being most exposed to the great waves from the outer sea. There are two grassy hollows across the narrow promontory. The landward one was the old fosse of the *Dún*, but has been filled, evidently very recently, by a mass of fallen rocks from the bolder cliff to landward. Beyond the fosse, which was evidently mainly natural, the last traces of a wall of thin slabs, rarely four or five courses of masonry remaining, can be seen along the further edge of the ditch at the southern end. From this the ground rises to a knoll, on which are the remains of a circular hut. The masonry is of slabs, regular and well curved and fitted; the lower part of the piers of the doorway which faced the land eastward are still extant. Part of the north-east wall, 3 feet to 4 feet high, still stands: the rest of the circular foundation is covered with great bosses of seapink; it is from 20 feet to 25 feet across. The headland was probably a knife-edged rock, and unoccupied beyond the second hollow, even in early days.

DUNANORE. The fort bears the same name as that ill-omened and blood-stained spot at Smerwick, where the slaughter of the Spaniards took place, in November, 1580; but what legend of gold attached to the O Driscolls' fortress we do not know.[1] At so exposed a place it is hard to fancy that the headland fort can be of any vast antiquity, though the hut in Dunthomais seems as primitive as those on Bishop's Island, Co. Clare, or Cashlaunicrobin. As I have pointed out, the wasting of cliffs is not steady, but by sudden rock falls, while an outer reef may have protected the headland for many centuries. I was not able to get on to the platform, but I heard that it was inaccessible. Mr. James Burke says that the causeway is broken, and that the castle cannot be reached at high water.[2] The path runs up a very slight ledge,

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[1] In this case the tradition must have preceded the Spanish wars of 1601. For the Smerwick fort and a discussion on its history, see Journal Roy. Soc. Antt. Ir., vol. xl, pp. 193–203. Windele (Topog. 12. J. 9, p. 1027) gives a curious legend of the Amadán mór.

[2] See Mr. James Burke's very interesting paper on the island in Cork H. and A. Journal, vol. xiv, pp. 119–120. The sea broke this path (*Cassaun*) in winter, 1831 (Windele).

flaking away and high above the creek, along the face of a cliff of polished silvery slate. The low neck joined it to the mainland, and the nearly perpendicular strata make the dock-like creek of Coosadoona, fort-cove, to the south· Beside this cove, opposite to the castle, an enormous precipice rises high above the tower top. In the other direction is a noble view across the wide, porpoise-haunted bay, and its low islands to the blue, many-channelled Mount Gabriel, and on to Mizen Head.

The castle has two rectangular courts; the outer to the east is smaller and lower than the other; it is surrounded by a strong wall along the three cliffs, demolished down to the field to the south and east, and is heaped with the *débris* and huge masses of the south-west angle of the tower. Some nearly levelled out-building adjoins the keep. The girding-wall of the upper court is better preserved to all sides save the west; there is a defaced building at the north-west corner, and the foundation of another, near the tower; in the centre of the garth is a small pit or well.

The peel tower closely resembles Dunlough, Dunmanus, and Lemcon, which we shall examine, and, like the last two, is probably of the fourteenth century, so prolific of residential and ecclesiastical buildings in Munster and Connacht. The south and half the east wall of the upper story are gone, and the staircase now rises westward up the south side, "bare to the sun." Doors to the south and east lead into the vaulted under-room, which has three stories. No windows appear in the lower story; but the next floor and the attic have lights to the east. The steps run up the east wall to the level of the attic, and then the fourth leads to a lintelled door into an apparent cross-passage at the vault and below the floor of the top room. There is a recess to the east, perhaps a garderobe. The main vault is broken behind this. A precipitous flight of five more steps leads up to the top room at the west wall. Five more ascend to the south-west angle at the small west window-slit; here the flight turned and ran more steeply up to the battlements.

The top room had windows to the east, and probably to the south; half of the former remains; the one to the west has a plain oblong light with flag lintels; the northern is in a deep recess with a very slightly pointed arch, the widening being intended to support a gable and leave space round the battlements. The side walls to the east and west have also a corbelling to widen the water-tables. No doubt the southern side had also another deep recess with the staircase up its west pier, and the thrust of its arch may have "kicked out" the south-east angle. The battlements are sufficiently well preserved to the north angles to show that they were neatly stepped.[1]

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[1] View Plate XXIII, No. 2.

PORT. On the north shore, near the end of the high cliffs, eastward from the North Harbour, lies the third of the promontory forts; though defaced, it is well known to the old people living near it as "Port." It is marked, but nameless both on the old and the new Ordnance Survey maps, near Stuckaunminaun, a rugged, knife-edged "stook" of uptilted slate. Minaun, apparently "kid," probably (as in Co. Mayo, in Achill and on Croaghpatrick), is intended for the little *ben* or head.[1] At some distance to the east the low coast is broken by a strand called Tradooncleara, which perhaps preserves (as creeks near forts often do) the original of the fort name, "the *dun* of Clear."

The "Port" is a level grassy platform, nearly cut off by a narrow creek from the main cliff, being joined to the field by a narrow neck. It commands a beautiful view of the stacks and cliffs westward past the north harbour to the dark tower of Dunanore. The neck is 30 feet across; a straight fosse, 6 feet wide below and only a few feet deep, runs along it, being much filled by the defacement of the inner mound. The latter is still 4 feet high and 15 feet thick; long trenches have been dug along it, probably by treasure-seekers. It was stone-faced and capped by a dry-stone wall; many set-blocks remain in the foundation. The garth is fenced all round by a late stone-capped mound, and in its enclosure, 15 feet behind the rampart, is a rectangular hollow, 3 feet to 4 feet deep, 15 feet north and south by 12 feet east and west. It seems of considerable age; the bottom is level; it was probably a house site. A large block of stone, 6 feet × 3 feet × 2 feet thick, lies close beside it to the east. An old road runs along the face of the hill, not far from the "Port," leading out on that amazing road that drops down the steep flanks of Knockauncoohig Hill to the North Harbour. The hill bears the name of the O Cohig family,[2] the ancient owners (as we saw in the first part of this survey),[3] from near Rosscarbery on to Timoleague.

The other antiquities of Clear Island may be brought together, though outside the general scope of this paper. There are several *gallâns*, or rough pillar-stones, none of exceptional height or character; one, named "Gallaun-

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[1] So Temple Benen is changed to Temple Minnaun in Aran. Minnaunmore, between Smerwick and Dunmore, in Kerry, and the Minaun Cliffs, in Achill, may be also corruptions of this word.

[2] The O'Cowhig family was traditionally Brigantian (see *Corca Laidhe*, p. 58). "O'Cowhig of the festive golden horn, O'Flynn-Arda, O'Driscoll . . . were clans not of the blood of Milesius." Ptolemy places the Brigantes further to the East, but the frequent appearance of the mythic Breogan in the tribal pedigrees of Southern Ireland tallies fairly well with his statement.

[3] Proc. R.I. Acad., vol. xxxii, p. 92, p. 108; *correct* on p. 92, line 12, the date 250; it is "*circa* B.C. 150."

nam-bawnoge," is in Glen West, on the hill to the east of the south harbour another is in Croha West; three more in Comillane; the western had fallen before 1840; another stands to the north-west of the Croha stone; and another, but little over 4 feet high, in a fence near Dunthomais.

Of church remains, the chief is the late fifteenth-century church of Templekieran, with its well Tobarkieran, near Trakieran strand.[1] The ruin is probably on the site of a far older church, dedicated to St. Ciaran; it measures 40 feet by 14 feet 6 inches inside; the walls are about 8 feet high. The east window, a mere slit, has a curious head, with two small pointed opes, leaving a cusp between, cut in a single block. Similar, but larger, windows are found at Kilbreedy, near Kilmallock, and elsewhere, but are rare in Ireland. The splays of it and the south window are plain, oblong, and lintelled. The south door is roughly made of small slabs, and is pointed; the only other features are two ambries, which I remember on my former visit as filled with skulls. There is a long buttress running southward from the south-east angle.[2] I have already noted the cross-scribed rounded pillar-stone at the strand.

Near the middle of the island is Killickaforavane children's burial-ground, while another *killeen* is named Kilmoon, and lies near the Comillane pillar; no trace of the buildings remains at either graveyard. Tobar Kilvroon has a holed stone called Cloch-na-geallamh.[3]

IVAGHA PENINSULA (O. S. 138, 146-148).

The first of the great peninsulas of Western Cork lies between Dunmanus Bay and Roaring Water Bay, in the barony of West Carbery, running 16 miles to 18 miles out into the sea. Having been held within recorded history by the Ui Ecach, or the descendants of Eochaidh, called the "Ivagha" in Tudor times, I use the term "Ivagha Peninsula." The form is better than "Iveagh," as the latter is the familiar spelling of a tribe in Ulster. It is used in the well-known map of Speed, about 1610, as "Erajh" (recte Evagh), the "peninsula" distinguishing it from the other tribelands, which extend even to Cork and to near Fermoy. "Tertium promontorium est Ivaugh, inter Bantre et Baltimor." The best-known fisheries on the south coast were at Evagh. The Spaniards and Portuguese frequented them for the cod fishery.[4] Near

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[1] It is covered by high tides, being a mere hollow in the strand.

[2] See R. Soc. Antt. Ir. Handbook, vi, p. 147, and Dr. R. Cochrane's account in Cork H. and A. Journal, xviii, p. 2.

[3] Through which lovers plighted troth, as at the stone of Stennis, in the Orkneys, and elsewhere.

[4] Lansdowne MS., Brit. Mus., 242.

the landward end is the great rugged mass of Mount Gabriel, 1339 feet high, so concealed by lower spurs and ridges as to be less impressive than when seen across the bay, or from the hills behind Skibbereen. Beyond it, only one mountain, Knockaunawaddery, or Knocknamaddree, exceeds 1000 feet in height. The lesser hills, rising 500 feet to 700 feet above the sea, are, however, sufficiently bold and striking. Schull, the terminus of the light railway, on a sheltered harbour, at the south foot of Gabriel, is the best centre for the exploration of the peninsula. Crookhaven, once a more important station, is now greatly decayed. Goleen is the only other village of any note.

The four fortifications along Dunmanus Bay are typical of their class; three are of the first and simplest type; the other has two lines of defence, and is perhaps rather a crescent fort than a promontory one, though once of the latter class.[1] Dunlough was a very unusual example owing to the complexity of the natural defences of the site and the modifications introduced at two later periods by the introduction of a mortar-built tower, and later of a new line of rampart, with turrets. The three "Castles" give its present name to Dunlough Head. Along the other faces of the peninsula we only find a minute fort on a narrow headland; two islets, possibly used for refuge; a low shore rock, with only the name Doonlea to mark it as a fort-site; and, lastly, the interesting fortified headland of Lemcon.

HISTORY.

According to my custom, I will give the general history of the promontory. As we have noted, Ivagha, though not now in common use, is the definite Elizabethan equivalent of the tribal name Ui Eacach (Ibh Eachach), and as such exactly meets our needs in topography. Originally part of the territory of the widespread Corca Laidhe, it was overrun by the Ui Eacach from Kinelmeaky, who transferred their name to the place under its oblique form, as Iveragh in Kerry; in Co. Limerick, O'Ross also became Iveruss.

In remote legendary descent the Ui Eacach, or Eathach, Mumhain derived from Eocho, or Eochaidh, son of Cass, son of Corc mac Luighdech, King of Munster, fifth in descent from Ailill Olom, the great mythical King, ancestor (reputedly) of all the reigning houses of Munster. There can, however, be but little question that the Munster chief pedigree had, perhaps till the eleventh century, the elasticity of the "Roll of Battle Abbey" for

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[1] English antiquaries put both under the same class, but in Ireland the difference is sufficiently marked to justify separate classification.

enrolling tribes (whom fortune had brought to the front after the tribal pedigrees had crystallized), and so connected the groups to one tribal ancestor.[1]

So laboriously has their history been collected and compiled by the Rev. Canon O'Mahony that I feel I am freed from the necessity of following their fortunes in any great detail.[2] A sketch, however, is necessary. The tribe produced a notable churchman, St. Finnbarr (son of the chief metal-worker of Tighernach, the chief of Rathleann), in about A.D. 570,[3] whose foundation of the see of Cork is proclaimed by the three tall white spires rising out of the valley in which Cork city lies. Tighernach (his descent runs through Aedh, Criomthann, and Eocho to Cass) was father of Fedlimid, who was chief till 585. Pichan, King of Ui Echah in the Rabelaisian vision of MacConglinne,[4] is possibly Bacc, grandson of the last; a contemporary of Cathal, son of Finguine, King of Munster A.D. 737. It must always be remembered that no critical list of the Munster Kings has ever been prepared, and the Dalcassian attempts to assert the mythical "alternate" succession with the Eoghanachts have affected our early sources, so that many records are biassed by suppression, or perhaps refusal to recognize various chiefs as provincial Kings. Therefore, if I fall in with my material, and call any chief "King of Munster," it is only an allegation that some keeper of those records (and presumably some tribes) regarded him as being such. Works like the "Wars of the Gaedhil," partizan pamphlets, and panegyrics, are as little to be received as decisive as the statements in the *Lives* of certain saints, making the holy man's father a king, or even a provincial king, instead of an obscure chief, or even landowner.

Donall, son of Cathal, was King of the Ui Eacach, fought the Norse, and

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[1] The claims of the Dalgcais to equal succession and position with the Eoghanachts, and the slow and unwilling acceptance of these fictions by their rivals, deserve special study.

[2] See Cork Historical and Archæological Journal, vol. xii, p. 182. I am greatly indebted to the work of Canon John O'Mahony, of Crookstown, though I had myself amassed the Records of the Dublin offices when commencing special work for my survey of the coasts of the three southern provinces in 1906. Rarely has such a mass of materials been brought together so available for workers on tribal history as in his papers. *Ibid.*, vols. xii–xv.

[3] Life of St. Barr (Bodleian MSS., Rawlinson, No. 485, of the fifteenth century). Barr, son of Amargenus, Smith to the Prince of Raithluyn, Tyagnacus, descended from Cass, son of Exhach [*sic*].

[4] "Aislinge Meic Conglinne. The Vision of Mac Conglinne" (ed. Kuno Meyer), 1892, from the Leabhar Breac. For Pichan, son of Maelfind, King of Iveagh, see p. 42, sqq. In so fanciful a tale it is possible that the name is a pure invention, and not intended for Bacc.

died A.D. 827;[1] Maelmora, Lord of Raithlin, took part in the fatal battle of Bealach Mughna, when the saintly King-Bishop of Cashel, the lexicographer, Cormac mac Cuilleanan, fell. Cian, son of Spellan, succeeded his brother Maelmora in A.D. 907.[2] His son was Bron, probably commemorated in the Rosbrins, whose son, Maelmuadh (born about A.D. 930), has a niche in Irish history (perhaps more sinister than he deserves), as slayer of Mathgamhain, brother of Brian, the King of Munster.[3] It must always be remembered that there is every reason to believe that the assumption of that position was as gross a violation of the claims of the Eoghanachts as that of the High Kingship by his brother Brian was of the ancient line of Tara—" Old Tara is dragged to Kincora," as Maelsechlainn's bard protested. Out of such bitter resentment, what but bloodshed was then to be expected? " Are we so much better than they" 900 years after? Mathgamhain had taken Maelmuadh's hostages, possibly those he held as claiming to be King of South Munster, if not of Munster, for, in " the Kings of the race of Eber," O Dugan makes Maelmuadh succeed, not Mathgamhain, in A.D. 976, but a non-Dalcassian predecessor, Fergraidh, in A.D. 959. " Maelmuadh of the piercing blue eye, son of Bron of endless prosperity," as even the *Wars of the Gaedhil* call him, died A.D. 978; contradictory accounts remain, the Dalcassians alleging the vengeance of Heaven for his broken pledge to Mathgamhain. His son, " Cian of the golden cups," succeeded as chief of Ui Ecach.[4]

Mathgamhain's brother, Brian, a man of wise and noble character, did all in his power to conciliate Cian, giving him his daughter Sadbh (by his first wife Mor, a lady of the Ui Fiachrach Aidhne) and many gifts and favours. MacLiac, Brian's bard, honoured the chief, leaving an interesting poem on his chief fort Raithlenn,[5] including him (if he be the " Cian ") in the dirge, " Where, O Kincora," and in another poem calling him " Cian of the Carn " (i.e. Carn Ui Neid), or Mizen Head, which is very pertinent to our studies as showing that he owned the Ivagha Peninsula in 1014. He also appears in another elegy on Brian, by Giolla Caomh, as " high chief of the hosts from Carn Ui Neid, and another by MacCoise, bard of the Ardrigh, Maelsechlainn

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[1] Ann. Inisfallen (Bodleian), Ann. Four Masters.

[2] Chronicon Scotorum, A.D. 907.

[3] Wars of the Gaedhil with the Gaill (ed. Todd), pp. 87–105.

[4] I use the Annals of Ulster, Inisfallen, "Munster" (the early ones often confused with Inisfallen), Loch Cé, Chronicon Scotorum, and the Four Masters, besides the Wars of the Gaedhil with the Gaill.

[5] This and the other poems have been studied in the *Gaelic Journal*, 1906—"Four poems of the eleventh century," by Canon Lyons.

He, like his predecessors, dwelt at the three ringed Rathleann,[1] a very early earthwork, in whose inner rampart sepulchral urns were found. It lies at Garranes in Kinelmeaky, six miles north from Bandon. About this time, probably, the "Book of Rights" was recast, or compiled. It gives the tribal privileges—

> "Entitled is the King of great Ui Eathach
> To a coat of mail and a spear for combat,
> And to two rings of gold,
> And to two steeds of no bad temper."[2]

It is said that in presence of the chief of the Dalgcais the chief of Ui Eacach only bowed his head, performing no other act of homage.[3] The tribe were evidently expert ship-men, as Brian "commandeered" them along with the Danes of Dublin and Waterford for a naval expedition.[4]

Cian with Tadhg, Brian's son, removed the wounded to Kilmainham after the battle of Clontarf. His claim of supremacy over the Dalgcais at Mullaghmast was ill-timed, but those, like our times, were uprooted from the older balance; and in his time, it is believed, the quarrels began that split the Ui Eacach into Cinel Aedha (Kinelea) and Cinel Laeghere, who "never met in amity" again.[5] Cian was glad of the aid of Donchadh Brian's son perhaps a year later; and soon after he and his brothers fell. Mathgamhain, his son by Sadbh, ruled over the Cinel Aedha, the Cinel Laeghere having migrated to Magunihy in 1015. He died in 1028 (Leabhar Oirus), or ten years later (Four Masters); Sadbh died in 1031. From him is derived the name Ui Mathgamhna or O Mahony.

Before resuming the fragmentary Annals of their chiefs (for we are more concerned with origins and early history, save when later records attach to the remains we specially study), let us define their territory. As the older Dalgcais territory is represented by the Bishopric of Killaloe, the Ui Fidhgeinte by Iniscatha, and Limerick, and the Ui H Eidersceoil by Ross, so the see of Cork closely represents the Ui Eacach tribe-lands at the time of the Synod of Rathbreasail, about A.D. 1112. It defined the limits of Cork diocese as from Corcagh to Carn ui Neid, from the Blackwater to the sea.[6]

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[1] Canon O'Mahony describes and notes the site in Cork H. and A. Journal, xiii, p. 27. See also *ibid.*, vol. ii, p. 146. R. R. Brash notes in "Ogham Inscribed Monuments," p. 158, "the immense rath with numerous subterranean passages." Views, but (as usual with planted earthworks) unsatisfactory, are given, p. 74.

[2] Book of Rights (Leabhar na gCeart), ed. O'Donovan, p. 257.

[3] Manuscript R.I. Acad., 23 G 22, p 49.

[4] Wars of the Gaedhil, p. 37.

[5] See Ann. Inisfallen, Ann. Ulster, Ann. Clonmacnoise, and Four Masters.

[6] Geoffrey Keating's "History of Ireland" (ed. Ir. Texts, vol. ix, p. 305), Book II, sec. xxviii.

The seventeenth-century deaneries corresponded to sub-divisions of the race—" Kinelea citra " to Kinelmeaky; " Kinelea ultra " to Kinelea; " Kilmughan " to Ui Flainluadh (Iffianloe in 1615); " Fonn Iartharach " to the Ivagha peninsula; besides Kerricurrihy, Cork City, and other Deaneries. Their chief (" Ard Righ ") Cathal Ua Donnchadha (O Donoghue) was slain in 1083. Mathgamhain's son, Brodchon (not Brodchu), was still chief in A.D. 1072, and led a raid against the Desi. The tribe was better employed in their great victory over the Danes of Dublin, Wexford, and Waterford, when the latter made their attack on Cork in A.D. 1088. They pillaged Rossailither in revenge for a cleric. They quarrelled again with the Dalgcais, A.D. 1089, under Cumara, son of Brodchon, and again in A.D. 1178, when they attacked the O'Brians, being piteously defeated, and (with various expelled Eoghanachts) were driven southward, and had to hide in the woods of Ivagha.[1] The succession of chiefs includes Cumara, slain A.D. 1091 (not 1107); Donchadh Donn, grandson of Brodchon; Cian, A.D. 1118–35, " O Mathgamhain, Donchad son of Cian," who was their chief at the time of the Norman invasion.[2]

Like most coast tribes, they lay but little within the ken of annalists; and as the King's writ did not run among them, they are equally absent from the most helpful records of judicial and fiscal history—the Plea, Pipe, and other Rolls. In our studies all round the coast we see how broken is the history of such tribes—the Ui Mhaille, the Clan Taidgh of Aran, the Ui mbreacain, the Ui Thorna, the Ui Fearbha, the Aes Ioruis, and now even the important tribes of Ui Mathgamhna and Ui hEidersceoil—all of whose Annals are nearly blank from the thirteenth to the close of the fifteenth century. The Ui Echach, apparently by voluntary arrangement, about A.D. 1260, split into two; Dermot Mór Omathgamhna (Omahony) chose the peninsula of Fonn Iartharach, leaving the apparently richer lands of Kinelmeaky to his brother Chonchobar.[2] It was no such foolish choice, as some have thought; if the hills were barren there was doubtless fine hunting, and he secured the seaboard with its numerous bays and creeks, its fisheries and the foreign trade in wine[3] and

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[1] The frequent occurrence of names compounded with *Derry* in the Ivagha peninsula tells its own tale.

[2] See MS. Pedigree in Irish H. 23, R.I. Acad.

[3] See Proc. R.I. Acad., vol. xxx, p. 417. In 1234 Amlaibh O H Eidersceoil, called Gaskunagh, chief of the O'Driscolls, was slain, *ibid.*, p. 384, *Corca laidhe*, p. 15. He derived his nickname from the Gascon wine trade. See also English Historical Review, 1914, " A Tract of 1580 ": "The places of the West of Ireland for seckes and gasconi wines," " and andolozia and Gaskone wines, a little woade, some Allem . . . some raire silk of divers colleurs, and some Brasill; but of wynes you shall dispatche greate store. And they will complye their bargaines very well, and ar men of more sivilitie than those of the northe partes."

other goods; two of the finest and most sheltered harbours were at Schull and Crookhaven; and the Creek of Dunmanus was, in those days of flat-bottomed ships, almost as valuable. He maintained himself free from the claims of the MacCarthies to tribute. In A.D. 1319 we hear of Finghin relieving his father, who was blockaded on Cregaire (Beare) by the sons of Finghin MacCarthy. The young chief, in the absence of his father's fleet, had only one ship; but, working by night, he enabled his father Dermod (son of Donagh), fourth chief of Ivagha peninsula, to hold out till the other ships returned and brought off the besieged to the Carn (Mizen Head). I confess to finding much obscurity in this entry. It throws doubt on the date of the tribal split, for Dermod More lived till 1327, and the "split" has been dated in 1260. Donal was chief in 1383; again an improbably long "reign," is asserted, for his son Dermod Runtach had sons apparently in their prime in 1473, or later. In fact, the received history is full of difficulties and evident errors.

O Huidhrin in his well-known Topographical Poem, before 1420, thus describes the peninsula—

> "Ui Eachach of the west of Banba,
> Is the great patrimony of Ui Mathgamhna.
> Land of fair mounts, irriguous, not undulating,
> Extensive is that plain of brown nuts."

Dermot, son of Donall, was called *Runtach*, "the reliable." His sons are connected in the family archives with several of the castles. His second son, Donagh Mór, built Dunmanus; his fourth son, Donall, Dunbeacon. "Dermot Runtach, lord of Fonn Iartharach, a truly hospitable man, who never refused to give anything to anyone, died" in 1427.[1]

Conchobar was the fifth chief of Ivagha Peninsula. He was named Cabaicc, an obscure title, variously rendered "the talker" or "the cape-wearer," and also "Kittoge," the left-handed. He built Leamcon, and died in 1473. The Annals of Loch Cé record the death of Concobar, son of Dermot, son of Donal, son of Finghin, son of Dermot More, at Ard an tennail, a castle whose ivied turrets rise in an older ring-fort to the south-east of Schull. Finghin, the next chief, we shall mention as a man of learning and literature.

The Ivagha peninsula seems to have escaped the notice of the Commissioners of the Papal Taxation in 1302–7. Working over the churches in the Deanery of Corkyghteragh we find, as so often, a regular topographical order, in this case from east to west, broken by the church of Sclenbercain (Glenberchon, or Castlehaven), which heads the list. Then there follow Crynfath (Creagh), Akadun (Aghadown), and Toulagh (Tullagh at Baltimore), Kikeran

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[1] Annals Four Masters.

in Berri (Kilkeran, in Clerri or Cape Clear), Kilcholy (Kilcoe), a Kilkyth (perhaps Kilfach' or Kilfaghnan), Micruss (Myross). Evidently the deanery stopped at Kilcoe. The four peninsular parishes, Schull and Kilmoe in Ivagha, and Durrus and Kilcrohane in Muintervara, are unnamed, but those at Beare are all given. All seems to imply the inaccessibility of the place; even the careful portolans pass it by.

The very incorrect O Mahony pedigree in the Herald's Office says that Carew granted Ivagha to O Mahony; this is a mistake, or exaggeration; even Camden in 1586 only says "ample estates," and this is based on the moderate and perfectly credible note in the Carew MSS. that when Dermod O Mahon married a daughter of Carew, the latter gave him Innisfoda or Long Island and Callowchraghe, both near Schull. It is also quite conceivable that this was merely a transfer of nominal rights which Carew had never been able to win into reality.

Sir Richard Cox, in "Carberiae Notitia," gives the branches of O Mahony as O Mahon Fune in West Carbery and O Mahon Yerer (an Iarthair), whose chief castles were Ardinter and Three Castle Head and Ballydivlin.[1]

The only one of these later chiefs of general interest was Finghin OMathgamhna, who died in 1496,[2] at Rossbrin Castle. Whether contact with foreign merchants helped to widen his interests or not, he was "intelligent, polished, and erudite, and learned in the history of the world in the east and thither," chief of Fun Iarthair Mumhan; he was "the general supporter of the hospitality and learning of West Munster, the most learned man of his time in Latin and English." Much of this panegyric refers to his extant work, the translation of Sir John de Maundeville's Travels; but we can endorse the praise of the obituary—"widening of his horizon over the world." The existing copy was made by Donald Fihelly in Kilcrea (Cillcreidhe) Abbey, on Maundy Thursday, 1475.[3] Probably some visitor to Finghin's ports opened that fascinating melange of fact and fiction to him. He died, and after his death there arose a struggle for the succession. Conor Fionn, son of Conor Cabaicc, the chief, who died in 1473, opposed his uncle Domnall of Dunbeacon Castle, and was the first "O Mahon Finn." His son, Finghin, had a castle at Cruachán, or Crookhaven; and of his three brothers, Finghin Caol

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[1] Cork H. and A. Journal gives "Carberiae Notitia, vol. xi, p. 142.

[2] Ann. Loch Cé, Ulster, and Four Masters. See also for his book, MS. Series R.I. Acad., 1870, p. 60. Revue Celtique, vii (1886), p. 66.

[3] Dr. Todd read the date 1472; it is more probably 1475. It gives the author's descent as Finghin, son of Dermod, son of Donall, son of Finn, son of Dermod. It was translated at Rossbrin Castle, farther up Roaringwater Bay than Schull, and outside our limits. See view, Cork H. and A. Journal, xv, p. 188.

(the slender, held Lemcon Castle, and Dermod, Dunlough. Conor died in 1513, and Finghin Caol succeeded as chief, and is named in the report to Henry VIII two years later. Little is told of the chiefs during the mid-sixteenth century. The O Mahonys did not obey the summons of St. Ledger. In 1537 Dermod of Dunloch, his brother, and Dermod's nephew, Conor Finn Oge, seem to have been chiefs. In 1562 Donall, son of Conor, the owner of Rossbrin, was tried for felony and executed at Cork, his estate being forfeited. The castle (valueless to the Government, as no English tenant would live there) was given to O Mahony Finn and Cornelius, his son. In 1571 Perrot gave the castle to MacSweeney, a gallowglas; and in 1576 we find a pardon to Teige MacConor O Mahony for rebellion. After 1584 Omahony came to terms with the representatives of the Crown. The Chief, Conor Finn, died in 1592, not long after the surrender of his lands to the Government. Among the chiefs who left for Spain early in 1602, we find Connor O Mahony, of Lemcon in Ivaghe, Connor, son of Sir Finghin O'Driscoyle (of whom we had much to note in a preceding paper[1]), O'Sullivan Beare's son from Beare Haven, Shane MacGillicuddy Shoulaghane of Beare, and Collo MacSwyne of Carbry.

A number of maps of the early seventeenth century, or the last ten years of the sixteenth, mark these districts, if imperfectly. Besides the interesting sketch-plan of the siege of Dunboy, we have maps with Scoolehaven, Crookhaven, Donmanyes, Loghan, the Sound of Dursey, and Kenmare. Hugh Norton, "a gentleman appertaining to Lord Thomas Howard," made surveys and soundings of the harbours for Carew.[2] His charts of Baltymore, Beerehaven, and Bantry are preserved.

Carew also gives a list of the forces of the chiefs in West Cork. O Mahon of Ivagha had 26 horse and 120 kerne; O Mahony of Brin (Rossbrin) 46 and 100; O'Sullivan Bere, 10 and 200; O'Driscoll, 6 and 200.[3] On what this computation was based the writer does not say. The impression given by other sources suggests a greater Irish force than about 600 kerne and under 90 horse.

SCHULL.

The little town of Schull (less properly spelled Skull) lies on its sheltered haven with a fine outlook over the Calf Islands to Cape Clear and Sherkin. Calf Island East has a long islet called Dooneen, a shore rock, on its north-west flank. I have seen it through strong glasses, so that I could even see a railing beyond it, but saw no fortification. It ought, however, to

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[1] Proc. R. I. Acad., vol. xxxii, p. 110.

[2] Carew MSS., p. 222.

[3] *Ibid.*, p. 205.

be examined, should anyone, not an inhabitant, take the trouble to land on it.

The name Schull is derived from a *School* founded near it by the monks of Ros Ailithir Abbey at Roscarbery[1]; not from the emblem of mortality. There is, however, a popular etymology that it was named from the abundance of human remains in the old graveyard. The school is said to have lain to the east of the harbour opposite to the ruined church. Bishop Dive Downes' Visitation, in 1700, notes that Skull church was uncovered, the walls standing and built of stone and lime. It is about 84 feet long and 24 feet broad. He appointed churchwardens to repair a portion 30 feet long. The church was almost rebuilt in 1720, a porch being added in 1796, but a neat ogee-headed window of the late fifteenth century is in the north wall of the chancel. I found no tomb older than 1729, one of Major William Hull. The building was used down to 1842. A Bull of Pope Innocent III, in 1199, confirming the privileges of the see of Cork, mentions Scooll, and later medieval documents call it "S. Maria de Scholia," but, as I noted, the Ivagha parishes do not appear in the taxations of 1302–7. The place has no history of moment. In the reign of Elizabeth, John O Mullbrien of Skull held the castle and fee of the same, "the myne and the ould Skull," at his death on December 2nd, 1598. Donough, his son and successor, was then aged only two years.[2] In 1623 the "Rutter for Ireland" mentions Cape Clear, Missine, Crook Haven, and Scole.

Setting out from the little town, a long ascending road in one direction brings us past a fine ring-fort with high, bushy mounds,[4] to an uphill district with a glorious outlook southward, and to the pass of Mount Gabriel.[5] "Gabriel's rough defiles" are very remarkable, narrow cuts through the purple rocks, carved and polished by ancient glaciers into regularly moulded cornices, tufted with delicate London pride, and ferns, the steep green ridges, rugged with outcrops of rock, running up to the summit 1339 feet above the sea. So wild was the district that in 1700 Bishop

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[1] Cork H. and A. Journal, vol. xv, pp. 89–127, ed. T. A. Lunham.

[2] Exchequer Inquisition, 1631.

[3] Carew MSS., Cal., p. 435.

[4] Lewis names the great forts of Liscaha, with two mounds and a fosse, traditionally the scene of a great battle with the Danes, some would have us believe that of 1088, which was probably fought at Cork. Rathtrovane was similar, but its mound was strengthened by a dry-stone rampart. It lies in Rathruane, near Ballydehob. Donogh, son of the chief Dermodmore, 1212–1250, was of Rath Dreoain (Pedigree, R.I. Acad. MS. H. 23).

[5] "Mount Gabriell," Book of Distribution, Co. Cork, Skull Parish, p. 2568. There were 1004 acres of common on it.

Dive Downes, of Cork, in his "Visitation" describes—"Mount Gabriel, in the Parish of Skull, is a haunt of wolves; there are no trees or shelter, except rocks and bogs . . . From the top of Mount Gabriel we saw Dunmanus Bay, and also Bantry Bay, with the hills of Beerhaven. We saw also from thence Ballinskellix Islands in Kerry. . . . on the Skellix the gannet, as big as a goose, breeds. There is a small lough on the top of Mount Gabriel."[1]

Westward the road is less attractive, running through a long and, in parts, boggy valley. We turn off southward to the west of the old signal tower, and through pretty strips of planting reach a beautiful group of little bays, beyond which, at the end of a long peninsula, rises the dark and conspicuous old peel tower of Lemcon. A little inlet, with clear depths, through which the sunken rocks shine like masses of aquamarine, is called Coosaphuca, attesting a belief in the elfish goat or horse which figures so largely in later Irish folk-lore.

LEMCON (O. S. 148).

A walk for "a short mile" along the flower-hung cliffs and narrow high-banked bridle-paths of old lanes brings us to two deep gullies, a collapsed narrow cave running across the headland, only bridged near the middle by the remains of a natural arch. The gully gives its name, Leimchon, the Dog's Leap, to the headland and the "Black Castle" beyond. In the name we meet evidence of a legend, a great favourite at similar sites. In Mayo we find Leamanirvore, or Great Man's Leap, near Downpatrick, and the Giant Deodruisge's Leap at Dunbriste, at the end of the latter prominent headland. In the Mullet we have the Priest's Leap (Leimataggart), at three spots, respectively near the promontory forts of Spinkadoon, Dunnamo, and Dunadearg; The Seahorse's Leap is at Dun Fiachrach. In Co. Clare we find Leimchaite and Leimcougher at Doonegall fort, The Leap of O'Brien's Horse at Dunlicka, and Cuchullin's Leap (Leim Chonchullin in 850) at the once walled rock at the end of Loop Head. In Kerry is the Leap of Ballingarry; here we have the "Hound's Leap" (Lemcon); at Ardmore, "the Heir's Leap" in Ardoginna, and in Wexford "Strongbow's Leap" at the great fortified headland of Baginbun. One could wish to think that, as in Co. Clare and Dromsna, so at Lemcon, it was no mere hound, but the great Hound of

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[1] *Loc. cit.*, p. 90. At Beerhaven he also notes, along with the *Cahannagh*, or arbutus, "We saw eagles upon the lands of Beerhaven; there are many wolves there." These notes render very improbable the received account that the last Irish wolf was killed in that year. Some assert that wolves existed down to 1760 n Co. Limerick.

Uladh, Cuchullin, who was commemorated; but I heard of no legend of any description purporting to explain the name. The arch was evidently far wider even in 1841 (if the O. S. map be reliable in details), but now much has collapsed, and the little that remains, though eked out by a beam to one side, is a "Brig of Dread," hardly a yard wide; how the cattle grazing on the "Island" are got across in safety is indeed a marvel.

The site was one best suited for a promontory fort in the peninsula, and as even the smallest coast spur, and even slight projections on the cliffs, were walled for defence, the headland of Lemcon could hardly have been passed over in early times. However, no *Dun*-name is recorded, and nothing remains of early work; if such existed, the new work has overlaid and replaced it. The neck or arch was defended by a mortar-built wall, with a gate-house a little to the north of the passage. These are nearly hidden in bosses of snowy campion and seapink. A wall and pier face the edge of the cliff commanding the neck, and running so as to leave a narrow path aslope from it to a gate-house. The northern gate-pier runs out beyond the line of works to the actual edge, so that no one had foothold to pass it. To the south of the gate is a small lodge for the porter, defaced, overgrown, and filled up. The gate-piers and a few stones of the arch remain to either side. The gate has a high sill or step. It is not improbable that a drawbridge was in use at one time as at Leckbevune, Dursey, Dunluce, Dunowen, and elsewhere, but whether it led from the gate-sill to a former pier on the landward edge of the gully, or whether there was none, only the skew path to the natural arch, I do not venture to assert. In Ballingarry Castle, Co. Kerry, there was no access from the natural neck only by the drawbridge across the chasm; the same seems true also of Dunowen Castle, Co. Cork, and Leckbevune Castle in Co. Kerry.

The Black Castle stands on the highest point of the "Island," on a knoll of rock. It closely resembles other peel towers in the district, such as Dunanore and Dunmanus, or the Keep of Dunlough, but has no side turret like the second. It measures 39 feet 6 inches by 27 feet 4 inches outside; the interior, 16 feet 6 inches by 27 feet 3 inches. It had two floors and an attic, under a pointed vault, turned over wicker, and an upper room. The staircase begins above the main door in the east wall, and was probably reached, as in the similar castles, by a removable ladder, perhaps in a projecting building or porch. The stairs rise southward up the wall straight to the south-east angle. They open on the second floor by a large door, with a window-slit opposite to it; they then run straight up the south wall to the middle window of the upper room.

The lower story is unlighted, and was probably used for a store; the second, beside the light through its door, had recessed windows to the north and south. The northern one has passages from its jambs running back to a garderobe eastward, and to a little chamber in the north-west angle. The entrances were probably concealed by wainscoting. The attic had only a small loop-hole to the east in a very deep recess. The passages in the wall were similarly lighted, and the drain had a ventilator high up the north wall. There are no fireplaces, and the battlements and gables have been blown away. The only ornamental feature, a neatly recessed and chamfered window, with a square hood and dropped ends, dates little before 1500, when so many peel towers were built in Munster.[1]

HISTORY.—Lemcon was one of the O Mahony Castles, built probably at some older residence late in the fifteenth century. In 1427 Dermot O Mahony (Ui Mathgamhna), Chief of Fonn Iartharach in Iveagh, died, and was succeeded as chief by his son, Conchobhar "Cabaicc" (the "talker," "exactor," or "cape-wearer," as his nickname is variously rendered), who married a daughter of O Dowd. In his later years he built Leamcon for his second son, Finghin Caol (the Slender), ancestor of the O Mahony Caol family, who still are proud to trace their descent from the first lord of the Black Castle, on Castlepoint. Finghin died in his castle of Ardantenail in 1473,[2] being succeeded by his brother, Donchadh Mór Ui Mathgamhna, of Dunmanus. During the whole sixteenth century the castle is rarely named, and played no part in history.

In 1602, after the siege of Dunboy, the English, when reducing the country, took Lemcon. It was owned by Conor O Mahony, son of Domnall, son of Finghin Caol. On July 13th, 1602, Sir George Carew reports, among the minor operations, that Captain Roger Harvey had taken seven castles strongly seated on rocks and necks of land, among the rest Lemcon. All are so "neere unto the sea where ships might safely ride, and fit places for an enemy to hold as, namely, Leamcon,[3] Donnegall," and others, so it was decided to burn them and (Dunanore), the one already taken on Cape Clear Island.

Canon O Mahony thinks that the broken base of Lemcon was injured by siege operation of a *sow*.[4] I only see normal decay and work of mischievous idlers. The English had little time to drag siege appliances about; a few shots, even with small cannon, sufficed, even forty years later, to take as

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[1] View Plate XXIII, No. 4.

[2] Annals Loch Cé.

[3] Pacata Hibernia, Book III, chapter x (p. 585).

[4] Cork H. and A. Journal, vol. xvi, p. 17. The capture only took a day or less. See Pacata Hibernia, as below.

strong peel towers; most, indeed, were "taken by paper pellets," notes demanding surrender. We read in *Pacata Hibernia* that an officer and party of Captain Roger Harvie's men recovered the Castle of Lemcon, near Crookhaven, from the Irish. Conor surrendered at discretion; he and his men received quarter, and he migrated to Spain, July 7th, 1602.[1] The Carew Manuscript says wrongly that Conor O Mahony, of Lemcon, one of the O Mahons of Ivagh, left for Spain with the consent of the English in 1601. It was granted to Captain William Hull, but the building was retained for the use of the soldiers, and even on October 15th, 1612, he had to ask that he might be recompensed, and that his tenants might not be abused. He writes that the Castle and Island of Limcon have been taken from him by Captain Pory, and that the soldiers had buried many pipes and hogsheads boards, so he asks that he may enjoy the grazing, as the king's services require the castle for the time. The O Mahonys were still connected with Lemcon in 1622, for the representatives of Connor leased certain ploughlands there to Sir W. Hull, and in 1631 Finin mac Cnoghor mac Ganekard O Mahoune held the castle, vill, and lands. The latter had, by a settlement of April 8th, 1617, enfeoffed Donagh O Driskoill and Walter Coppinger of these, and by another deed, April 25th, 1625, feoffed Finin Oge, his son, in other lands. He died 10th May, 1627, and was succeeded by his son, Conoghor, who, on April 1st, 1630, demised Lemcon to Hull. Finne na Cnoghir mac David O Mahoune, late of Lemcon, died 10th July, 1626, leaving a son, Cnoghor, of full age, and married; Dermot, his son, appears in another demise to Hull, October 4th, 1622. The family, like so many others, fell into trouble in 1641, and Connoghor O Mahowny, of Leamcon, was outlawed. Sir William Hull has left a deposition giving a long account of events at the outbreak of the civil war. He says that on December 5th, 1641, he was robbed of goods worth £769, and profits of lands and leases £1148. He names O Mahowne, of Killmoo, in the Parish of Crookhaven, in West Carbry, and others there, and in Scull Parish. I will only select those resident at the places here described. Dermond Cartye was of Dunbeacon Castell, and the O Mahownes held Lymcon. John Mac Dermond, of Long Island, and some 700 or 800 persons, came about Christmas, and besieged the castle and town of Crookhaven, and took all the goods of the townsmen, save what were stored in the castle. The deponent then names Daniel Canty, the landlord, of Donkelly. The long items of losses include the ten ploughlands of Lymcon, held by Hull, £183. The house was fortified with towers and works (p. 254), and was well able to defend itself against four or five

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[1] Pacata Hibernia, Book III, chapters ix, x.

thousand before the ordnance belonging to it was obtained. The rebels plundered his fishing sellers at Dunbeacon, Drishane, and Lymcon, and took some 800 barrels of new salt. They took out of the seller at Lymcon, called "The Myne," many masts, &c., for ships; also boats at Donbeacon and Lymcon, including a 12-ton boat at the latter going to Clonakelty. The stores were rich in supplies of timber of all descriptions, pitch, malt, and ammunition, and afforded a rich spoil to the natives of Ivagha. The timber helps to account for the disappearance of the dense woods of this part of Co. Cork. He alludes to the breaking of rocks at Lymcon and Clonakelty, and other improvements, and claims (apparently) £1065, but the statements, though very valuable for students of social history, tell us very little else about the buildings and their owners.

Another deposition of John Fletcher, of London, tells how he put into Crookhaven from stress of weather, and was taken prisoner, robbed, and maltreated, and escaped to Bandon.

Richard Hull, Knogher O Mahowne (7 ploughlands), Donogh Macffinne, and Knoghr Macffinne appear as owners. The Down Survey lists state, "near Leamcon Castle is a fair stone house, with an orchard,"[2] but this was probably at the modern house at the featureless fragment of the second castle, not on the unsheltered rocky headland. Lastly, the Book of Distribution[3] notes "Leamcon, 11 plough lands, 1241 acres of Richard Hull."

ALTAR TO MIZEN HEAD (O.S. 147, 146).

The remains from Lemcon to Mizen Head are worthy of a separate paper, and mostly lie outside the scope of this survey. The drive round Toormore Bay on to Ballydivlen is pleasing and picturesque. The fine dolmen of ALTAR has two cups rudely chipped in the cover. It has been described and figured in Borlase's "Dolmens of Ireland,"[4] and elsewhere. DOONLEA was very probably a fort on a low shore-rock, once a headland, and lies about 10 miles from Schull. An old road leads down to the shore near it, but I could see no traces of fortification on it; the drift bank may have

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[1] Mss., T.C.D., F. 2, 17, Cork, vol. iii, p. 253, October 22, 1642; also (Fletcher), p. 265. The uncritical acceptance or rejection of these very curious documents is a reproach on Irish historians. A fine field lies in the depositions for unprejudiced students of social history, and (no matter how much or how little of the statements about the outrages may be unreliable) there is no excuse for those who cast aside the whole mass on the dictum of Gilbert or any other historian. In no other country could such neglect have been tolerated, still less defended.

[2] See Cork H. and A. Soc., vol. xv, p. 126.

[3] Co. Cork, Kilmore, p. 525.

[4] Vol. i, pp. 44, 45.

been denuded, and the earthwork or drystone wall destroyed. The Rev. Mr. Desmond tells me that he never heard the name Doonlea of the maps applied to the rock which is locally known as Gurteendyne. BALLYDIVLIN castle is utterly levelled.[1] We pass Goleen; just beyond it, overhanging Crosshaven, is a group of low hills which local antiquaries should carefully survey. There are several *gállâns* or pillar-stones; a stone circle of no great size in Letter; two dolmens on the plateau where Arduslough and Tooreen townlands adjoin, and another dolmen lower down in the former townland. Several gallâns lie north from Kilbarry.[2]

The large headlands of Streek and Brow Head seem likely sites for cliff-forts; there is none on the spurs of the latter, and I saw none at Streek, but could not examine it closely. Beyond Kilbarry is a large tidal intake studded with swans and their cygnets on the day of our visit and separated from the sea by a beautiful strand at Barleycove. Passing the hill road west of that bay we reach the new signal station on Illaunbirrane, or Cruckaun Island, at Mizen Head. I carefully examined the upland above the Head, but found no antiquities.[3]

MIZEN HEAD.—The headland bore in early times the name of Carn Hui Neit, and its legend appears in the Dind Senchas.[4] Bres, son of Elathan, son of Net, from whom the cairn was named, died there in the reign of Nechtain the red-hand, or the fair-hand, a legendary King of Munster. Bres demanded the milk of 100 hornless dun cows from the latter, for every house in the province. Nechtain, maddened by the exorbitant demand, singed or stained with a porridge of flax seed all the cattle to a dun colour, and made sham cows full of liquid peat. The tribute was paid, and as Bres was under a *geis*, or tabu, to drink all the milk, he swallowed the peat as well; he then sickened and died seven years seven months and seven days afterwards. The meaning of this strange legend is obscure, like so much in the Dind Senchas. Bres was not a human hero, but an early god: his "date" alleged to be 1721 before Christ. He is divergently called "son of Elatha, son of Delbaith," and "son of Eladan, son of Net; he was High King of exceeding greatness." In another legend "seven years were reigned by

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[1] A bronze spear-head and socketed celt were found at Ballydivlin; it is on a low headland. See paper by late Robert Day, Cork H. and A. Journal, xi, p. 187.

[2] Borlase, "Dolmens," vol. i, p. 45, merely names them.

[3] Lady Chatterton (Rambles in the South of Ireland during 1838, ed. ii, p. 82), on seeing Mizen and Three Castles Heads from the sea, notes the rock from which a doctor took two eaglets; the parents offered no opposition. Caha mountain was then famed for its 150 lakes and for its eagles (*ibid.*, p. 100).

[4] Rennes Dind Senchas, *Revue Celtique*, vol. xv, p. 408.

him, it was not long death, he died of the red wound." He was High King until the god Nuada's lopped hand was healed,[1] and he is usually said to have fallen at the second battle of Magh Tuired.[2]

It is very interesting to find situations at and near the promontory forts so closely connected with gods and mythic heroes. Carn Ui Neid, Dun Cearnmna, Dun Sobhairche, Leim Chonchulainn, and Dunbalor have tales of the remoter past. Caherconree, Dun Fiachrach, Dunadh Certain, Dun an aeinfhir, Dunadearg, and perhaps Portacloy (the *cladh*, being the fosse of Dunminulla fort) are connected with the Red Branch; Dundahlin, Moher, and Dermot's Island, with the Finn Sagas.

In 975 the "Munster Annals" (usually confused with those of Inisfallen) give Carn Ui Neid and Carn Thigernach, near Fermoy, as the bounds of the Ui Eacach, under Cian. The Synod of Rathbreasail, in 1112, supports this by fixing the limit of the See of Corcagh, on the west, as Carn Ui Neid.[3] The later traces of the name are found in a group of documents between 1580 and 1601. The Hardiman maps give Missen Head *alias* Carene Head (No. 1); Mizen Head *alias* Carowne (No. 4), Baptist Boazio, 1590. In 1601 (July) one of the Carew MSS. says: "The haven of Beere is 12 miles to the north of that promontory of Myssen Head, or Caron Head." Grandyers, "Rutter for Ireland," in 1623, mentions Cape Clear to Missine,[4] and the Down Survey Map 111, Mizon Head; but the ancient Carn name is gone, nor does it appear in *Carberiae Notitia*, 1686,[5] where the *alias* is Carrigaglaveen. The summit has a magnificent outlook along the extremities of the coast to Dorsey Island.

DUNLOUGH OR THREE CASTLE HEAD (O. S. 146).

One of the most interesting fortified headlands on the coasts of the three southern provinces is Dunlough. In one respect (that, so to speak, of its being a legible palimpsest of a true promontory fort) it is even more interesting than Dunluce. It occupies a very remote and somewhat inaccessible nook among low hills at the north angle of the Ivagha peninsula. Penetrating a maze of narrow roads, through dull valleys, in a

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[1] Todd Lecture Series, R. I. Acad., Ser. iii, p. 155.

[2] Keating's "History of Ireland" (ed. Irish Texts Soc.), vol, i, p. 221 (Book i, sect. xii).

[3] Keating, "History of Ireland" (ed. Irish Texts Soc.), vol. iii, p. 305.

[4] Carew MSS., Cal., p. 435.

[5] Cork H. and A. Journal, vol. xii, p. 142, so far, at least, as I have seen extracts

long circuit behind Mizen Head, we come once more upon the coast. There we get a striking view of the great rock islands of Caher, Illaunacaheragh, and Illaunbirrane; the gossamer-like bridge to the Mizen signal station is seen across the farther chasm.

Caher Island is accessible only from fallen masses of shore rocks and a long, narrow wing up to its northern flank. Its name is only derived from the townland of Caher, and I saw no trace of fortification or enclosure on its sides.

OUGHTMINNEE.—Where the road dwindles to a laneway, at the little stream and deep valley, south from the Three Castles, is a little boat cove named Cooshacuslaan, at Oughtminnee.

Its southern point is a bold, steep mass of upturned grey slate, a narrow, almost parallel-sided, little headland. Small though it be, it was thought worthy of fortification in early times. A scoop, or hollow, at one place was filled, and revetted with well-laid horizontal masonry of moderately large slate slabs. A similar wall ran straight across the neck, but its most palpable trace is the pier-like end next the stream rising from a ledge. Dr. Fogerty first noted the revetment. It is a fort as small as Cooshaneimme or the spur fort near Ballyvoony, in Co. Waterford,[1] and, like them, illustrates "the fear that accompanied the early shore-dwellers" and led them to fortify even so sorry a refuge as these ledges afforded.

A walk through barren, rounded, craggy knolls brings us to a valley with a little reedy lake, blue as turquoise, and jewelled with pearly sea-gulls on our visit. Facing us, at first hardly distinguishable from the crags, we see three turrets and a long range of wall from the cliff to the lough, and round the north shore of the latter, and its outflow to the farther sea.

Evidently the lake has constantly diminished in size owing to the deepening of the stream-channel that drains it at the north-east end. The valley shows the older shores, and, so far as I can judge, the original fortress presupposes a water-level perhaps 6 to 10 feet higher when the early wall was built. The fort-makers ran a nearly straight reach of wall from the south-west cliff to a rocky bluff projecting into the lake, and probably beyond the lake along the stream. The enclosed space was the "Dun of the Lake," or Dunlocha. The later castle-builders erected a tower in the line of the old rampart on the highest knoll. A still later generation of builders entirely remodelled the place, demolished the old wall to its foundation, cutting fosses and making a mortar-built wall across the shortest reach from the keep to the cliff, and a more irregular wall with turrets down to the

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[1] *Supra*, vol. xxxii, p. 224.

then shore of the lake. They built the new entrance in the more defensible corner near the last, and made a quay-like wall around the inner shore. They did not, however, build the group of houses that growing want of convenience and comfort led the owners to add to the hill towers on similar fortified headlands elsewhere, like Dundeady or the Old Head of Kinsale. The surface of the lake is still 262 feet over the sea.

DUNLOCHA.—The remains of the ancient *Dûn* are well marked, and run N.N.E. and S.S.W. in a straight line. The end reaches remain, but all the part across the bare rock of the knoll has been removed, like the upper part of the rest, for building material for the later towers and wall. The two reaches can be seen in line from the rising ground at the cliff. Inside the triangular space between the southern reach and the later rampart are two fosses; the older work lies 6 feet out from the inner end and consists of the foundation of large blocks of the wall and gateway. Three slabs and the gaps from which two others have been removed run for 12 feet to the gate. The latter is 4 feet 6 inches to 4 feet 4 inches wide; its left (south-west) jamb is 5 feet deep, 3 feet thick, and 3 feet 9 inches high; the other 4 feet 4 inches by 3 feet × 3 feet 6 inches high. Five large blocks run for 21 feet towards the cliff, and the foundation is faintly traceable nearly to the edge. The line is destroyed for 200 feet across the knoll at the keep; it was probably of smaller stones, and built on the bare rock, so was easily obliterated. We find the north-east reach from about 57 feet from the north-east angle of the keep. For 72 feet it is 3 feet to 4 feet 6 inches (at one point nearly 5 feet) high, of large slabs, usually nearly 5 feet long (one 5 feet 6 inches × 3 feet × 1 foot 6 inches, another 4 feet 8 inches × 2 feet 3 inches × 15 inches, few under 4 feet long, and 2 feet thick); they end, neatly built into the crags of the bluff.

The later works are two fosses, with mounds and a glacis, formed of the natural ridge carefully cut into shape. At 42 feet back from the cliff the slope is 23 feet wide from the wall to the inner fosse, which is 9 feet wide and 8 feet below the bank; the intermediate mound is 12 feet thick and 3 feet high, the fosses being evidently somewhat filled. The outer fosse is 6 feet to 8 feet wide.

Along the top of the terraced glacis, the rampart runs, commencing at the cliff (above Coosnaronety or Seal cove), where is a slight pier 6 feet wide and a bending wall returned outward, showing that no alteration has taken place at the edge since at least the fifteenth century. The rampart runs for 97 feet 6 inches from the cliff to the keep; it is broken at about 42 feet from the former, and usually 7 to 9 feet high.[1]

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[1] Plan, Plate xxiv; View Plate, XXIII, No. 3.

The Keep or peel tower is an oblong building, the face 28 feet long, the interior 19 feet 3 inches × 13 feet 9 inches, the walls 5 feet 9 inches to 6 feet thick, of good plain masonry, without any moulding or carving. A side building is attached to the eastern[1] face, but is greatly broken; the staircase is over the doorway of the tower on this side, and was evidently reached by a ladder. The doorway has a plain pointed arch; its door, as usual, shut back into a recess. There are narrow, deep recessed windows in the side walls. Beside the basement, a second floor and an attic are under the pointed main vault, which was turned over wicker centering. The floors rested on plain corbels. The top story was only roofed, and had larger windows in each wall. I saw no garderobe or fireplace, which favours the age of the tower, but I can hardly believe that it dates from 1207, or even a century later. The stairs ran up the eastward wall, bending at theangle, and rising westward up the southern side, as at Leamcon and elsewhere.

Turret.—The rampart runs down the rock for about 70 feet to a turret, 13 feet 2 inches long, and projecting from the outer face, 7 feet 3 inches. The latter tower has a garderobe in the basement and two lofts, formerly reached by ladders. The top story has lights to the west and south, with a door opening on the top of the rampart. No battlements remain on any of the walls or towers. The rampart runs in two bends of 27 feet on to a gatehouse of some complexity.

The Gatehouse stands on the shore of the Lough. The entrance had inner and outer arches, which were closed and barred from the inside, I presume lest anyone should get into the enclosed hill, hide till night, and then open the gate treacherously. The outer gate is 6 feet 10 inches wide, the inner, 6 feet 3 inches and 9 feet 8 inches apart; they have slightly pointed arches. From the interspace a small door opens into a little court, or rather passage, round the other two sides of the gate tower. This turret has a vaulted basement 9 feet by 9 feet 9 inches, and walls 4 feet thick, with a loophole, commanding the outer face of the gate. There are two stories or lofts, reached by a ladder through a trap-door and under another vault. The second floor has slits in each face; the third, one to the south, and a torn gap westward above the gate. Over the upper vault is a little gabled attic, with an ope overlooking the lake. A small stair runs spirally up the north-west corner. The walls having been very thin there, have fallen, or been broken, down to the basement vault. A short wall runs from the gatehouse out into the lake. The inner bank is walled by a revetment 4 feet thick, following

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[1] Rather the N.N.E. I use simpler language—"northern" for N.N.W., southern for S.S.E., etc.

the line of the winding shore. The low ground inside was tilled, probably during the wars of Napoleon.

The Castle thus closely resembles that on the old Head of Kinsale, having a long line of wall from cliff to cliff, a keep, and two turrets. Instead, however, of following the line of the older promontory fort, it cuts across it.

THE LAKE is reputed to be infested by a "worm," or *peist*, with a horse's head, as John Windele notes. He also (like Bolster in 1827) tells of an enchanted woman, or water nymph, there. One Kean Mahony saw her, and (as happened to others before him) died soon afterwards. Our guide, Mike Leary of Dunlough, never heard of the lake being haunted by anything, so the tale is probably forgotten.[1]

THE HISTORY is very brief. The castle is believed to be the place named in the ancient Annals of Inisfallen often identified with Dunloe—"1207, the Castle of Dunlochy, was built," as Duald Mac Firbis translates the lost original. Some interpolate "by the English."[2] It was an O Mahony Castle, but its history from its remote position is a blank. Conor Finn O Mahony, chief in 1496, the son of Concobar "Cabaicc," gave Dunlogh and eight ploughlands to his fourth brother, Dermot, and died 1513; the latter succeeded to the chieftainry, after the succession of another brother, Finghin Caol, of Leamcon, already noted. I do not think that the Plea Rolls, Fiants, or Pacata Hibernia name it. It appears on the map of Baptist Boazio as "Donlough," about 1590, but not on the other maps of that period, though it was one of O Mahon Finn's chief castles. The Down Survey Map, No. 111, gives "Three Castles Head"; and the Book of Distribution, about 1655, names "Dunlough" and 1868 acres of unforfeited lands as belonging to the Earl of Cork and Dermod Coghline.[3] It is called "Downlough" on John Jannson's map, 1661, engraved at Amsterdam. I may lay myself open to criticism, but the "Vision of Mac Conglinne" (the scene of which is laid from Cork monastery to Duncobha chief fort of the Ui Eacach) describes a fort, built of food, but copied from a real dun, wonderfully similar to Dunlough. Omitting the materials (with one exception), I note that Mac Conglinne describes the *Dunadh* with its fortification as beyond a *loch*. It had a "Cashel," or dry-stone wall, and a door with pillars. It lay near the sea, and had streams and pools. Garden plots, with onions and carrots, and an orchard, lay between the fort and the hill. The sides of the door in the

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[1] Bolster's *Magazine*, 1827; Windele "Topographical MS.," R. I. Acad., 12 J. 9 (1844), p. 822. See Cork H. and A. Journal, vol. xv. 1909, p. 192, for views.

[2] The Bodleian Annals end at 1196.

[3] *loc. cit.*, p. 259.

satire are of curds; in the reality of Dunlough, there are blocks with white quartz masses, which might well suggest the idea. So curious is the similarity that I put it on record without daring to assert that the author thought of Dunloch, though he certainly pictured a closely similar fortress.[1]

DOONLEEN-MAOLÁN (O. S. 138).

The remaining promontory forts lie upon Dunmanus Bay along the north shore of Ivagha. The name of this fort seems uncertain, and its remains are nearly effaced. It is Doonleen in the map of 1842, but Dooneen, and the bay near it is Dooneen-coos, on the new maps. I was told by an old man living near it that "Mweelaun" is its *Irish*, and "Dooneen" its *English*, name. I presume that by "the English" he meant the workers on the Ordnance Survey. It is not recognized as a fort, but this is true of several other far better preserved promontory forts,[2] owing to people thinking only of ring-works as "forts." It is a rocky peninsula with low cliffs over which huge waves break in western gales, getting concentrated in the narrow bay by their run along the line of cliffs. The surface is usually washed away, as the name *Maolán*[3] implies. The fort lies in the townland of Lackavaun. The old maps show a wall convex to the land between two of the creeks and a straight wall between two others; the latter is alone ancient, and, with the name, implies a true fort. The wall was evidently a slight mound along the rock-ledge, with a toe of large slabs set deep on the ground. On it rested a wall of rather small, flat stones, forming a revetment to the ledge in parts, and backed with earth at the breaks. It is 78 feet long; two or three layers of the laid masonry remain in parts, notably to the west, where the mound is cut away by a cliff fall. Some of the base slabs are 6 feet long, and rise 2 feet 6 inches over the soil. The outer fence, though curved and faced by similar slabs, hardly seems very old, and the ground rises outside it. At 75 feet from its western end is a horrible crumbling edged gap (like one of the Mayo Poulashantonas) into a long cave; the roof in parts is hardly a foot thick. A man was driving a beast loaded with two panniers, one day into the Maolán, when its foot went down into a hole. He got it out safely, and soon afterwards the roof fell in, and is still falling away along the line of fence. At the eastern end at

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[1] "Vision of Mac Conglinne" (as cited above), pp. 36-38.

[2] Like the great and elaborate *Dún* of Kilmore, in Achillbeg; Doonaunroe, in Co. Clare; the Dunruadhs in Kerry; and many others.

[3] *Maolán* seems to be used for a fort (presumably flat-topped) in the *Tain bo Flidhais*, Mayo version; see Journal R. Soc. Antt. Ir., vol. xliv, p. 151.

Coosadooneen the rock has fallen into a chaos of great masses, still sliding and settling after rain.

The headland, like its neighbours Dunkelly and Dunmanus, commands a very fine view of Sheep Head and Muintervary Peninsula, across the fiord. Its namesake on the opposite shore, Dooneen in Garranes (near Kilcrohane, at Foillmore cliff), is clearly visible. It is a high mound 5 or 6 feet higher than the garth, and bushy, being convex to the land. I was told at Dunmanus that it is called Dooneen Island, but it is not an island, being entered by a narrow gangway "only the width of a cart," across the deep ditch. Every bush in the fort and every window in the cottages is visible, and the Dunmanus folk say they can call across the water to their friends on the farther shore.

Dunkelly (O. S. 138).

This is an interesting and curious curved earthwork and fosse on the low, pleasant, flowery coast of Dunkelly townland, about a mile to the west of Dunmanus. There is a souterrain in the garth marked "cave" on the 1841 maps. The site shows the very clever adaptation of natural features so usual with the cliff-fort-builders. One of the clear little brooks that fall from ridge to ridge, among the ferns and foxgloves, down the long hillside had cut a deep gully forming a delta near the cliff. The fort-makers cut a fosse convex to the land, and some 10 feet deep, through the triangular platform, shaping the remainder into a crescent mound by scarping and shaping the gullies to the same curve. They seem to have dammed the eastern branch of the rivulet by a slab wall and the mound to turn it round the greatest reach of the fosse westward, but, after the fort was deserted, the stream never rested till it cut through the obstacle and made a beautiful little natural cistern on its site. The fosse is 25 feet wide and 12 feet to 15 feet deep to the west: the southern cut is 10 feet deep, 6 feet wide at the bottom, and 16 to 18 feet at the field level. The remaining bank has also been shaped outside, making a double ditch at the apex of the delta. Between the scarping and piling up the earth into a bank 5 to 6 feet above the garth, the inner fort rises 15 feet over the gully to the south-east, and over 23 feet to the west. It measures about 54 feet north and south, and 40 feet east and west. In the north-east corner is the "cave," more like the earth of a fox or a badger than a souterrain: it has been filled till the ope is barely 18 inches across, and the interior made inaccessible.[1] The great earth cap rests on high rocky ledges on the shore, which is sheltered from the great waves by the rocky

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[1] Plan, Plate XXIV.

projection of Leighillaun to the west. There is a ring-fort on the edge of the townland. I do not know which is the actual *Dún* of Dunkelly; opinion favours the cliff-fort.

The place is called Dunnekilly in the "Book of Distribution,"[1] as held in part by Gillagh Canty, in 1655; he sold his share to Sir William Petty. Another part, consisting of 15 gneeves, was divided among Donough Canty (6), Donogh m^cOwen Canty (3), Donogh m^cMueall-Murry Canty (3), and Donogh m^cGilly Canty (3), which they sold to the same all-absorbing purchaser.

DUNMANUS AND KNOCKEEN (O. S. 138).

These lie along the shore eastward, but can be best visited direct from Schull through a country of Osmunda fern and willows and another ice-scarred defile.

We pass a high-banked earthen fort, with a fosse and two rings on a green ridge, with a fine view down the bay; it is probably the fort that gave its name to Dunmanus. The peel tower bearing the name is on a rounded knoll of nearly bare rock, which was once nearly (if not quite) surrounded by water when the tide was high. It is still washed by the tide for over half the circuit.

THE CASTLE is of the type so common in the peninsula—a peel tower, 16 feet 9 inches by 13 feet 10 inches inside, the walls 5 feet 4 inches to 6 feet thick. There are two floors and an attic under a pointed vault, turned over wicker; the stairs (as usual here, but very different from those in counties Kerry, Limerick, Clare, and Galway) begin at the second floor. At the south-east angle is a smaller turret, each face 17 feet 2 inches long. The rest of the main south wall is in a strangely shaken and shattered state, as if struck by lightning or weakened by a drain down it. The top room has ogee-trefoil heads to its two light windows, the only ornamental features, though the masonry is large and good.

The place has hardly any history; it is, perhaps, the "Donemarae" (Donemanas) of the second Hardiman Map, *circa* 1590–1600. During the Spanish war, when Dunboy was stormed in May, 1602, a serjeant of the Earl of Thomond with a small party of soldiers swooped up on Down-Manus and carried off sixty-six cows and many garrans. In the following month (June 4th), "Owen O'Sullivan and two of his brothers took by surprise Donmanus Castle, killed four of its guards, and kept it and the prey and spoyle of the town." Captain Harvie took the castles of Donmanies and Leam-con, indeed

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[1] *loc. cit.*, p. 259.

all in the district save Kilcoe and Cloghan. The Carew manuscript of June 13th corroborates this, adding notes of the burning of Rincolashy, Donnegall, and (Dunanore) Castle on Cape Clere. In 1636 Daniel MacCarty, *alias* MacCarty Reogh, held Dunmeanus, with " lez tribus carrucatis terrae de Twovintery dorcke," and in 1655 Dermod na Buolly and others held Dunemanus, which was sold to Emanuell Moore with 200 acres, and 754 acres sold eventually to Sir William Petty.[1]

Dolmen.—Passing round the creek, we find (in a swampy field, overflowed by high tide) a large block, evidently a dolmen. The monument is irregular in plan; it has a chamber of three blocks, one lying E.N.E. and W.S.W. The cover is irregular, 30 inches to 36 inches thick, rudely octagonal, 6 feet 2 inches across to the east, 6 feet 4 inches along the south. The question of dolmens on tidal land is important; the upheaval of the raised beaches has been dated in Neolithic times, but evidence as to the date of subsidence on the Irish coast is very vague. The case of the Rostellan dolmen, also in Co. Cork, has been treated with equal confidence and scepticism by various writers, for the reconstruction in the last century vitiates the evidence; the tide rises a couple of feet up its side at present.[2] The Gortbraud dolmen, near Murrisk, on Clew Bay, is another case in point as within tidal range, at least at very high tides.[3] Its alignment leads to a low earthen ring from which it is separated at half-tide. In the centre is a line of six stones, 20 feet long, E.N.E. and W.S.W. (like the axis of the Dunmanus cist), and a seventh one now fallen. The ring-work is about 5 feet thick and rarely 3 feet high, with a shallow outer fosse; there are ten large blocks to the south. An ancient stone causeway, only seen at lowest water, crosses the muddy creek to the west. These three cases suggest submergence of the Irish coast in the human period, and deserve to be very carefully studied without prejudice by a scientific expert. As Dr. Robert Munro points out, there is a great mass of evidence for submergence in the Neolithic period. Not merely implements, which might have been dropped, but " a chipping-floor or implement factory," occurs in the submerged area in Caermarthenshire. Implements are found in many such deposits. Still

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[1] Pacata Hibernia, Book ii, pp. 544, 546, 585; Cal. Carew MSS. under date; Inquisition No. 410, 1636; " Book of Distribution," p. 255.

[2] Dolmens of Ireland, vol. i, p. 16; also Irish Naturalist, vol. xvi, pp. 265, 269; Cork H. and A. Journal, vol. iii (1894), p. 164. Human remains were found in this dolmen, which proves it to be an ancient cist. The submergence of the Ardmore crannog, as well as of the Rostellan monument, has been questioned. See Windele's Supp., vol. ii, p. 665.

[3] Proc. R.I.A., vol. xxxi, Part 2, p. 44. I have seen its earthwork submerged.

more apposite is the submerged "cromlech," a double circle 8-shaped in plan at Er Lanic in Brittany, dating from the later Stone Age.[1]

KNOCKEEN.—Crossing the fish-abounding stream by an old causeway (or by a strange bridge of timber and concrete on the point of collapse), we go out to the point opposite Dunmanus Castle, and find a very remarkable earthwork and castle site in Knockeen townland.

Old people about Dunmanus tell how the castle at Knockeen was intended to be the actual castle of the district. While it was being commenced a wise man, a stranger, travelling in the district, saw the men at work. Going over the ground he warned them, "don't build the castle there, for the sea will come there." The builders consulted the chief, who took the wise man's advice and founded Dunmanus Castle upon a rock opposite. A somewhat similar legend is told in an early Life of St. Senan about the selection of a grave site,[2] and St. Patrick is said to have denounced a fort site which long proved useless because of the badness of the soil.

The remains[3] consist of two crescent mounds. I do not attempt to decide whether the inner was once a circle, but the outer certainly abutted on the steep, grassy bank of the low cliff, and its ends are intact. Perhaps little has been cut away during the centuries; changes in such sites take place very suddenly—a fire or heavy rain strips off the grass where it grew for ages, and if the bank does not get clothed with new vegetation it continues to crumble. I have met instances where more change has occurred in the last five or six years than before that time in the memory and tradition of the oldest people. Dunnaglas and Dookeeghan in North Mayo, Dunnagappul and Dunallia in Cliara, Kilmore and Porteen in Achill, Illaunadoon in Co. Clare, the Stack fort and Lisheencankeeragh in Co. Kerry, and Portadooneen near Courtmacsherry, and Dunsorske in Co. Cork, are striking cases in point; nearly all were fairly uninjured in 1838; most have undergone extensive denudation since 1875. The rock bases at Knockeen, like those at Porteen and Doonah, with which I close this paper, probably long protected the clay bank from the waves; it is the destruction of the grass that causes that of the cliff-edge.

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[1] Prehistoric Britain, p. 133. Etudes Antiques d'Archéologie Préhistorique. Rev. R. A. Gatty, "Pit Dwellings at Holderness" (Mar. 1910, 48). Nature, 1912, excavations at St. Helier. "Guides to Barrows, &c., in Brittany," W. C. Lukis.

[2] "Lives of the Saints from the Book of Lismore" (ed. W. Stokes), p. 212.

[3] Lewis, "Topographical Dictionary," notes the remains of a castle "on the shore of the lake of Dunkelly." Canon O'Mahony says Dunmanus is built on the site of an old dun; but for his mention of Knockeens in the same sentence, we might suppose he alluded to it, as there is no trace of a ring round Dunmanus. Cork H. and A. Journal, xv, p. 73.

The Dun of Knockeen is a fine, well-preserved earthwork, save that much of the outer fosse has been filled up, and the outer ring refaced and built up in parts. The fosse remains intact, 5 feet deep at the north edge and 3 feet deep in parts round that segment. It is 12 feet wide, but has been defaced by a deeper and narrower modern trench to the east. The furzed outer ring is 4 feet to 5 feet high and 6 feet thick, the ground of the enclosure being nearly level with its summit. The rings are not concentric, being from 69 feet at the north to nearly 90 feet apart. The southern part has been tilled, but is now in good grass.

The inner defence has a filled fosse, rarely over 2 feet deep and about 12 feet to 15 feet wide. It, too, is nearly 5 feet deep at the bank. The mound is 23 feet thick, and rises 15 feet to 16 feet outside; some of the revetment of small slabs remains round the north-east segment, and it was doubtless capped by a dry-stone wall. The enclosure is about 80 feet across, but slightly irregular, and is 12 feet above the outer ward or 16 feet above the fields. The bank runs into an angle, the edges 63 feet and 57 feet long. The castle was at the south end of the ring, its foundations overhanging the bank. It was a small oblong turret; the large oblong foundation shown by the older maps in the middle of the garth is not traceable. A hollow, like the foundation of another turret, is at the north end of the crescent.[1]

DOONAGH, DUNBEACON (O. S. 130).

Driving from Schull through the bold eastern pass of Mount Gabriel, with magnificent views back to Cape Clear and Sherkin, we enter a wide valley with disused mines. It is sad to see that the destruction of the too scanty plantations has been carried out here, the fine wood on Gabriel being cut down to the roots. We pass round the flank (seeing two earth forts with fosses and bushy rings) and wind through quiet little valleys to the shore of Dunmanus Bay at Dunbeacon. The tall fragments of the east wall and the south-west angle of the castle stand on a low, rocky knoll by the bay; they have large, plain, late windows and long bond stones at the angles. Near it is a midden of shells (periwinkles, oysters, and limpets) at the end of the little creek to the north of the tower.

The Mahony tradition, like most of the assertions as to the building of stone castles, seems unreliable, the forts in many cases being meant by the records, and "building," as usual, being intended for "rebuilding." Dermod Runtach (the reliable), chief of the Ui Eacach in 1460, had a second son,

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[1] Plan, Plate XXIV.

Donchada Mór, who built Dunmanus (and presumably was the founder of Knockeen), and a fourth son Donall, who built Dunbeacon; this might be dated about 1460 to 1490, which tallies well with Dunmanus, and is not impossible for Dunbeacon, though the tower seems later, but may have been remodelled. We hear of Finin O Mahony receiving Dunbeacon and four townlands from his father, the first O Mahony Finn.[1] He was then resident at Cruchán Castle or Crookhaven.[2] Donall, Finin's son, owned Dunbeacon till 1579; it possibly was confiscated soon after, about 1584, along with Rossbrin, but its owner survived till 1600. "Donbeken" appears about 1590 on Francis Jobson's map. "Downbekhane" was held in September, 1577, by Teige O'Hengerbye, *alias* Harrington, who was "fined a cow" and pardoned by the Government.[3] Morogh mac Edmond mac Swyny of Downebeacon gent. Ellen ny Crotty, his wife, and several yeomen were pardoned after the rebellion of James, "the Sugan Earl" of Desmond in 1601. In 1655, Dunbecon and Derryfunstone, 1190 acres, belonged to Dermod Carty, *alias* Clarke,[4] and later on to Colonel Richard Townsend in 1668.[5]

Doonagh.—Canon John O'Mahony regards Doonagh as the fort from which Dunbeacon is named, but says nothing about the earthwork itself. The *Dunadh* once evidently defended a longer headland, a deep bank of drift on low rocks and 24 feet high; this has crumbled away even since 1840, when the maps show it projecting nearly its own depth beyond the present edge. The works are, however, still intact, abutting on steep, grassy slopes, covered with vetches, sea-pinks, and campion. It is only the north face that, being nearly perpendicular, presents a bare, yellow, unprotected front exposed to the storm and spray of the fiord. High reefs mark clearly the base of the older headland. The shore is of sharp parallel ridges of rock, yellow with acorn barnacles and rich in pools starred with red and olive sea-anemones, shells, and dark purple clusters of mussels and sea-urchins. I found an old, narrow path scaling the very steep slope up to the north end of the fosse; probably, as it touches a little spring, it was the water-path of the fort-dwellers and a means of securing shellfish and fish.

The earthworks are about 80 feet across; no trace of an outer ring remains, but there is a depression at its probable site, such as elsewhere marks the

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[1] Pedigree, Harleian mss.

[2] Cruachan, later Crookhaven, is a good example of a recasting of a name so as to be assonant. The Crook family obtained lands in this part of Co. Cork late in the sixteenth century. The castle has disappeared, and the site is not certainly fixed.

[3] Fiants, Elizabeth, No. 3080, No. 3535.

[4] Book of Distribution, Cork, p. 528. The Down Survey map calls it Dunceacon.

[5] Act of Settlement Confirmations, anno xx–xxi Car. II, pars 10. f. 15.

trace of a dry-stone wall. The ditch is well-shaped, 11 feet to 14 feet deep, and 10 feet to 12 feet wide below. A gangway crosses it at 30 feet from the east end and 90 feet from the west. The inner mound rises 20 feet to 22 feet above the fosse, and 6 feet over the garth; it, too, has a set-back from the garth-level all round the outer face,[1] showing that (like Dunsorske, which it so closely resembles) it had a dry-stone revetment, and possibly a cap-wall. It is 28 feet thick at the base and 6 feet on top; only the ledge and a few blocks remain of the stone-work. The whole is covered with bushes (sloe, hawthorn, and furze, and a fine willow tree grows at the south end of the bank) occupying the summit of the highest ground; it is a conspicuous object, even as seen at a distance. The garth is a garden of wild hyacinth and bracken; it is only 21 feet across to the crumbling bank; there is a long, straight hollow, like a collapsed souterrain, close to the dangerous edge.[2]

In the same field, and to the south-west, is a somewhat pyramidal stone 3 feet 6 inches high, polished and with scorings up its south-west arrise. They yield no legible ogmic text, and are possibly the work of some idler.

About three miles from Doonah is a somewhat similar earthwork, with a slightly curved fosse, on a low drift cliff near Blair's Cove house on Dunmanus Bay. It is in the townland of Coulachta in Durrus Parish, and therefore rather belongs to the Muintervara group of forts, for which I must reserve it.

ANTIQUITIES IN IVAGHA PENINSULA.[3]

GALLANS OR PILLAR-STONES.—(O. S. 147) Cloghanculleen; Ballyvogemore; Letter (circle); Dough; (148) Kilpatrick; Beakeen (two); Gunpoint; (138) Coradarrigan (near Schull station); (130) Dunbeacon circle.

DOLMENS. — (O. S. 147), Ballyvogebeg; Leenane; Arduslough (two); Tooreen; Ballydivlen; Ballyrisode; (148) Arderrawinny; Altar.

FORTS.—(O. S. 146) Caher; Oughtminnee; Dunlough; (147) Corboge; Cloghanculleen; Lisagriffin; Balleen; Gortnagashel (site); Ballyvogemore; Caherbaun; Derryleary (two); Cove; (148) Cahervirane; Derryleary; Rahaliv; Croagh; Gubleen; Caherlusky; Colla; Ardintenant; (138) Doonleen; Dunkelly (two); Baunnacaheragh; Letter East; (139) Caherolickane; Laharan; Shantully; Lisderreen (with "cave"); Raheenroe; Mount-Gabriel; Derryfunchid; Cashelfeean; Lissaboagy; Meenane; Lissacaha; Glan; Skagh; Ratooragh; Ballyvonane; Knockeen; Dunmanus (two); (130) Doonagh.

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[1] As at Rathmorgain, Co. Mayo, and other forts.

[2] View Plate XXXIII, No. 1, Plan and Section, Plate XXIV.

[3] This is, of course, a tentative list; the peninsula is worthy of a detailed survey.

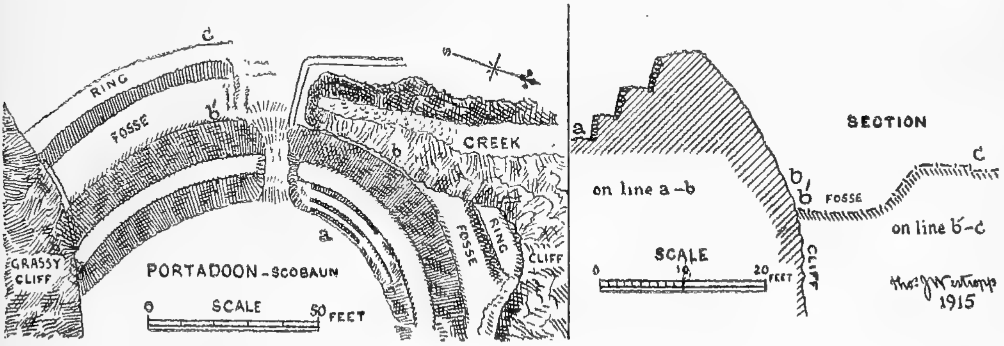
CHURCHES and GRAVEYARDS.—(O. S. 146) Cloghane-kill; (147) Milleen Corboge; Kill; Kilmoe; Killeen; Ballyrisode; Killane; Kilbarry (two); Enaghkill; Crook; Kilbrowne (church in ring); Coorlacka; (148) Cove (in ring-fort); Kilpatrick; Kilmurry; Lowertown (in a ring-fort); Rahaliv; Coosheen; Skull Church; Crookhaven (site); Ardintenant; (139), Killeenagh; Kilcoman; Kilcarriel (138).

CASTLES.—(O. S. 146) Dunlough; (147) Kilmoe (site); Castlemehigan[1] (site); Crookhaven (site); Ballydivlen (site); (148) Lemcon (two); Ardintenant; (139) Knockeen; Dunmanus; (130) Dunbeacon.

ADDENDA.

A few points call for addition in the first section of this survey, where later visits have given me material important to the study of the forts.

CARRIGILLIHY (*supra*, vol. xxxii, p. 95).—This is a good specimen of the simple type. The works are convex to the land; the outer ring was stone-faced, 3 to 4 feet high, in its present state, with traces of the north pier of a gate at the gangway; it is 6 feet thick. The fosse is not less than 6 feet deep at the centre, deepening to 9 feet outward; it is 15 feet wide below, nearly 21 feet above. The gangway is 10 feet wide, from which to the N. cliff is 96 feet, and to the S. about 54 feet, the fosse being 162 feet round. The inner rampart was faced with a stone revetment at the field-level; it was 21 feet thick and 5 to 8 feet high; the revetment was from 3 to 5 feet thick, but very little of it remains. There are no hut-sites, but a path leads down to the sea at the end of the low headland. It has a fine outlook up Glandore and out to Galley Head. The width of the fosse is misprinted "30 feet" instead of 20 feet.



Portadoon Promontory Fort, Castlehaven, Co. Cork.

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[1] The O'Meighans, like the O'Dalys, were a bardic family, settled by Dermod mor, chief of Ivagha, on his lands here, about 1215, as is stated.

SCOBAUN, PORTADOON (*ibid.*).—This is also a fine example of the small high-banked promontory forts. They are so rare up the west coast, from Cork northward, that I can only name Lissadooneen and perhaps Faillnamna in Kerry, Dundahlen in Co. Clare, and Bunnafahy (Achill) in Co. Mayo. It is strange that so much labour was expended to fortify such small headlands. The fort is probably of considerable age. The sea has cut along a line of cleavage, leaving the inner rampart intact, and, at the northern end, a few yards of the fosse and outer ring. The headland is about 93 feet across; the works are boldly convex, and 105 feet round the summit. The outer ring is hardly traceable along the south segment of the fosse; it is 6 feet wide. The fosse is from 12 feet to 18 feet wide, and 6 feet 6 inches deep. The inner rampart is 24 feet to 6 feet thick, and from 6 feet to 10 feet higher than the garth, and 16 feet to 19 feet outside, above the fosse. It is remarkable among promontory forts for having the inner face terraced by revetments of small, well-laid masonry, forming berms or terraces 3 feet by 3 feet, 4 feet by 3 feet, and 3 feet by 6 feet along the northern segment.

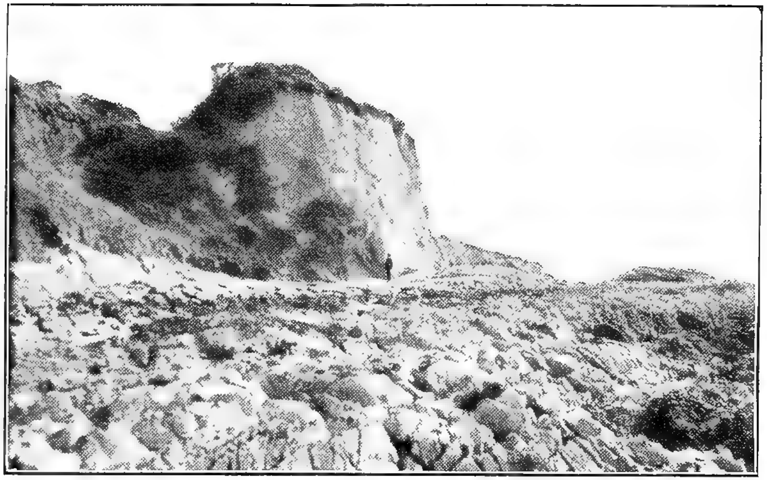


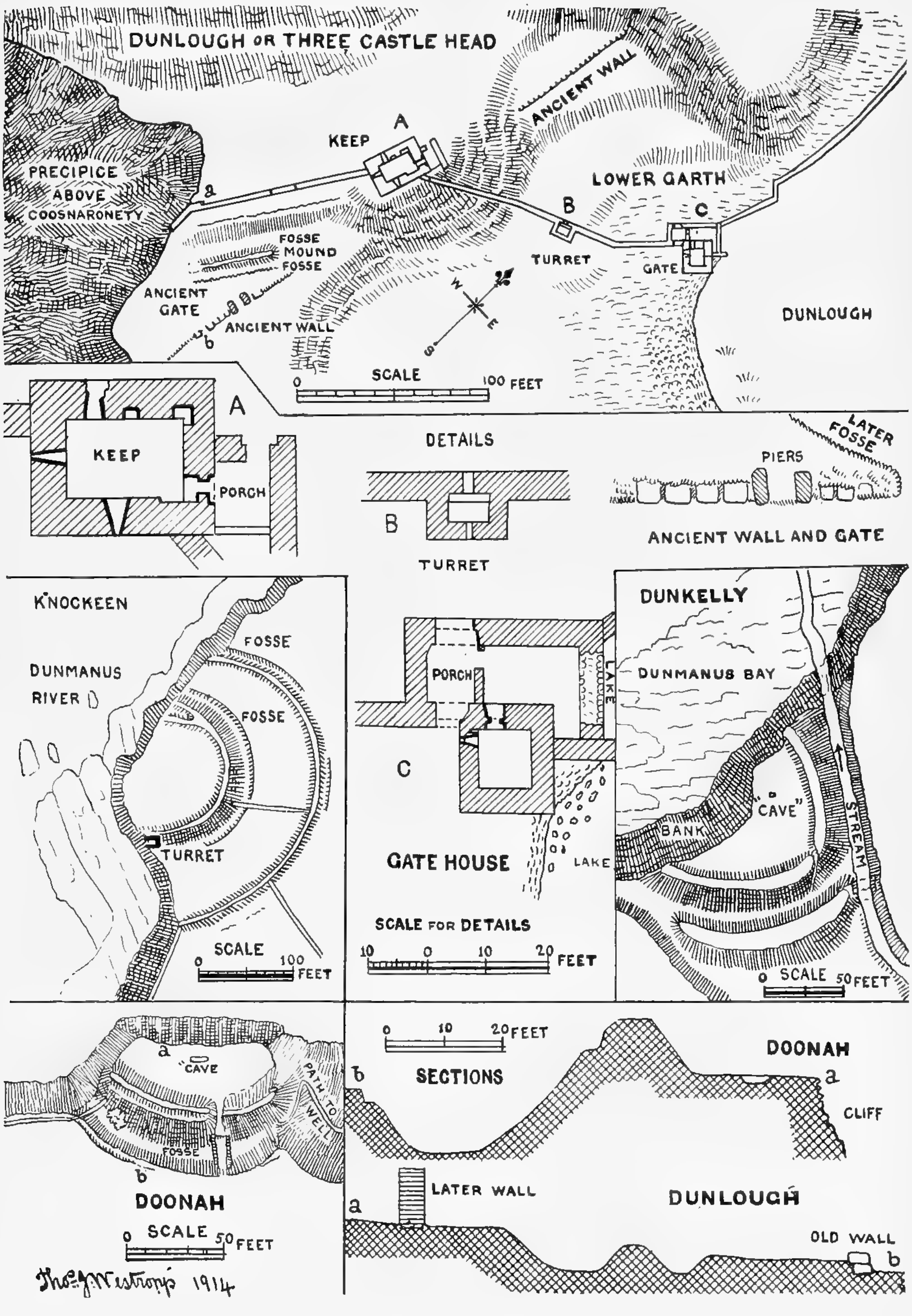
Fig 1.—Doonah Fort, Dunbeacon.

Fig 2.—Dunanore, Clear Island.

Fig 3.—Dunlough or Three Castle Head.

Fig 4.—Lemcon, Schull.

Westropp.—Fortified Headlands in Western Co. Cork.



Westropp.—Fortified Headlands in Western Co. Cork.

XVIII.

CATALOGUE OF THE SILVER AND ECCLESIASTICAL ANTIQUITIES IN THE COLLECTION OF THE ROYAL IRISH ACADEMY, BY THE LATE SIR WILLIAM WILDE, M.D., M.R.I.A.

EDITED BY E. C. R. ARMSTRONG, M.R.I.A.

PLATES XXV-XXVII.

Read FEBRUARY 8. Published AUGUST 16, 1915.

INTRODUCTORY NOTE.

SIR WILLIAM WILDE'S catalogue of the antiquities in the collection of the Royal Irish Academy was published in three parts—the catalogue of the stone, earthen, and vegetable materials in 1857, the antiquities of animal materials and bronze in 1861, and of the gold antiquities in 1862. Sir William Wilde had intended to publish a catalogue of the silver and ecclesiastical antiquities, and also of those of iron. The MSS. of these (in a very incomplete state) are extant, and were long in use by the curators of the Academy's collection for the purpose of identifying specimens; some wood blocks had also been made to illustrate the remaining portions of the catalogue when published.

The question as to publishing these further portions having been brought before the Academy, it was decided that this should be undertaken, and Mr. E. C. R. Armstrong was requested to edit the work. The present is the first instalment; the MS. catalogue of the iron antiquities, having proved to be in a much more unfinished state than that of the silver and ecclesiastical objects, a considerable time will be required to prepare it for the press.

As has been stated above, the MS. catalogue was in an incomplete condition, and many of the descriptions of the antiquities required emendations and additions. Therefore, when it has been possible to identify the objects mentioned in the catalogue, they have been compared with the descriptions, and, where it seemed desirable, the latter have been amplified and amended. In most cases the context will make the added portions clear, while in important instances the insertions have been directly indicated. It may be mentioned that a number of the weights given in the MS. catalogue, having been tested and found correct, it has not been considered necessary to re-weigh every object; and the same remark, *mutatis mutandis*, applies to the measurements.

Class V. Metallic Materials.

Order IV. Silver and Findruine.

Irish antiquities of silver (in Irish aıꞃᵹeaꝺ) are much rarer and their varieties more limited than those of gold, being chiefly confined to armillae, pins, and brooches. These latter articles, however, far exceed in size, beauty, and style of ornament any others known in Europe. But although more elaborate and massive, they are also much less ancient than the gold antiquities described in the foregoing section of the catalogue; they evidently belong to Christian times, and partake of that style of art observed in our shrines. crosses, and illuminated manuscripts. We possess undoubted evidence of the existence of native gold from the very earliest times, but the localities from whence the silver of our antique manufactured articles were obtained is not so clear. The great bulk of the Irish silver of the present day is derived from our lead; but we can scarcely suppose that the artificers of the date of these articles were acquainted with the mode now employed of separating the silver from the baser metal. There is comparatively little notice of silver to be found in our ancient records, most of which date from a period antecedent to that which can be assigned to these articles of personal decoration. That many of the objects are of Irish manufacture there can be little doubt.

Several of our Irish ring-brooches of silver are inlaid with gold filigree, and many of them jewelled. But besides these we possess others of the same form and style of art, composed of a white metal, a compound of silver, tin, and copper, called in ancient Irish authors *findruine*, or white bronze, of which mention has already been made at page 358 of vol. i.

Though antique articles of silver are much less frequent than those of gold, the number of ingots, bars, and rudely or partially manufactured specimens of the former is much greater than that of the latter. Silver articles are when found of a much darker colour than those of white bronze or *findruine*, and the metal is so very pure as to be excessively friable, even in some cases crumbling on very slight pressure. When cleaned it is of a very white lustre, which it retains untarnished for a long time.

The editor wishes to add that the silver torcs, ingots, and bracelets which form the bulk of the silver objects in the Academy's collection belong to the Viking period, and exactly resemble silver ornaments that have been found in hoards in the north of England, Orkney, and various parts of the Scandinavian lands. Of these the Cuerdale hoard is the best known in the British Islands. It was discovered in 1840 at Cuerdale in

Lancashire, and consisted of a large number of silver ingots, torcs, bracelets, fragments of brooches, etc., also about 7000 coins (chiefly Anglo-Saxon, French, and some Oriental); from the dates of these it was estimated that the hoard was deposited about the year 910 A.D. A similar hoard was discovered at Sandwick, Orkney, in 1858, including Oriental coins of the early part of the tenth century. The island of Gotland, where numerous discoveries of silver ornaments and oriental coins have been made, was an important centre for trade with the east established by the Vikings, and from the close of the ninth century large quantities of silver and goods of various kinds were brought by way of the Caspian Sea across Russia to the Scandinavian countries, and thence to Britain and Ireland, in the wake of the Viking expeditions. A good deal of the silver was doubtless reworked in the Scandinavian lands, but the ornamentation of many of the objects has an eastern rather than a western appearance.

The antiquities of exactly similar character discovered in Ireland and described below were probably derived from deposits of which the records have been lost. The illustrations will show the types of the different ornaments, and it will be noticed that the hammer only has been used in the making of the greater part, and that the decoration has been produced by means of punches of very simple form, the more complicated patterns being obtained by repeating the same punch or by the combination of two or more, also that none of the various objects bear any decoration approaching human or zoomorphic forms; this in itself is an argument for their eastern origin, as the depiction of human or animal forms is not permitted by the religion of Mohammed.

Plate XXV, fig. 1, shows, one-half the actual size, an ingot (no. 3); it measures $3\frac{9}{16}$ inches in length, and is $\frac{5}{8}$ of an inch in thickness; it weighs 2 oz. 16 dwts. 18 grs. It has been cast in a mould made of metal, or possibly of baked clay, and is marked with a cross in relief. An ingot of the same type and also marked with a cross was found at Cuerdale, and is figured in the description of that find.[1] The ingots vary much in weight, and probably many of them were cast in sand.

On Plate XXV, fig. 5, is shown the pattern on a bracelet (no. 62). The central decoration is produced by placing triangles enclosing three pellets apex to apex, and thus making shapes like an hour-glass. The bracelet measures $2\frac{15}{16}$ inches in diameter, and weighs 2 oz. 8 dwts. 19 grs. The next example, Plate XXV, fig. 6 (no. 64), shows various forms of punches, and the hour-glass pattern is again used. The bracelet measures $2\frac{1}{2}$ inches in diameter,

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[1] *Archaeological Journal*, vol. iv, p. 112, fig. 1.

and weighs 17 dwts. 17 grs. Plate XXV, figs. 2 and 4 (nos. 67 and 78), show the patterns on two bracelets; the first measures 2½ inches in diameter, and weighs 2 oz. 6 dwts. 8 grs., and the second measures 2⅞ inches in diameter, and weighs 1 oz. 17 dwts. 18½ grs. The patterns of the bracelets shown in Plate XXV, figs. 13 and 3 (nos. 76 and 81), resemble each other, but the first is very broad in the centre, measuring 1⅜ inches, while it is closed by wires coiled round in a spiral as shown in the figure. It measures 2½ inches in diameter, and weighs 1 oz. 9 dwts. 23 grs. The second is a penannular bracelet of the usual type, and has a diameter of 2¼ inches, and weighs 15 dwts. 12½ grs. Plate XXV, fig. 7 (no. 104), shows the pattern of a portion of a bracelet which measures 3¼ inches in length, and weighs 14 dwts. 2 grs. Two bracelets of a different type are shown in Plate XXV, figs. 8 and 11 (nos. 87 and 90). They are quadrangular in section, and were closed by having their extremities, which taper towards the ends, entwined with wire. The block for number 87, which is half the actual size, was made from a model, but the original bracelet has since been acquired, and is now in the collection. Its diameter is 4¼ inches, and it weighs 11 oz. 14 dwts. 19 grs. The other bracelet measures 3¼ inches in diameter, and weighs 2 oz. 5 dwts. 11 grs. The illustration is one-third of the actual size. It was given by W. Holmes, Esq., to Dean Dawson (no. 31 in the latter's catalogue). The bracelet shown on Plate XXV, fig. 12 (no. 70), is composed of a double coil of wire with a diamond pattern, and is fastened by coils of wire twisted round the ends of the bracelet with a spiral in the centre. It measures 2¾ inches in diameter, and weighs 15 dwts. 14 grs.

An example of a similar type of bracelet (no. 74) is also shown on Plate XXV, fig. 9, the illustration being one-third of the actual size. The bracelet weighs 18 dwts. 4 grs. A bracelet of octangular section, with gradually decreasing extremities which overlap and entwine each other, is also illustrated, Plate XXV, fig. 10, one-third of the actual size. The bracelet is numbered 91, and weighs 1 oz. 1 dwt. 6 grs. A chain of six plain rings linked together is also figured, above half the actual size, on Plate XXV, fig. 14.

The illustrations of the ingots and bracelets should be compared with those of the Cuerdale hoard published in the *Archaeological Journal*, vol. iv, pp. 111 and 189, when it will be seen that the objects found in Ireland are identical with those discovered in England; and a perusal of the description of the English find, with an examination of the evidence there adduced, can leave no doubt as to the origin and period to which these silver antiquities are to be ascribed.

1. A silver ingot, rudely cast, 4½ inches long, weight 2 oz. 15 dwts. 16½ grs. Found in the county Down. 2. Do., shorter, weight 2 oz. 7 dwts. 20 grs.; obtained with the Dawson Collection. 3. Do., described on p. 289. 4. Do.,

rude, $2\frac{7}{8}$ inches long, weight 1 oz. 12 dwts. 5 grs.; procured from the county Down. (Dawson Collection.) 5. Do., triangular, $2\frac{3}{8}$ inches in length, weight 1 oz. 4 dwts. "Found with sixteen ingots of the same shape at Blackcastle, near Wexford." 6. Do., cut off at end, weight 17 dwts. 1 gr. "Found in the King's County in 1828 with some Saxon coins; the gift of W. Holmes, Esq., to Dean Dawson." 7. Do., weight 16 dwts. 1 gr. "Found at Ballyadams, Queen's County." (Dawson Collection.) 8. Do., a fragment, weight 6 dwts. 5 grs. 9. Do., weight 9 dwts. 14 grs. 10. Do., larger, weight 11 dwts. 9 grs. 11. Do., weight 12 dwts. 10 grs. 12. Do., weight 2 dwts. $17\frac{1}{2}$ grs. 13. Do., weight 3 dwts. 16 grs. 14. Fragment of a manufactured ring, quadrangular in section; weight 2 dwts. 9 grs. 15. Fragment of a bar, apparently in the working process, weight 5 dwts. 9 grs. 16. Fragment of a curved ring, eight-sided in section; weight 16 dwts. 2 grs. 17. Fragment of a cylindrical rod; weight 5 dwts. 15 grs. 18. Do., weight 6 dwts. 1 gr. 19. Do., weight 6 dwts. 1 gr. 20. Do., weight 7 dwts. 11 grs. 21. A small horse-shoe-shaped silver bar; weight 2 dwts. 3 grs. 22. An unclosed ring, fractured at the end; weight 9 dwts. 19 grs. 23. Do., narrowing towards extremities like some of the rude flat gold bracelets, slightly rounded at extremities; weight 17 dwts. 7 grs. 24 to 31. Eight rude silver rings linked together; their total weight is 10 oz. 16 dwts. 3 grs. Six of these are illustrated (Plate XXV, fig. 14). 32. Fragment of a rude flat ring apparently in process of formation; weight 2 oz. 13 dwts. 3 grs. Found at Ballyadams, Queen's County, 1832. (Dawson Collection.) 33. A plain, flat, thin unclosed ring, oval, tapering towards the ends, $2\frac{3}{8}$ inches in long diameter; weight 1 oz. 13 dwts. 5 grs. 34. Larger, and representing more of the bracelet character, flat, plain, broad in centre, tapering to ends, diameter $2\frac{3}{8}$; weight 1 oz. 18 dwts. 11 grs. Found near Virginia, county of Cavan. (Dawson Collection.) 35 to 38. Four fragments of a thin flat bracelet, weighing together 2 oz. 3 dwts. 4 grs.; said to have been found in the county of Galway. 39. An unclosed ring, cylindrical, rude; weight 19 dwts. 3 grs. 40. Do., more perfect, oval, bar tapers towards ends, diameter $2\frac{3}{4}$; weight 1 oz. 7 dwts. 6 grs. 41. Do., smaller and thinner, extremities pointed; weight 13 dwts. 2 grs. 42. An unclosed armilla, wide in opening, quadrangular in section, ends flattened; weight 9 dwts. 7 grs. 43. Do., four-sided, ends flattened, oval, diameter $2\frac{7}{8}$; weight 1 oz. 12 dwts. 9 grs.; slightly corroded on surface. 44. Do., somewhat larger, very smooth and perfect, $2\frac{5}{8}$ inches long diameter; weight 1 oz., 2 dwts. 12 grs. 45. Do., but slighter, tapers slightly at ends, diameter $2\frac{7}{8}$; weight 18 dwts. 9 grs. 46. Do., slighter ends, slightly flattened, diameter $2\frac{1}{4}$; weight 9 dwts. 7 grs. 47. Do., but more tapering towards small pointed extremities, diameter $2\frac{3}{8}$; weight 12 dwts. 20 grs. 48. Do., but much smaller, resembles a child's bracelet, quadrangular in section, tapers slightly to flattened ends, external diameter 2 inches; weight 10 dwts. 19 grs. 49. An unclosed massive ring, differing in pattern from all the foregoing, hexagonal in section, oval in figure, 1$\frac{7}{8}$ inches in long diameter: weight 1 oz. 16 dwts. 11 grs. This article is evidently unfinished. 50. Silver torque, broken into three portions, formed of two ornamental silver wires twisted rope-like, and reducing in thickness towards ends: weight 3 oz. 0 dwt. 19 grs. See *Transactions R. I. A.*, vol. xxii, pt. 1, p. 319. (Sirr Collection.) 51. Do., formed of central wire surrounded by plaited network of fine wire: weight 1 oz. 5 dwts. 22½ grs. 52. Portion of silver torque formed of seven wires plaited into a curve of triangular section at one end, either forged or beaten into a solid mass, or originally drawn from that mass; weight 8 dwts. 13 grs. 53 to 56. (Three pieces of) a silver torque formed of three plain wires twisted together rope-like: ends of the torque formed of the three wires wrought into a solid mass and reduced to a tapered point; weight 3 oz. 3 dwts. 4 grs. Found in the county of Galway; obtained from Donegan.[1] 57 and 58. Portions of a torque of quadrangular section, ornamented in two outer surfaces by punched triangular markings. Found as 53 to 56: weight 2 oz. 0 dwt. 19 grs. 59. Silver bracelet (?), imperfect, ornamented with a raised linear pattern; weight 1 oz. 19 dwts. 60. Part of a silver torque decorated all over the surface by punched ornament; weight 2 oz. 7 dwts. 11 grs. 61. Fragment of similar ornamented bar, weight 7 dwts. 15 grs. 62. Silver bracelet described on p. 289. 63. Silver bracelet, ornamented; weight 2 oz. 3 dwts. 4½ grs. 64. Do., described on p. 289. 65. Do., weight 3 oz. 10 dwts. 12 grs. (Dawson Collection, 20.) 66. Do., weight 2 oz. 16 dwts. 17 grs. Found in county Galway; obtained from Donegan's collection. 67. Do., described on p. 290. 68. Do., weight 17 dwts. 4 grs. (Dawson Collection, 19.) 69. Do., weight 16 dwts. 2 grs. 70. Do., described on p. 290. 71. Silver bracelet in two parts, joined by a hinge-joint, each portion being of beautifully chased and ornamented silver, hollow. Presented by the executors of Leslie Ogilby, Esq., of Prussia Street; weight 19 dwts. 22 grs. (This object (no. 71) is modern, and probably of Indian origin. 72. Silver bracelet formed of ornamented wire similar to that in 70, but composed of three coils, the ends being loosely wound round them. Mr. Wakeman states it was found near Galway town, January 2nd, 1862. Obtained from Mr. Wakeman; weight 1 oz. 10 dwts. 6 grs. 73. Do., formed of two coils of silver wire ornamented on the convex side with beading, the ends are wound round the centre portion or meeting of the coils; weight 17 dwts. 9 grs. The identification of this is uncertain.) 74. Do., de-

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[1] A silver Scandinavian torc of similar type to the above described is figured in the *R.I.A. Celtic Christian Guide*, 2nd ed., p. 92, fig. 104, No. 2.

scribed on p. 290. 75. Composed of a silver bar of oblique quadrangular section passing into round wires at the ends, mutually entwined and grasping the quadrangular parts; weight 1 oz. 13 dwts. 11 grs. 76. Described on p. 290. 77. Silver bracelet, ornamented. (Dawson Collection, 16); weight 3 oz. 7 dwts. 6 grs. 78. Do., described on p. 290. 79. Silver bracelet, small, ornamented; weight 9 dwts. 21 grs. 80. Do., weight 1 oz. 5 dwts. Found with several others in the scarp of a rath, townland of Emy, county of Monaghan. (Query Dawson Collection, no. 13 or 15.) 81. Described on p. 290. 82. Do., weight 14 dwts. 17 grs. (34 Sirr.) Found near Emyvale, county of Monaghan. 83. Portion of silver bracelet, ornamented; weight 1 oz. 9 dwts. 8 grs. 84. Portion of silver bracelet stamped with chevron pattern, weight 1 oz. 9 dwts. 1 gr. Found in the county of Galway; obtained from Donegan. 85. Portion of no. 84; weight 10 dwts. 16 grs. 86. Silver bracelet, ornamented by a St. Andrew's cross in the centre and by rude flutings; weight 1 oz. 9 dwts. 4 grs. 87. Plated model of silver bracelet of oblique quadrangular section in centre, gradually diminishing towards closure, then passing into strong wires firmly bound together. (This is the model the original of which is described on p. 290.) 88. Silver bracelet, ornamented; weight 17 dwts. 6½ grs. 89. Do., of the same type as 75, but it has the angles taken off or beaten down, and the ends are cut off; weight 16 dwts. 6 grs. 90. Do., described on p. 290. 91. Described on p. 290. 92. Do., massive, portion missing; ornamented by zig-zag punched indentations; weight 3 oz. 13 dwts. 16 grs. (Dawson Collection, 17.) 93. Do., fragment of a bracelet, ornamented by longitudinal punched indentations; weight 4 dwts. 15 grs. 94. Do., ornamented by punched indentations; weight 3 dwts. 4 grs. 95. Do., weight 3 dwts. 5 grs. Found as no. 84. 96. Do., weight 11 dwts. 6 grs. 97. Do., a fragment, perhaps a portion of 86; weight 1 dwt. 17 grs. 98. Do., perfect bracelet, massive, ornamented on both edges by rows of quatrefoil-shaped punchings; weight 3 oz. 8 dwts. 16 grs. 99. Do., small, ornamented (Dawson Collection, 25); weight 15 dwts. 16 grs. 100. A portion of a silver bracelet, ornamented; weight 6 dwts. 17 grs. 101. Do., weight 17 dwts. 23 grs. 102. Do. (in two portions), weight 8 dwts. 15 grs. 103. Do., fragment of, ornamented by chevron-shaped punchings; weight 11 dwts. 7 grs., unidentified.) 104. Portion of bracelet described on p. 290.

BROOCHES.

The following portion of the catalogue deals with the silver brooches in the collection. Of these, numbers 1–23 are mediaeval or later ring-brooches; most of them are plain, but a few are ornamented, and two have inscriptions. Number 12 is the largest and most ornamental; it has ten empty settings on the ring and one on the pin. The small ring-brooches have a diameter of about an inch. Two of these (nos. 7 and 14) are illustrated full size (Plate XXVI, figs. 20 and 21), and will show the type.

Numbers 24 and 26 are silver pins of early type, and numbers 27 to 45 are Celtic brooches of the Christian period, and include such well-known examples as the "Queen's" and "Killamery." The original catalogue of these has been considerably expanded; and as the more important brooches have been frequently described and illustrated, references to the literature dealing with them have been added in several cases. Of these brooches numbers 33 to 35 belong to a well-known type of penannular brooch in which the expanded ring terminals are ornamented with bosses in the form of plain caps joined to one another by strap-work dividing the surface of the brooch into panels, which are filled with interlaced work. Fragments of brooches of this type have been found in the Cuerdale hoard, and they may be dated to the tenth century. Numbers 38 to 41 belong to the "thistle" variety, and may be dated to the early tenth century. It has been suggested that the thistle brooches are due to oriental influences which operated in the Baltic during the Viking period, and the frequent discovery of cufic coins with such brooches lends support to this view.[1]

One of the least-known brooches in the collection is the fine example found in County Tipperary, which does not appear to have been illustrated previously. This is depicted (Plate XXVII), and it is hoped the figure will prove of interest.

In the descriptions of the brooches dates have been suggested where there were any grounds for arriving at them: but as the brooches are few in number, and sundry belong to the same type, it has not been thought necessary to enter into any attempt at a detailed chronology. Mr. R. A. Smith, who has devoted much time to the study of penannular brooches, has dealt very fully with the age of the different types, in a monograph which students are recommended to study; it is printed in *Archaeologia*, vol. lxv, p. 223. The chapter on penannular brooches in the Academy's *Celtic Christian Guide* should also be consulted.

1. Silver ring-brooch, ornamented with a chevron pattern, diameter $\frac{13}{16}$ of an inch: weight 1 dwt. 14½ grs. 2. Do., diameter $\frac{3}{4}$ of an inch; weight 14½ grs. 3. Do., the ring is ornamented half with chevron and half with lines, diameter $\frac{11}{16}$ of an inch; weight 1 dwt. 16 grs. 4. Do., the back of the ring is ornamented with a dotted chevron pattern and a cross, diameter 1 inch; weight 1 dwt. 16 grs. 5. Do., unornamented, 1 inch, weight 1 dwt. 6. Do., diameter $\frac{15}{16}$ of

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[1] *Archaeologia*, vol. lxv, p. 241.

an inch; weight 1 dwt. 7. Do., diameter $\frac{15}{16}$ of an inch; weight 16 grs. 8. Do., diameter $\frac{15}{16}$ of an inch; weight $17\frac{1}{2}$ grs. 9. Do., diameter $\frac{7}{8}$ of an inch; weight 17 grs. 10. Do., diameter $\frac{15}{16}$ of an inch; weight $15\frac{1}{2}$ grs. 11. Do. diameter 1 inch; weight 1 dwt. $15\frac{1}{2}$ grs. 12. Large ring-brooch; the ring is ornamented, and has ten raised settings, all of which are empty; the pin is ornamented, and has an empty setting in its centre. Diameter $1\frac{7}{8}$ inches; weight 11 dwts. 20 grs. 13. Small ring-brooch; it is ornamented with a step-pattern on the front in niello, and a chevron pattern with remains of niello at the back. Diameter $\frac{5}{8}$ of an inch; weight 23 grs. 14. Silver ring-brooch unornamented. Diameter $\frac{15}{16}$ of an inch; weight 20 grs. 15. Do., worn, ornamented on the front and back with floral patterns, diameter $1\frac{1}{16}$ inches; weight 2 dwts. 15 grs. 16. Do., ornamented. Diameter $\frac{15}{16}$ of an inch; weight 2 dwts. 9 grs. 17. Do., the ring is inscribed ЄNNAIDARGAIRAMЄVA + (?) Diameter $1\frac{1}{16}$ of an inch; weight 1 dwt. 17 grs. 18. The ring is inscribed + AVЄ(D)V + AVЄX. (?) Diameter $\frac{7}{8}$ of an inch; weight 1 dwt. 19. Do., ring ornamented. Diameter $\frac{7}{8}$ of an inch; weight 18 grs. 20. Do. Diameter 1 inch; weight 1 dwt. $18\frac{1}{2}$ grs. 21. Do., the brooch is oblong and ends in two hands with their palms joined together. There is an empty setting at the head of the brooch; it is $1\frac{5}{16}$ inches in length, and weighs 1 dwt. $15\frac{1}{2}$ grs. 22. Small circular brooch; half of the ring is twisted and beaded; the other half is plain. Diameter $\frac{3}{4}$ of an inch; weight 1 dwt. $11\frac{1}{2}$ grs. 23. Do., ornamented on front and back. Diameter $\frac{7}{8}$ of an inch; weight 1 dwt. $19\frac{1}{2}$ grs.

24. Small silver pin; the head is roughly circular; the upper portion is formed of pellets; the lower is expanded and decorated with Celtic ornament. (Plate XXVI, fig. 29.) The pin is $3\frac{3}{8}$ inches long, and weighs 3 dwts. $18\frac{1}{2}$ grs. It is an early form of the so-called "hand-type" pins. It was purchased from Mr. W. F. Wakeman, and was found in 1848 at Castletown, Kilpatrick, County Meath, together with a pin of hand-type now in the collection (No. P. 634). See *Proceedings Society of Antiquaries of London*, 2nd series, vol. xx, p. 351.

25. Silver bodkin $5\frac{7}{8}$ inches long, marked E. G. Weight 9 dwts. $10\frac{1}{2}$ grs.

26. Silver pin with a circular head decorated with spiral ornament. The shank is decorated with a number of designs in oblong panels. The pin is $9\frac{7}{8}$ inches long and weighs 2 oz. 9 dwts. 6 grs. It is illustrated *R. I. A. Celtic Christian Guide*, 2nd ed., p. 36, fig. 46.

27. Silver hinge-brooch, the kite-shaped pendant, which is ornamented with inset panels of gilt filigree and granulae work, terminates in an animal's head grasping a ring. The shank of the pin is ornamented; it is $6\frac{7}{8}$ inches long, and the total length of the brooch with the head stretched out is

9½ inches; its weight is 1 oz. 12 dwts. 2 grs. It is similar in character to that found at Clonmacnois, and now in the possession of the Rt. Hon. the Earl of Dunraven, K.P., which is figured by the late Mr. J. R. Allen in *Celtic Art in Pagan and Christian Times*, p. 221.

28. Small silver ring-brooch; the ring is engraved with chevron patterns terminating in beaked heads, and there is a projection from its centre furnished with a movable swivel which has four amber settings. The head of the pin and the neck of the swivel are ornamented with fine wire-work The pin is 4⅞ inches long, and the ring has an outside diameter of 1½ inches. The brooch weighs 1 oz. 2 dwts. 13½ grs.

29 and 30. Ring and pin of silver annular brooch; the hoop of the ring is plain, and ends in animal heads grasping a circular setting, now empty; the pin, which is broken at the back of the head, has an empty circular setting on the front. The pin is 5¾ inches long, and the ring 2⅛ inches in diameter. The brooch weighs 1 oz. 19 dwts. 9 grs.

31. This is described as "portion of fibula." It is a silver bracelet with large knobs at the end. It weighs 1 oz. 13 dwts. 4 grs.

32. Silver penannular brooch; the hoop is plain and ends in animal heads at its junction with the terminals, which consist of four-sided plates, having in the centre a plain boss with a beaded border surrounded by pierced zoomorphic work of a degraded character. The pin is 6½ inches long, and its head is slightly ornamented. The hoop is 3½ inches broad, and the brooch weighs 3 oz. 7 dwts. 8 grs.; it is figured by Salin, *Altgermanische Thierornamentik*, p. 334, fig. 715. It probably dates from about the middle of the ninth century.

33. Silver penannular brooch of the Viking period. The expanded ring terminals are each ornamented with five bosses in the form of plain caps, which, when perfect, were surrounded at the base by a raised beaded ring. The bosses are joined to one another by strap-work, dividing each plate into three panels, which are filled with zoomorphic ornament. The head of the pin is decorated, and the terminals display a slight ornamentation on the back. The brooch weighs 6 oz. 6 dwts. 9 grs.; the pin is 7¾ inches long, and the ring-breadth is 4½ inches. It was found near Virginia, County Cavan, and is figured *R. I. A. Celtic Christian Guide*, 2nd ed., Plate IV, fig. 1. Fragments of brooches of this type were found in the Cuerdale hoard, and may be dated to the tenth century A.D.

34. Silver penannular brooch of similar type. The pin is broken at the end and is 7⅛ inches long. The ring is 5 inches in breadth, and the brooch weighs 7 oz. 19 dwts. 13 grs. For particulars as to its purchase see *Proceedings R. I. A.*, vol. vi, p. 203, and p. xiv of the Appendix.

35. Silver penannular brooch of similar type; the pin-head is broken at the top. The pin is 7¼ inches long, and the ring is 4⅝ inches in breadth. The brooch weighs 6 oz. 12 dwts. 20 grs. It was formerly in the Sirr Collection (no. 21).

36. "Portions of ring of fibula." (Unidentified.)

37. No particulars of this object are given except its weight—3 oz. 5 dwts. 4 grs.—and that it is no. 39 Dawson Collection. Under 39 Dawson Collection it is described as a small fibula, and the weight given as 1 oz. 8½ grs. (Unidentified.)

38. Silver penannular brooch. This brooch belongs to the well-known so-called "thistle type," the pin-head and ring-bosses being decorated on one side with numerous small spikes, and on the other with curved and rectilinear patterns. The pin measures 10¼ inches long, and the ring is 3⅞ inches broad. The brooch weighs 7 oz. 7 dwts. 13 grs. For particulars of its purchase, see *Proceedings R. I. A.*, vol. vi, p. xiv of Appendix. Brooches of this type belong to the Viking period; they have been found in the Cuerdale hoard, and may be dated to the tenth century.

39. Silver penannular "thistle" brooch of similar type. In this case the thistle ornament covers both sides of the bosses and pin-head, which is slightly broken. The pin is 10⅝ inches long, and the ring is 4⅜ inches in breadth. The brooch weighs 11 oz. 13 dwts. 10 grs.

40. Silver penannular "thistle" brooch of similar type. The pin, which is slightly ornamented in the centre of the shank, is 10 inches long, and the ring is 4¾ inches broad. The brooch weighs 12 oz. 18 dwts. 8 grs., and was found "near Mr. Deese's place, county of Kildare." It is figured *R. I. A. Celtic Christian Guide*, 2nd ed., p. 30, fig. 35.

41. Head of very large "thistle" brooch. It measures 4⅜ inches long, and weighs 9 oz. 9 dwts. 11 grs. It is stated to have been found in County Kilkenny, and was purchased with number 38. If the rest of the brooch was in proportion to this ring, the pin would have been 2 feet long, and the diameter of the ring some 10 inches. The back of it is shown one half the actual size on Plate XXVI, fig. 15. It is also figured, both sides, *R. I. A. Celtic Christian Guide*, 2nd ed., p. 31, fig. 36.

42. Silver ring-brooch; the expanded portion of the ring contains raised plates surrounded by an edging of interlaced work. Each plate contains a diamond-shaped space filled with delicate gold filigree patterns. The connexion of the expanded and unexpanded portions of the ring is marked by a setting containing amber. The plates are joined in the centre by a circular boss containing an amber setting at each end (the lower one of which is missing), and a central bar which contained interlaced work. The head of

the pin is of semi-triangular form, with a diamond-shaped space filled with interlaced work; the head has an edging of interlaced work, and there is an amber setting at each angle. The pin is 10 inches long, and the ring, which is slightly ornamented at the back, is 4½ inches in width (Plate XXVII). The brooch weighs 9 oz. 5 dwts. 12 grs., and was found in County Tipperary. It was purchased for £8 2*s.* 2*d.*, and it is stated that "2 pieces of lead are enclosed in the chambers of the ring," the meaning of which is, apparently, that the raised plates have a leaden filling; the raised portion of the pin-head also appears to be filled in the same way.

43. Silver ring-brooch, gilt. The narrow portion of the hoop is ornamented with interlaced work terminating in zoomorphic heads. The expanded portion is decorated with a raised three-lobed ornament containing a central boss filled with granulae and filigree work. The joining of the terminals is marked at the ends, by two human heads, and in the centre, by a bar with interlaced work. The flat portion of the expanded hoop is decorated with zoomorphic work, and at each division of the raised lobes is an animal head. The head of the pin consists of a similar lobed boss to those on the terminal plates. The junction of the hoop and terminals is marked at the back by two boldly executed outline animal heads in relief. The pin, which has a small panel of interlaced ornament in the centre of the shank, is broken at the end; it measures 7¼ inches in length. The hoop is 4½ inches in breadth, and the brooch weighs 7 oz. 18 dwts. 3 grs. It is generally known as the "Queen's" brooch, as a copy of it was presented to Queen Victoria. It is stated, on the authority of Messrs. Waterhouse and Co. of Dublin, to have been found in County Cavan. It is illustrated *R. I. A. Celtic Christian Guide*, 2nd ed., Plate III, fig. 1; see also *Archaeologia*, vol. lxv, p. 231.

44. Silver ring of annular brooch; the hoop is decorated with interlaced ornament, and the terminal-plate with two raised circles containing spiral ornament. The terminal-plate is ornamented with interlaced work and four raised settings containing amber. The division of the terminal-plate is marked by two oblong open spaces, and on the outer edge of the brooch at its junction with the hoop are two bird-like heads. A rope pattern ornaments the outer edge of the brooch; it has three twists at the base. The expanded portion of the brooch is ornamented at the back with four circles, the two upper of which contain gilt panels of geometric, and the two lower of interlaced ornament. The hoop is 3½ inches in diameter, and weighs 2 oz. 1 dwt. 20 grs.

45. Silver penannular brooch; the hoop is highly decorated with panels of spiral filigree work gilt, and in the centre with interlaced filigree work, and a setting now empty. The expanded terminals are square in form and have a raised diamond-shaped boss, with filigree work in the centre, and around

it; the terminals are edged with settings of coloured glass, or garnet, and amber. The head of the pin is broken; it measures 5¼ inches long, and the hoop is 3⅞ inches in breadth. The brooch weighs 5 oz. 1 dwt. 16 grs. It is stated to have been found at Kilmainham, and is figured *R. I. A. Celtic Christian Guide,* 2nd ed., p. 28, fig. 23. See also *Archaeologia,* vol. lxv, p. 239.

FINGER RINGS.

The finger rings dealt with by Sir William Wilde in his MS. catalogue only include those of silver or white metal, and are a varied assortment. The descriptions in the MS. list, which are of a very summary character, have made the identification in several cases uncertain and in some impossible. For such of the rings as have been identified (either certainly or with considerable doubt) a more technical and modern description, taken, with alterations where necessary, from the Museum's Catalogue of the Academy's collection of finger rings,[1] has been substituted for that of the catalogue, while some blocks from the same work have been made use of by permission of the Director of the National Museum.

Of the rings described, numbers 22 to 26 belong to a form allied to the well-known and widely distributed stirrup type, which goes back to the thirteenth century, though the rings described are probably somewhat later than this date. Numbers 27 to 29 and 30 are decade rings. These are rings which have, as a rule, ten projections for the fingers to touch while prayers are recited, their use being similar to that of the rosary. The rings described are probably of seventeenth-century date.

1. Silver, a plain hoop, inscribed on the inside *feare God only.* Greatest external diameter ⅞ of an inch; weight 4 dwts. 17½ grs. (Dawson Collection, 127.)

2. Silver, plain hoop, inscribed on the inside ✠ FOR + GET + ME + NOT. Greatest external diameter ¾ of an inch; weight 1 dwt. 17 grs. (Dawson Collection, 128.)

3. Silver, a plain hoop; 1492 is scratched on the exterior, and on the inside Æ and other marks and letters. Greatest external diameter ⅞ of an inch; weight 3 dwts. 2 grs. (1881: 125). (Identification uncertain.)

4. Silver, a plain hoop, inscribed on the inside *feare god only.* Greatest external diameter ⅞ of an inch; weight 4 dwts. (Dawson Collection, 127.)

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[1] *Catalogue of the Finger Rings in the Collection of the Royal Irish Academy in the National Museum, Dublin,* by E. C. R. Armstrong. (To be obtained at the Museum, price 2d.)

5. Silver, plain hoop, inscribed on the inside *Love God.* Greatest external diameter $\frac{7}{8}$ of an inch; weight 4 dwts. 5 grs. (Dawson Collection, 127.)

6. Thick silver hoop, ornamented with conventional patterns; engraved on the inside with the motto: KEEPE * FAITH * TILL * DEATH. Greatest external diameter 1 inch; weight 4 dwts. 11 grs.

7. White metal broad hoop, decorated with a plain border at each edge and vertical lines between. It is broken. Diameter $\frac{7}{8}$ of an inch; weight 2 dwts.

8. Silver, a broad, flat hoop, with incised diamond and line patterns, each of the diamond patterns having a small cross within it. The inside is engraved with a pentagon followed by the letters TRFWHFORFWFR IK. It is tempting to read the first word as a blundered form of *true* or *truth for ever.* This ring is possibly amuletic, judging by the pentagon which appears at the commencement of the legend, and which usually had a magical significance. It is a palimpsest, the present letters having been apparently engraved over a former inscription. Greatest external diameter $\frac{7}{8}$ of an inch; weight 3 dwts. 8 grs.

9. White metal, thin ornamented hoop, broken and roughly soldered. Diameter $\frac{3}{4}$ of an inch; weight 23 grs.

10. Silver, a plain hoop divided into sections and inscribed on the outside

✠ AVE MARIA GRA|CIA| PL.

Greatest external diameter $\frac{7}{8}$ of an inch; weight 1 dwt. $21\frac{1}{2}$ grs.

11. Described only as "broken in three places." (This has not been identified.)

12. Silver, hoop ornamented with oblong bosses. Greatest external diameter $\frac{13}{16}$ of an inch; weight 1 dwt. 3 grs. (Dawson Collection, 130.)

13. Silver, hoop much broken and roughly repaired; two hands clasping a heart surmounted by a crown. Greatest external diameter $\frac{7}{8}$ of an inch; weight 1 dwt. $23\frac{1}{2}$ grs.

14. Silver (?), ornamental open-work hoop. Greatest external diameter $\frac{3}{4}$ of an inch; weight 3 dwts. $23\frac{1}{2}$ grs.

15. Silver, hoop widens to form the bezel, which is divided into three compartments with ornament in relief; the centre panel has a cruciform pattern, and on each side is a quatrefoil. Two rows of dots divide the panels, and there are four rows of dots outside them. This ring resembles one figured by Dalton (*Catalogue of Finger Rings in the British Museum*, p. 249, no. 1740), which is described as English and assigned to the twelfth century (Pl. XXVI, fig. 24). Diameter $\frac{7}{8}$ of an inch; weight 1 dwt. 18 grs.

16. Unidentified; it is described as "resembling very much some of the silver armillae in ornamentation which does not extend to the extremities."

17. Silver, made of a long thin rod, ornamented with a raised diamond pattern, triple in front and double at the back, the whole secured by the wire-like ends of the rod being twisted round the ring on each side. This is a Scandinavian ring of the Viking period. Diameter $\frac{7}{8}$ of an inch; weight 2 dwts. 4 grs.

18. Silver; the hoop is decorated with incised linear ornament, and on one shoulder there is a cross formy, and on the other a quatrefoil. The bezel is narrower than the hoop and is pointed; it is ornamented on the front with dots in relief, and on the sides with incised lines (Pl. XXVI, fig. 18). Diameter $\frac{7}{8}$ of an inch; weight 19½ grs.

19. This has not been identified.

20. Silver, roundish hoop; the bezel is pointed and resembles the stirrup type; on either side it has a square panel decorated with a cross saltire within a square in niello; the pointed bezel has an incised chevron pattern on the front and a cross on each side (Pl. XXVI, fig. 25). Diameter $\frac{15}{16}$ of an inch; weight 1 dwt. 23 grs.

21. Silver, decorated hoop with a pointed bezel, ornamented with square dots on the front and incised lines on the side, capped by flat knob ornamented with an incised flower; the shoulders are ornamented with square panels decorated with a flower (Pl. XXVI, fig. 27). Diameter $\frac{13}{16}$ of an inch; weight 1 dwt. 13½ grs.

22. Silver; the bezel is pyramidal and ornamented with a knob composed of five pellets; the hoop is inscribed on the outside

A | V | E | M | A | R | I | A | .

Greatest external diameter, including bezel, $1\frac{3}{16}$ inches; weight 4 dwts. 15 grs.

23. Silver, similar type; the bezel is ornamented with three single knobs; the hoop is inscribed on the outside

A | V | E | M | A | R | I | A | G.

Greatest external diameter, including bezel, $1\frac{1}{16}$ inches; weight 2 dwts. 15 grs.

24. Silver, similar type, with traces of gilding; the bezel is ornamented with a cross composed of five knobs in the centre, and two large knobs composed of pellets at the sides; the hoop is inscribed on the outside

A | V | E | M | A | R | I | A.

Greatest external diameter, including bezel, $1\frac{1}{4}$ inches; weight 6 dwts. 12 grs.

25. Silver; the bezel is ornamented with a large cross composed of pellets in the centre and a small one on each side (Pl. XXVI, fig. 17). The ring is

stated to have been found in a stone coffin in Ballymore Eustace Churchyard, County Wicklow. Greatest external diameter, including bezel, 1⅜ inches; weight 7 dwts. 23 grs.

26. Silver, with traces of gilding, similar to the last, but all the crosses on the bezel are smaller (Pl. XXVI, fig. 26). Greatest external diameter 1 3/16 inches; weight 5 dwts. 14 grs.

Numbers 27–31 are decade rings.

27. Silver, with ten projections, oval bezel inscribed with a cross beneath the letters INR. At the back of the bezel are engraved the letters E.M. Greatest external diameter, including bezel and projection, 1⅛ inches; weight 4 dwts. 19½ grs. (Dawson Collection, 109.)

28. Silver, ten projections, oval bezel engraved with a cross fitchy above the letters IHS. Greatest external diameter, including bezel and projection, 1 1/16 inches; weight 3 dwts. 4 grs.

29. Silver, ten projections, heart-shaped bezel engraved with a cross above the letters IHS. Greatest external diameter, including bezel and projection, 15/16 of an inch; weight 1 dwt. 14 grs. (Dawson Collection. 109.

30. Silver, thin hoop, with ten small knobs, oval bezel with a rayed cross in relief, having above it the word JUBILE and below it the date 1826. Greatest external diameter ⅞ of an inch; weight 21 grs.

31. Silver, ten projections; the bezel is replaced by a standing cross (Plate XXVI, fig. 23). Greatest external diameter, including the cross and a projection, 1 9/16 inches; weight 2 dwts. 20 grs. (Dawson Collection, 109.)

32. Silver, thin hoop; the bezel consists of two conjoined hearts surrounded by a beaded border and surmounted by a beaded crown. Greatest external diameter ⅞ of an inch; weight 1 dwt. 11½ grs.

33. Silver, a thin plain hoop with a small oval bezel ornamented in relief with a rude figure of the Virgin and Child; below the figures is the word HAL. Greatest external diameter, including bezel, ¾ of an inch; weight 19½ grs.

34. Silver, plain hoop; the bezel consists of a central knob surrounded by filigree work with five smaller knobs with filigree work on each side. Oriental. Greatest external diameter, including bezel, 1/16 of an inch; weight 2 dwts. 1 gr.

35. Silver, clasped hands in front, hoop ridged at back, with an inscription ·brd naza Renvs· (Jesus of Nazareth). Fifteenth century. (Plate XXVI, fig. 28.) Greatest external diameter ⅞ of an inch; weight 3 dwts.

36. Silver; the hoop is much bent out of shape and worn. It is ridged, and there are two side panels which were apparently engraved. Greatest external diameter 1 inch; weight 6 dwts. 1 gr.

37. Silver, the hoop is ridged and engraved with half-lozenges, hands clasped at back; bezel oblong and similarly ornamented as the hoop.

Greatest external diameter $\frac{13}{16}$ of an inch. Fifteenth century; weight 3 dwts. 16½ grs. (Dawson Collection, 121.)

38. Silver or white metal, which has been coated with a poor kind of gilding; the broad hoop is engraved with a sort of rope pattern; the shoulders are engraved with saltires and circles, and the ridged bezel with a kind of leaf decoration. External diameter, including bezel, $\frac{7}{8}$ of an inch. This is probably of German origin; weight 7 dwts. 6 grs.

39. Not identified (described as massive, gilt, ornamentation lozenge-shaped spaces with central circle, and highly engraved).

40. Silver; the back of the hoop is plain; the shoulders are ridged and engraved with a chevron plait ornament; the bezel is ridged and engraved with a similar ornament. Fifteenth century. External diameter, including bezel, $\frac{15}{16}$ of an inch; weight 7 dwts. 18 grs.

41. Silver, engraved hoop with a knob in the centre opposite the bezel; oval bezel engraved with concentric circles, and in the centre a saltire. An oriental ring of mediaeval date. Greatest external diameter, including bezel, $\frac{7}{8}$ of an inch; weight 2 dwts. 10 grs.

42. Silver, uncut signet, engraved hoop ornamented with five knobs, plain oval bezel. An oriental ring of mediaeval date. Greatest external diameter, including bezel, $\frac{7}{8}$ of an inch; weight 6 dwts. 14 grs. (Dawson Collection, 114.)

43. Silver; wide hoop with two ridges, and between these incised lines in pairs. Circular bezel with a simple interlacing ornament of a single band. Diameter $\frac{13}{16}$ of an inch; weight 3 dwts. 9 grs.

44. Silver signet, ornamental ridged hoop, roughly circular bezel engraved with a cipher within a beaded border. Greatest external diameter, including bezel, $\frac{7}{8}$ of an inch; weight 4 dwts. 15 grs. (Dawson Collection, 113.)

45. Silver signet, octagonal bezel, engraved with a cipher within a beaded border. Found near Castlestewart, County Tyrone. External diameter 1 inch; weight 6 dwts. 9½ grs. (Dawson Collection, 131.)

46. Silver signet, ornamental hoop, large oval bezel, engraved with the letters **I I S** within a beaded border. External diameter, including bezel, $\frac{15}{16}$ of an inch; weight 7 dwts. 5½ grs.

47. White metal, engraved shoulders; the circular bezel is engraved with the letters ΔIHITOI. Byzantine. Greatest external diameter, including bezel, $\frac{13}{16}$ of an inch; weight 2 dwts. 24 grs. (Dawson Collection, 115.)

48. Silver; the bezel is broken and the setting missing; the hoop, which is much worn, is inscribed on the outside + ... **EGO** . **NEA** ..... The inscription is unreadable, but was probably of a religious character. Greatest external diameter $\frac{15}{16}$ of an inch; weight 2 dwts. 14½ grs. (Dawson Collection, 118.)

49. Silver; the hoop is broad and flat, with applied foliate ornament, joined at the back by a beaded line. The bezel is missing. (Plate XXVI, fig. 19.) External diameter $\frac{15}{16}$ of an inch; weight 4 dwts. $12\frac{1}{2}$ grs. (Dawson Collection, 118.)

50. Unidentified.

51. Silver; ornamental hoop with shoulders of pierced work. The bezel is tooth-shaped and contains a tooth; it is engraved at the back with a crucifixion, and on the inside of the ring in Irish characters is inscribed the well-known term of endearment, Cuıꞅle mo Ċꞃoıḋe. This and the following ring belong to a well-known German type of seventeenth century or later date. The German examples are often set with the teeth of the young roebuck. This ring would seem to have been used as a love ring in Ireland, but the type may have been amuletic, the teeth being used as charms. The Irish inscription was probably engraved on the ring in the early nineteenth century. It was found in Townsend Street, Dublin, in 1831. Greatest external diameter, including bezel, 1 inch; weight 1 dwt. $13\frac{1}{2}$ grs. (Dawson Collection, 106.)

52. Silver, similar to last, but the shoulders have a piece of glass set in gold placed upon them *en placard*. There is no inscription or crucifixion on the inside of the ring. (Plate XXVI, fig. 16.) Greatest external diameter 1 inch; weight 5 dwts. 17 grs. (Sirr Collection, 47.)

53. Silver; plain hoop, pointed-oval bezel with a projecting knob at each side, the shoulders being similarly ornamented. Greatest external diameter $\frac{15}{16}$ of an inch; weight 2 dwts. $7\frac{1}{2}$ grs.

54. Silver; broad hoop ornamented with grooves, bezel star-shaped with eight points; the four claws contain a piece of coloured glass. Greatest external diameter, including bezel, $1\frac{1}{8}$ inches; weight 3 dwts. 7 grs.

55. Silver or white metal plain wire hoop, circular bezel with a beaded edge, containing a setting of iron pyrites; diameter, including bezel, $\frac{15}{16}$ of an inch; weight 1 dwt. 15 grs.

56. Silver; the hoop is round in section; the shoulders are decorated with a lotus flower in relief; the pointed-oval bezel contains a faceted piece of red glass. Possibly oriental. Greatest external diameter, including bezel, 1 inch; weight 2 dwts. 15 grs. (Dawson Collection, 105.)

ECCLESIASTICAL ANTIQUITIES.

Chalices, Patens, and Crosiers.

The portion of the catalogue dealing with the ecclesiastical antiquities is short, though the descriptions of the objects are very full. One chalice, a base of a chalice or monstrance, one paten, four crosiers, and six bells are described. For a general discussion of the crosiers and bells the student is referred to the chapters dealing with those objects in the *R. I. A. Celtic Christian Guide*, 2nd ed., 1910. The late Mr. J. R. Allen's *Celtic Art in Pagan and Christian Times* may also be consulted with advantage, as well as *Early Christian Art in Ireland*, by Miss Stokes (revised edition).

1. This was catalogued in error as a chalice. It is a late eighteenth-century Sheffield-plated cup. It was purchased from Mr. Murray of Mullingar in 1853.

2. Silver stand of chalice 7⅛ inches high, and 5¾ inches in greatest breadth across its hexagonal foot or bottom, at about ⅜ inches within the edge of which arise four steps having on their faces three sunken mouldings, and surmounted by six compartments gradually narrowing with a concave curve from about 2⅜ inches to ¾ inch at the top; along this lower part is the inscription—

✠ ORATE * PRO * AIABVS * DONALDI MARTIN * ET * JOANNAE *
HOLAGHAN * EIVS * VXORIS * QVI ME * FIERI * FECERVNT
A° $\overline{\text{DNI}}$ 1640,

one compartment being ornamented by an engraved representation of the Crucifixion, with ladder, spear, sop, a skull and bone; another with that of the Virgin and Child, standing on a crescent and surrounded by floral emblems; and a third with the mitred figure of an ecclesiastic robed and holding an archbishop's cross in his left hand, and having his right raised in benediction; the three other compartments have engraved floral embellishments.

3. Brass stand of a monstrance or chalice. The foot is divided into six compartments engraved with the letters IHC and XPC alternately. The compartment that was engraved with the Crucifixion is cut away; the knop is lobed and has six diamond-shaped projections with conventional floral patterns; the stem is cabled at the angles above and below the knop, and at the junction of the foot and stem there is an openwork, gate-like pattern. It is 5½ inches in height, and the base measures 7⅜ inches in width. It probably dates from the first quarter of the sixteenth century, and is stated to have been found at Mellifont, county Louth.

4. Paten, pewter, 5½ inches in diameter, and having in the centre a raised figure of the Crucifixion. Purchased from Mr. Murray, Mullingar.

5. This was described in error as a "Patina, Brass." It is a bronze spoon-shaped object belonging to the La Tène period. The exact use of such spoons is unknown, but it has been suggested they may have been used for the preparation or application of paint. (See Déchelette, *Manuel d'Archéologie*, vol. ii, part 3, p. 1277.) The object is figured in the *Archaeological Journal*, vol. xxvi, facing p. 66. It was purchased from Mr. Murray.

6. This object, also described as a "Patina, Brass," is similar to No. 5. It was purchased from Mr. Murray.

7. Ancient ornamental crosier belonging to the Abbots of Clonmacnois (No. 75, Sirr's Catalogue, p. 25). This elaborately and beautifully ornamented article stands 3 feet 2¼ inches in height, and is 1¼ inches in diameter of the main shaft; a length of 2¾ inches of the lower part consists of a spike, and frustum of a cone, separated by a projecting convex band, above which for a length of 2½ inches is an ornamental barrel-shaped portion about 1⅜ inches in diameter at top and bottom, and 1¾ inches in the centre, where it is surrounded by an inlaid band divided into four compartments by sunken-headed knobs, which evidently had each a blue bead inserted in it similar to two which may be seen on the corresponding barrel-shaped portion below the crook of the crosier. From near each of the four proceed pairs of narrow bands towards the top and bottom; these with the top and bottom bands divide the surface into sixteen triangular compartments, fourteen of which retain various interlaced patterns executed on brass inserted in each compartment, no two being of precisely the same design. Next above appears the main shaft of the crosier, in length 2 feet 2¾ inches, but appearing to extend into and be enclosed by the foregoing and its corresponding upper ornament, as of course the ring of quadrupedal figures. The shaft is of timber (perhaps yew) surrounded outside by thin sheet-brass with a coating of leather between both. Around the shaft's centre is placed a band 1⅝ inches in greatest diameter and 3½ inches in greatest length, having its surface inlaid with patterns of silver and niello in curved grooves, forming by their interlacements and intersection three crosses at the swell, and entwined knottings at the end of the ornament, through which the shaft has been passed into this. Surmounting and encircling the head of the shaft is a ring 1$\frac{11}{16}$ inches in length, ornamented by four grotesque quadrupedal figures having bird-like claws in place of feet, their quarters are adorned with scroll-like indentations, their necks and sides by carved ones; their tails are formed each into a triangular knotted emblem, and terminate in pairs above two heads like those of the figures—one of them retaining a blue inlaid bead such as had been used for all the eyes—two beads remaining in like manner in two of the grotesque quadruped heads of the eight originally inserted.

Next above is the second barrel-shaped portion, referred to before when describing that near the bottom, being 3 inches long, 1¾ inches in diameter in the centre, and 1½ inches at top, and divided as the lower one into sixteen triangular compartments, thirteen of which retain the inserted bosses with interlaced patterns, each of which is in all probability different from any other on either of the two portions. There are the same number of knobs for holding beads, of which two large and two small remain perfect; a third small one is fractured.

The crook has both its sides ornamented with curiously interlaced curved patterns formed by inlaid straps of silver; the zoomorphic cresting consisting of a series of dog-like quadrupeds, commencing from a head-like ornament and continuing to the front of the head; about five more of the series being deficient. The front of the head is $2\frac{1}{2}$ inches long, having at the top a grotesque human head, and under it the figure of a bishop $1\frac{1}{2}$ inches long, holding in his left hand a crosier, and having his right raised in benediction.

This crosier is a fine example of the Hiberno-Danish style, and probably belongs to the eleventh or early twelfth century. It is figured *R. I. A. Celtic Christian Guide*, 2nd ed., Plate XV.

8. Shaft of a very ancient crosier, supposed to be the crosier of St. Columba, formerly belonging to the Abbey of Durrow, in the county Meath. Purchased from Mr. Nugent. See *Proceedings R. I. A.*, vol. v, p. 86, and the account of it there. It is 3 feet $7\frac{3}{8}$ inches in length, $1\frac{9}{16}$ inches in diameter at one end, and $1\frac{1}{2}$ inches at the other, formed of timber surrounded by seven portions of sheet-brass, one brazed, tube-like, and surrounded by a short portion of similar tubing, the other not quite surrounding the wood; two barrel-shaped rings of cast brass, one plain $2\frac{1}{4}$ inches in length and greatest diameter, and having a band of silver encircling its central swell, having at one end four brass-headed nails, and at the other, one remaining of six, for fastening it on the shaft, the other having on its surface the remains of elaborate ornamentation, and being $\frac{1}{16}$ of an inch less in length and diameter than the plain one. The coverings of sheet brass are fastened to the timber shaft, which is broken, by numerous brass nails.

9. Upper boss of No. 8 formed of yew timber surrounded at the thick end by a ring of brass $1\frac{5}{8}$ inches in length and $1\frac{3}{4}$ inches in diameter, ornamented by a prominent pattern of curved interlacements formed by bands of different breadths and by two circles at either end, one ornamented with chevron pattern, the whole surface appearing to have been gilt. Adjoining the last portion is a barrel-shaped rim $2\frac{1}{8}$ inches long and $2\frac{7}{8}$ inches in greatest diameter, divided by a central sunken zone into two circular compartments, each of which is occupied by a series of repeated ornamental devices peculiar to itself—except two portions of the upper one, to which ornaments were attached. The zone is divided into four by three rectangular spaces, two of which retain places for settings, and by a space ground off for attachment of some ornament, the divisions of the zone being ornamented with gilt devices, either side of which are raised portions of bands. Next above is the remaining part of a

brass ring 1¼ inches in length and $1\frac{13}{16}$ inches in diameter, which had about four rectangular opes about ⅝ inch by ⅜ inch, and elevated bands at both top and bottom running into cross bands which separated each pair of opes, the opes and adjoining portions of the ring appearing to have held some additional ornament now wanting. To one of the compartments of the barrel-shaped portion, and adjoining the existing cross band, is attached by a brass nail an ornament with its surface decorated by an interlaced pattern, and evidently that from which sprung whatever class of embellishment was placed outside the convex surface of the crook which formed the continuation of the crosier from the last described ring, as the curve of the pointed shaft denotes. The central wood of the article to within about 1¾ inches of its top is surrounded by thin sheet-copper, not the same as that of brass which surrounds the shaft, making it doubtful whether this boss and the shaft (no. 8) ever formed parts of the same crosier. The wood of both should be microscopically examined. The complete crosier is figured *R. I. A. Celtic Christian Guide*, 2nd ed., p. 59, fig. 57.

10. Ancient Irish crosier-head supposed to be the remains of the crosier of St. Blathmac, of Rath Blathmac near Corofin, in the county Clare. Purchased December 2, 1830, from the Rev. Stephen Walsh. See *Proceedings R. I. A.*, vol. v, pp. 85–6. This consists of a barrel-shaped portion which measures, with the attached ornament below, 5 inches in length and 2⅛ inches in greatest diameter (and is a brass casting, several various-shaped apertures over its body having had the solid surface inlaid with silver), and of a crook 14½ inches in length over convex surface and front, formed of two corresponding divisions attached side by side, and having their surfaces divided by raised bands with circles at the crossings into lozenge-shaped compartments. The ornamentation of the front is not forthcoming. This crosier is figured *R. I. A. Celtic Christian Guide*, 2nd ed., p. 60, fig. 58.

11. Ancient crosier-head of copper measuring in convexity 14¼ inches. It consists, like no. 10, of a barrel-shaped portion 3 inches or 3½ inches long and 1¾ inches in greatest diameter, having on its surface twelve circular sunken indentations, most likely for holding glass or other settings, each hole originally surrounded by an inlaid circle of silver, a straight inlaid band of silver connecting each adjoining circle; the indentations placed in three rows round the body of the portion—one of four round the greatest diameter, and two of four more each at either side of last, half way between it and the ends, each pair above and below corresponding to the centre between each pair of those in the first central row. October, 1866, Mr. Clibborn says it was purchased from Underwood. It is figured *R. I. A. Celtic Christian Guide*, 2nd ed., p. 62, fig. 61.

IRON BELLS.

1. Square iron bell. Bell formed of hammered-out or sheet-iron, joined along the narrow sides or ends by an overlap of nearly an inch, which is secured by three rivets. The handle, which passes through two apertures on the top, appears to be continued so as to form on the inside an attachment for the clapper. It stands 12 inches high exclusive of the handle (with the handle, over 14 inches), and is about 9 inches by 6 inches at the mouth, which is oblong. Found in Castle Mylogh, near Oldcastle, Co. Meath. The edge of mouth shows that it was washed or coated with bronze or brass. (Dawson Collection, 10.)

2. Similar bell, in metal and construction, but has five rivets, and stands $9\frac{3}{4}$ inches high, and with the handle, over $11\frac{1}{2}$ inches. It was coated, inside and out, with bronze or brass, which may be seen on portions of the surface in raised lumps or corrugations. From Cashel, Co. Tipperary. (Dawson Collection, 11.)

3. Bell, similar in construction and coating to the last, and about the same height; it has only three rivets at the ends, and measures at the mouth 8 inches by 6 inches; it has not so much appearance of the bronzing, and is in worse preservation. Found at Tybroghan, near Mullingar, on a flat stone over a grave. (Dawson Collection, 12.)

4. Bell, similar in construction and coating to no. 3, and likewise partly destroyed by corrosion. It has the handle continued through the top in the same manner for suspending the clapper as no. 1. Near one of the angles at the mouth is a slit artificially made, running $1\frac{3}{4}$ inches into the body of the bell; height same as no. 3; breadth at mouth, $7\frac{1}{4}$ inches by 6 inches. Found at Tybroghan, near Mullingar, on a flat stone over a grave. (Dawson Collection, 13.)

5. Bell, similar to foregoing; it is very imperfect, and wants the handle; it shows little, if any, traces of bronzing. It stands $8\frac{1}{2}$ inches high, but appears to have been originally as tall as no. 3 or 4. From Ennisnag, Co. Kilkenny. (Dawson Collection, 14.)

6. Bell, similar to foregoing; it is much destroyed by corrosion, wants the handle, has remains of bronzing well marked, stands 9 inches high, and is at the mouth $6\frac{3}{8}$ inches by $5\frac{1}{4}$ inches. Found near the ruins of Labbamologa, near Mitchelstown, Co. Cork.

See the chapter on Bells, *R.I.A. Celtic Christian Guide,* 2nd ed., pp. 65–67; and also the figure of St. Patrick's bell in the same work, p. 47, fig. 52, as an example of the type of these iron bells coated with bronze.

MISCELLANEOUS OBJECTS.

The descriptions of the following miscellaneous objects, numbers 62–82 and 88–100, have been allowed to stand in their original form. The various antiquities described appear to be for the most part foreign and not of an important character. The most curious point is the statement that nos. 63–70 and number 96 were found in an oak box in the excavation for the harbour wall at the mouth of the river Boyne, near Drogheda, and the Tara brooch with them. The editor has not been able to find any confirmation of this assertion, and previously the Tara brooch has been said to have been found in 1850 on the strand at Betaghstown, near Drogheda. Nothing appears to be known as to other antiquities having been found with it, while of the objects (numbers 63–70 and number 96) stated to have been so found, none appear to be Irish, with the possible exception of the twelve beads (number 68), which may have been rosary beads. Of the remainder number 63 may be oriental; numbers 64, 65, and 66 are possibly of European origin. Numbers 67 and 69 may be oriental, while number 96 is probably some form of chatelaine of Russian origin.

62. Silver top of sword-pommel inlaid with fine wire filigree. Purchased from Mr. Murray. See *Proceedings R.I.A.*, vol. vi, p. 203; weight 2 oz. 16 dwts. 3 grs. 63. Silver handle, composed of fifteen square wires twisted into a spiral bundle round a central wire, and in the opposite directions from the centre of the handle are attached on the concavity and convexity of it two round knobs of beads. Portions of this, as examined by Mr. Mallet, contained 95·87 per cent. of silver, 3·59 per cent. of copper, ·17 per cent. of gold. See *Transactions R.I.A.*, vol. xxii, Pt. I, p. 319, no. 7; weight, 8 oz. 7 dwts. 4 grs. This was found with no. 96 and nos. 64–70 in the excavation for the harbour wall at the mouth of the river Boyne, near Drogheda. in an oak box, and along with them the brooch called that of Tara. It is said that the boxes covered with filigree work, numbers 64 and 65, were attached to the ends of number 63. 64. Silver box covered with filigree work, imperfect at the top, and having at the upper end of each narrow side a round knob attached, which, as well as the box, appears to have been subject to much friction. See no. 63; weight 1 oz. 8 dwts. 20 grs. 65. Silver box similar in every respect to no. 64, except that it is nearly perfect at the top. See no. 63; weight 1 oz. 9 dwts. 14 grs. 66. Chased hollow bangle with hinge-joint, on either side of which it was beautifully ornamented on the convex surface for a length of nearly 5 inches; weight 3 oz. 8 dwts. 3 grs. The bracelet, or a part of its hinge, was examined by

Mr. Mallet, and the analysis gave 92·38 per cent. silver, 7.21 per cent. copper and ·30 per cent. gold. See *Transactions R.I.A.*, vol. xxii, Pt. I, p. 319, no. 8. 67. A collection of silver ornaments strung on wire and consisting of 7 triple silver beads, ornamented round the apertures, of 7 double beads, having one of each ornamented as previous 7, and the other spherical, similar to the 12 composing no. 68—of 24 beads single, each similar in size, etc., to those forming the first 7 triple ones—of 33 ornamental links or drops of a sort of chainwork, consisting each of 5 parts, so that all the different parts amount in number to 71, or, reckoning the individual parts of the 3 links as one, to 202 in number; weight (including the wire) 20 oz. 10 dwts. 11 grs. They were found with and as number 63. 68. Twelve spherical perforated silver beads. Found with and as number 63; weight 7 dwts. 22 grs. 69. Five portions of a silver fillet-like ornament. Found with and as number 63; weight 1 oz. 16 dwts. 4 grs. 70. Eleven silver beads similar to the 24 described under number 67. Found with and as number 63. (These have since been strung upon the same wire as number 67.) 71. Silver bead formed of two cones joined at their bases; weight 4 dwts. 19 grs. 72. A similar article; weight 4 dwts. 22 grs. 73. A hollow silver tube having at the larger end a termination similar to some of the beads in number 67, and at the other a row of small knobs; at either end of the central shaft of the article one-third of it is covered by a coil of wire plaited; weight 7 dwts. 20 grs. 74. A similar article to number 73; weight 10 dwts. 18 grs. (Pl. XXVI, fig. 22). 75. Do., do.; weight 10 dwts. 16 grs. 76. Ornamented silver bead or part of a brooch (Dawson Collection, 145); weight 2 dwts. 22 grs. (Unidentified.) 77. Three silver beads different in shape and differently ornamented. (Dawson Collection, 150.) This number probably should be attached to 71 and 72; weight, 11 dwts. 19 grs. 78. Five antique silver beads; all are in shape like numbers 71 and 72, but ornamented. (Dawson Collection, 149.) This number probably belongs to number 77; weight 5 dwts. 4 grs. 79. A piece of silver which appears to be a portion of the ornamented head of a large silver nail or rivet; on part of the surface may be seen ornamental punchings; weight 2 dwts. 4½ grs. 80. Small plated spoon with corrugated handle. Found at Trim, Co. Meath, with numbers 81 and 82, and presented by the Dean of Clonmacnois. (Unidentified.) 81. Small silver spoon with spirally twisted handle and hole at its end. (Unidentified.) 82. Small silver spoon with round handle ornamented by slight punchings. (Unidentified.) (There are no entries for the numbers 83–87.) 88. Silver spur ornamented, and having large iron rowel; weight 8 oz. 4 dwts. 20½ grs., including iron rowel. (The iron rowel at present fitted to this spur appears to be earlier in date than the silver portion, and is probably not the original rowel.)

89. Silver ornament, circular, embossed ; weight 5 dwts. 4 grs. (Unidentified.) 90. Silver circular ornament having various perforations, and ornamented by waving double lines of dottings. (Dawson Collection, 227.) 91. Portion (smaller) of no. 90. (Dawson Collection, 228.) These portions are now joined, and the total weight is 7 dwts. 23 grs. 92. Portion of handle of spoon (?), plated; weight 4 dwts. 8 grs. 93. A silver reliquary, presented by Dr. Aquilla Smith. See *Proceedings R. I. A.*, vol. iii, p. 409; weight 7 dwts. 19 grs. 94. Silver buckle, two perforated silver plates and two studs with loops for being inserted in the plates, one of the studs being set with amber; weight 1 oz. 3 dwts. 10 grs. (Sirr Collection, 267.) (Unidentified.) 95. Silver and cameo button with heads of William and Mary; weight 1 dwt. 20 grs. (Sirr Collection, 57.) 96. Silver ornament composed of a barrel-shaped ornamented bead, beneath which are alternate rows of beads and bars gradually increasing in width from 2 beads to 11. From the last bar depend 10 pieces of chain holding an ornament of similar make to that above them, the beadings increasing from 11 in first row to 15 in last, below which the last bar holds one large and 10 small plates inlaid with niello. This was found near Drogheda. See number 63. Purchased from Donegan ; weight 10 oz. 0 dwts. 12 grs. 97. Silver chain and rings, 6¾ inches long, holding at one end two portions of similar chain, ⅞ inches long, and terminated each by a small, heart-shaped ornament furcated at the end; weight 5 dwts. 5 grs. 98. A similar article to number 97; weight 7 dwts. 11 grs. 99. A similar article to number 97 ; weight 7 dwts. 21 grs. 100. Silver spoon with round handle. (Unidentified.)

NOTE.—It must not be inferred that objects marked 'unidentified' are missing from the collection, but merely that the catalogue descriptions have not enabled the editor, at the time of writing, to make the necessary identifications.

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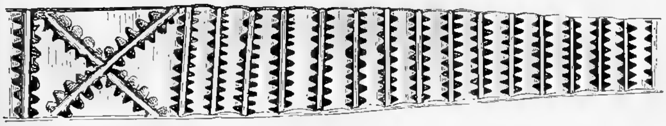

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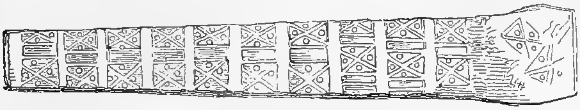

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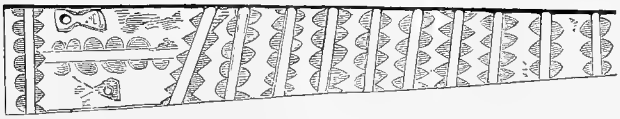

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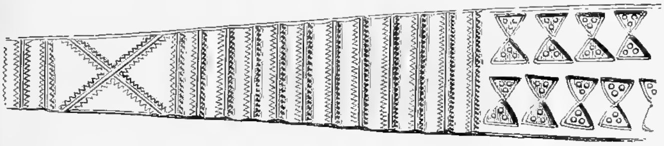

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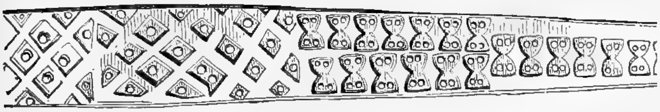

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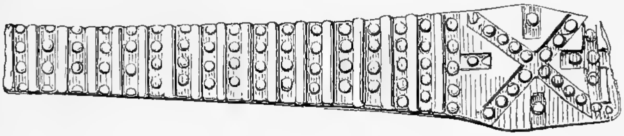

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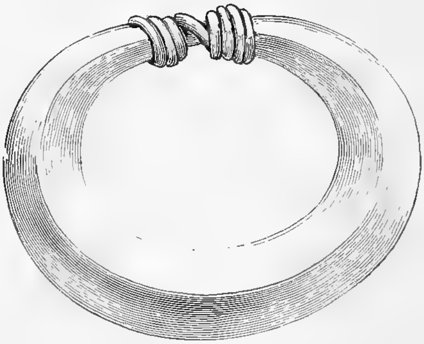

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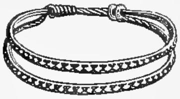

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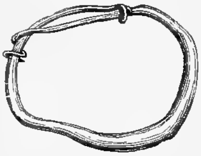

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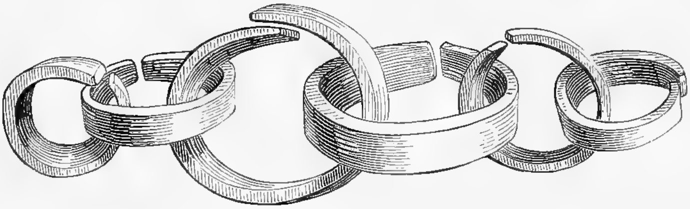

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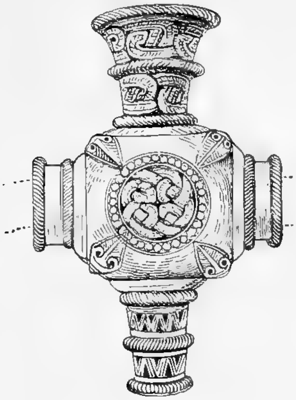
Armstrong.—Wilde's Catalogue of Silver Antiquities.



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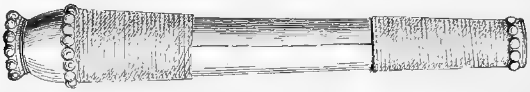

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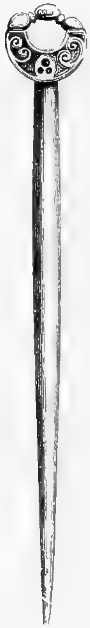

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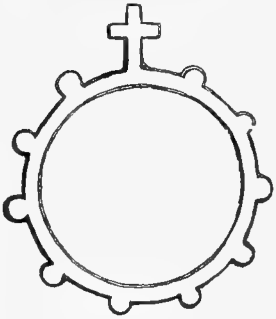

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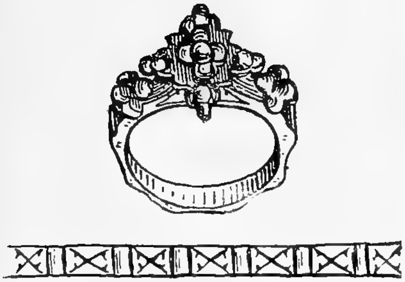

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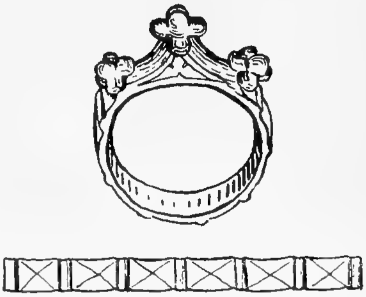

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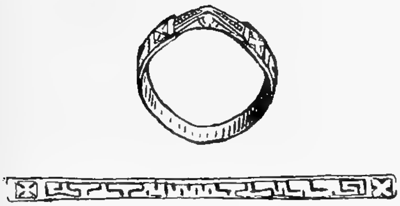

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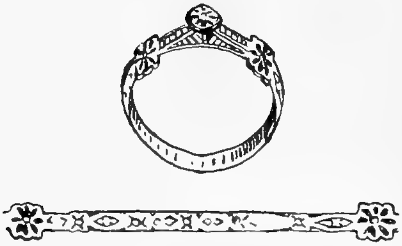

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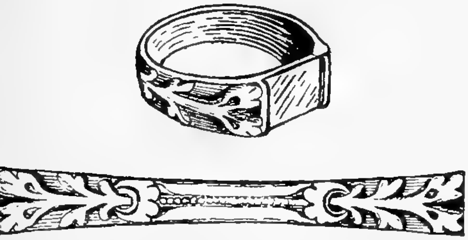

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ARMSTRONG.—WILDE'S CATALOGUE OF SILVER ANTIQUITIES.

Brooch found in Co. Tipperary ($\frac{2}{3}$).

ARMSTRONG.—WILDE'S CATALOGUE OF SILVER ANTIQUITIES.

XIX.

A CHARTER OF DONATUS, PRIOR OF LOUTH.

By REV. H. J. LAWLOR, D.D., Litt.D.

Plate XXVIII.

Read April 26. Published August 16, 1915.

It is nearly two years since I introduced to the notice of the Academy a Charter of the Priory of St. Mary, Louth, preserved among the muniments of the Marquis of Ormonde at Kilkenny Castle. I endeavoured to show that it may be assigned to the year 1187–8, and that it is of considerable interest from an historical point of view. Shortly after it appeared in the *Proceedings*[1] Lady Constance Butler was so kind as to send me a transcript of another charter of the same Priory. It will be included in the Calendar of the Ormonde Deeds which is being prepared for the Historical Manuscripts Commission by Dr. H. F. Berry (no. 332); but its interest justifies the printing of the text and a discussion of its contents.

In the following copy the contractions of the original are expanded.

Donatus Mis*er*acio*n*e diuina lugdone*n*sis eccl*es*ie dict*us* p*r*ior *et* toci*us* loci ei*us*de*m* *con*uen*tus* Vniu*er*sis s*anct*e Matris eccl*es*ie filiis ad q*u*os p*r*e*s*en*t*es lit*er*e pe*r*veneri*n*t sal*utem* i*n* chr*ist*o. Nouerit huniu*er*sitas v*est*ra nos assensu *et* co*m*muni co*n*silio toci*us* capituli n*ost*ri *con*cessisse *et* q*u*ietas cłamauisse [Rogero Pipard et heredibus suis] p*r*e*s*entacio*n*es *et* donacio*n*es o*mn*ium eccl*es*iar*um* *et* decimaru*m* toci*us* cantedri (!) de mucherne[2] excepta t*er*cia p*ar*te decimar*um* d*e* blado. *et* de lana. *et* d*e* agnis. d*e* feudo .v. militu*m* .*scilicet*. de feudo vni*us* militis ap*u*t Ros. *et* de feudo q*ua*tuor militu*m* de d*omi*nico de douenacmai*n*. qua*m*

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[1] Vol. xxxii, Sect. C, p. 28.

[2] This word might be read ‘ matherue.

*ter*cia*m* *par*te*m* *pre*fat*us* Rog*er*us pipard caritatis i*n*tuitu eccl*esie* n*ost*re i*n* pura*m* *et* *per*petuam elemosinam *con*cessit *et* sigilli sui munimi*ne* *con*firmauit. Et ut h*oc* rat*um* *et* in*con*cussu*m* i*n* poster*um* *per*maneat testimonio i*m*p*re*ssio*n*is sigilli capituli n*ost*ri corroboravim*us*. His *testibus*. Toma ep*iscopo* d*e* clocker. Illario subp*r*iore. Gille Furs soler Sim*one* d*e* cli*n*tune. Rad*ulfo* derepe*n*teni Will*el*mo g*er*aun. Math*eo* de Fulesaga. Rob*erto* *per*sona de adh*er*det. *et* Multis aliis.

Attached to the Charter is an excellent impression in green wax of the capitular seal of the Priory. Surrounding a representation of the Mother and Child is the legend, of which only a couple of letters are lost:

✠ S^{c} C[AP]LI CANONICORVM SCE MARIE DE LVGVE.

The Virgin holds a lily in her right hand.

The Charter, it will be seen, is a grant of the advowsons and tithes of the cantred of Mucherne, saving the third part of the tithes of a fee of one knight at Ros, and of a fee of four knights out of the lordship of Douenacmain. These denominations can be identified without difficulty. Among the Fiants of Queen Elizabeth, there is a lease to John Wakely of certain "rectories and spiritualities" which had belonged to the suppressed monastery of Louth.[1] The list of them includes "Megherosshe and Donagmayne." There is also a lease to Edward Moore,[2] which mentions, among other denominations, "the rectory of Maghyrcloo, in Inferny, half the rectory of Rosse, called Maghyrrosse, in Inferny, lands of Capperaghe, with half the parsonage of Donnaghenney, in Inferny." Here Donnaghenney appears to be an *alias* of Donagmayne,[3] and Rosse is expressly stated to be an *alias* of Maghyrrosse. Thus the Ros and Douenacmain of our Charter are undoubtedly the parishes of Magheross (in which is the town of Carrickmacross) and Donaghmoyne, both in the barony of Farney, Co. Monaghan. It is not without interest to observe that Wakely's lease proves that before the sixteenth century they had returned to the ownership of the Priory, from which they were alienated by our Charter. Their history is so far parallel to that of the

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[1] No. 1312 in the Calendar published in Reports xi–xxii of the Deputy Keeper of the Public Records of Ireland.

[2] *Ibid.*, no. 1723.

[3] It is so regarded in the index to the Fiants.

Church of Clonkeen.[1] The cantred of Mucherne evidently included both Ros and Douenacmain; and since the two parishes just named make up the greater part of the barony of Farney, it would appear to have been coextensive, or nearly so, with that barony. Farney (Fearnmhagh), in fact, is sometimes called by what I suppose is the tautological name of Magh fearnmhaighe,[2] the dative case of which (Maigh fhearnmhaighe: *f* quiescent) would readily give rise to the form Mucherne.[3]

By a curious blunder of the scribe, the name of the grantee has been omitted; but it can be supplied from the context, and I have accordingly inserted the missing words in the text, enclosed in brackets. He was that Roger Pipard whose name appears so frequently in the Chartulary of St. Mary's Abbey, Dublin. It is probable that a member of the Pipard family received a grant of Farney from Prince John in 1185,[4] and it is practically certain that the Castle of Donaghmoyne, which was erected in 1193,[5] was built by a Pipard, probably Roger or Peter.

The date of this Charter of Donat, Prior of Louth, cannot be fixed with the same accuracy as that of the companion charter of Bishop Cristin. But I believe it may be determined within narrow limits. In the first place, the character of the script, the form of the letters on the seal, and, above all, the mention of Roger Pipard in the body of the document point to the end of the twelfth century or the beginning of the thirteenth. These, however, are vague indications; for more definite clues we must turn to the list of witnesses.

Of these the first is Thomas, Bishop of Clogher. It will be remembered that from the death of Gillacrist I (Christianus) in 1139, or from a somewhat earlier year, to the death of Gillacrist II (Cristinus) in 1193, the bishops of the diocese of Uriel were seated not at Clogher, but at Louth.[6] The fact that our Charter is witnessed by a Bishop of Clogher therefore proclaims it to be not earlier than 1193. But, further, Sir James Ware tells us that Cristinus was succeeded by a certain Maelisa, son of a bishop named Mac Maoil Ciaran, and that this Maelisa, who had been Abbot of Mellifont, presided over the diocese for four years.[7] This implies that Maelisa's episcopate ended in

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[1] *Proceedings, l.c.*, p. 38.

[2] For references see Hogan, *Onomasticon, s. v.* Mag fernmhaighe. But see note, p. 323.

[3] Place names are commonly in the dative.

[4] G. H. Orpen, *Ireland under the Normans*, ii, 119, 123. See also *Journal of Royal Soc. of Antiquaries of Ireland*, xxxviii, 263.

[5] *Annals of Loch Cé.*

[6] *Proceedings, l.c.*, p. 29f.

[7] *De Praesulibus Hiberniae Commentarius*, Dublin, 1665, p. 45 (Harris, *Ware's Works*, i. 181).

1197. From what source Ware derived his information I do not know.[1] But he must have had some authority; and his statement is confirmed by the *Annals of Lough Cé*, which under that year place the death of Ua Maoil Ciarain, Bishop of Uriel.[2] We may assume therefore with little hesitation that Cristin's immediate successor in the bishopric of Uriel was Maelisa Ua Maoil Ciarain (O'Mulkerin), and that he died in 1197. Whether his see was at Louth or at Clogher we need not inquire. It suffices for our purpose that his name was not Thomas, and that consequently the charter of which Thomas, Bishop of Clogher, is a witness, cannot be earlier than 1197.

There can be no doubt that by the year 1218 the see of the diocese had been transferred from Louth to Clogher, for under that year is recorded in the Annals the death of Gilla Tigernaigh MacKilronan, Bishop of Clogher. From 1218 onwards the see has always been at Clogher, and we have a long list of bishops of that place, the substantial accuracy of which can scarcely be disputed. It is a curious fact, however, that no Bishop of Clogher, early or late, has hitherto been known who bore the name of Thomas. Where can we find a place in the succession for the Thomas, Bishop of Clogher, of our Charter? Most probably before Gilla Tigernaigh MacKilronan. It is true indeed that the few years following the death of MacKilronan, are not closed against him, for we do not know the date of the consecration of Donough O'Fury, who was translated to Armagh in 1227[3]; and it is just possible that he was not the immediate successor of MacKilronan. But an examination of the names of the other witnesses will show it to be very unlikely that the Charter can be as late as 1218

In a former paper[4] I argued that the date of the grant of Bishop Cristin to Peter Pipard, referred to above, is 1187, or the spring of 1188. I was obliged, however, to admit that it might be somewhat later. I may claim to have established the fact that it was executed before the last occasion on which Gilbert Pipard and Bertram de Verdun were together in Ireland. But though I showed that Verdun left this country, probably for the last time, in June, 1188, and that Pipard had settled in England by September, 1189, I was unable to give rigorous proof that Verdun did not occasionally re-visit Ireland, or that he could not have met Pipard there late in 1188 or in the

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[1] The only document which he cites is an instrument of which there is a copy in the *Crede Mihi* (ed. Gilbert, p. 70). It is a release of M., Bishop of Louth, to John (Comyn), Archbishop of Dublin (1182–1212). So far as I can see there is nothing to show that this M. may not be Maelisa O'Carroll (Bishop of Louth, † 1187).

[2] In *Proceedings*, *l.c.*, p. 30, note 9, I displayed unnecessary scepticism about this entry in the Annals. I had not taken account of Ware's obviously independent evidence.

[3] *Cal. of Close Rolls*, 1224, p. 201.

[4] *Proceedings*, *l.c.*, p. 32f.

following year. I am now, however, in possession of evidence which tells strongly against that hypothesis. It appears from the Pipe Rolls of England that from 1185 to 1189 Gilbert Pipard was sheriff of the Honour of Lancaster.[1] For nearly four years he executed this office by deputy, employing for that purpose his brothers, Hugh and Peter Pipard.[2] It has been suggested[3] that this arrangement was due to the demands made upon Gilbert by his duties as justice itinerant. But it is clear that his residence in Ireland during those years—he had accompanied Prince John thither in 1185—would suffice to explain his inability to do the work of a sheriff in England. Now, from Michaelmas, 1188, he acted as sheriff in person.[4] This continued till after the death of Henry II in July, 1189, when he surrendered his office. We may conclude that from September, 1188, to July, 1189, Gilbert Pipard was not in Ireland. At any rate his visits must have been rare and brief; and the chance that he met Bertram de Verdun there is so remote as to be negligible.

I take it, therefore, as proved that Cristin's Charter must be dated, at the latest, early in 1188. Now, it has one witness, or, as I rather believe, two witnesses in common with our Charter. The name of Matthew de Fulsaue re-appears in the slightly variant form, Matthew de Fulesaga, and Robert the clerk is probably identical with Robert the parson of Ardee.[5] Thus it would seem that our Charter was written not many years after 1188, and that it cannot be brought down to 1218.

This conclusion is confirmed when we examine Ralph de Vernon's grant of Balisconan to St. Mary's Abbey, Dublin.[6] This document is proved by external evidence to be earlier, perhaps considerably earlier, than 1216.[7] Indeed, it seems to be but little later than 1188, for of its eight witnesses no less than three are found among those of Cristin's Charter—Richard de Heddeshoure, Geoffrey Sturmin, and Matthew de Fulsiage. This coincidence

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[1] W. Farrer, *The Lancashire Pipe Rolls of* 31 *Henry I and of the reigns of Henry II, Richard I, and King John*, 1902, p. 53ff. This book, for my knowledge of which I am indebted to Dr. James Wilson, gives extracts from the Pipe Rolls relating to Lancashire for the closing years of Henry II, not yet included in the publications of the Pipe Roll Society.

[2] *Op. cit.*, p. 53, 31 Henry II (Michaelmas, 1184, to Michaelmas, 1185)—"Gilbertus Pipard, Hugo frater eius pro eo reddit compotum"; and similarly, p. 58 (1185–6); p. 62 (1186–7), and p. 67 (1187–8)—"Gilbertus Pipard, Petrus frater eius pro eo reddit compotum." Note that here the fact is established, which with Mr. Orpen (*Journal of Roy. Soc. of Antiquaries of Ireland*, xxxviii, 244) I left doubtful, that Gilbert and Peter Pipard were brothers.

[3] By Mr. Farrer, *op. cit.*, p. 56. I have not found evidence that Pipard was an itinerant justice as late as 1185.

[4] *Ibid.*, p. 72—"Gilbertus Pipard reddit compotum." See also Mr. Farrer's note, p. 73.

[5] Possibly the Simon of Cristin's Charter was Simon de Clinton. See next paragraph.

[6] J. T. Gilbert, *Chartularies of St Mary's Abbey*, i, 55. [7] *Proceedings*, *l. c.*, p. 39.

is the more remarkable inasmuch as the two deeds are concerned with different districts and different religious houses. It is explicable by proximity of date, on the supposition that the three witnesses just named were retainers of the Pipards, of whom Vernon was a sub-feudatory. Now, Vernon's charter has also two witnesses in common with Donat's—Simon de Clinton and Matthew de Fulsiage.

I have discovered no mention of Fulsiage except in the three deeds here referred to. Simon de Clinton appears also as a witness in a group of three deeds—all grants of Ralph de Repentini (one of our witnesses), and of nearly the same date.[1] I am inclined to think they may belong to the years 1194-1196; but they may be as late as 1213.[2] I have not found Clinton's name elsewhere.

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[1] The Charters numbered 12, 13, 14 in Gilbert's *Chartularies of St. Mary's Abbey*, vol. i, pp. 37-39. The ten witnesses of no. 14 and the eight of no. 13 are found in nearly the same order among the thirteen of no. 12. No. 14, however, is somewhat later than no. 12; for in the latter a witness named Radulfus is simply "clericus de villa Macgarm"; in no. 14 he has become "Magister Radulfus." He is probably the same as "Magister Radulfus canonicus S. Patricii Dublin" in a confirmation charter of Peter de Repentini (*ib.*, p. 41), identified by Gilbert with Ralph de Norwich, who is said to have been Canon of St. Patrick's in 1227, and who was still Canon in 1256 (A. Theiner, *Vetera Monumenta Hibernorum et Scotorum*, 71f.). It is more probable that he was Ralph de Bristol, who was already a prebendary when he was appointed Treasurer in 1218. He became Bishop of Kildare in 1223, and died in 1231.

[2] No. 14 appears to have been confirmed by Eugenius, Archbishop of Armagh, in the Synod at Drogheda in 1215 (Gilbert, *op. cit.*, i, 150, 155). But the grant must have been at least two or three years earlier, since one of the witnesses is William Petit, who died in 1213 (*ib.* ii, 312). It is not improbable, in fact, that the confirmation was sought from the Archbishop when he succeeded in getting temporary possession of the district south of Carlingford Lough, and may have been given many years after the original grant. All the charters in the group have two witnesses in common with Vernon's charter mentioned above (*ib.*, i, 55); but the substitution in all of them of Galfridus de Hadeshore for Ricardus de Hadeshore, who witnessed both Vernon's charter and Cristin's charter of 1188, points to a slightly later date. A clue is perhaps given by the fact that in nos. 12, 13, William Petit takes precedence of Roger Pipard, Repentini's superior lord, while in no. 14 the order is reversed. This is explained if Petit was justiciar when he witnessed nos. 12, 13, but had ceased to hold office when he witnessed no. 14. Now, Harris states (*Ware's Works*, vol. ii, *Antiquities*, p. 102), on what authority I do not know, that he was justiciar in 1191. That he was joint justiciar with Peter Pipard appears from a document (Gilbert, *op. cit.*, i, 143) which, because it is witnessed by John Bishop of Leighlin, Mr. Orpen (*Ireland under the Normans*, i, 16; ii, 114) would date as late as 1198. There is, however, some reason to believe that there was a John Bishop of Leighlin *c.* 1192, and no reason to assume that there was not. Hence, this document may quite well be placed as early as 1192, though it can easily be shown that it is not earlier. Further, there is independent evidence that Petit's colleague, Peter Pipard, was justiciar in 1194, when he was disgraced (Annals in T.C.D. MS. E. 3. 20, p. 135). And finally, Hamo de Valognes was justiciar from 1196 (Orpen, *op. cit.*, ii, 113). These facts hang well together, and they tend to show that Valognes succeeded Petit as justiciar in 1196. If no. 14 belongs to that year, it may be concluded that apart from our Charter all the known documents in which Simon de Clinton is mentioned are prior to 1200.

These considerations point to a date for our Charter little, if at all, later than the year 1197.

The form of our Charter is, in essentials, identical with that of the instrument issued by Bishop Cristin and Prior Thomas some ten or twelve years previously. The only difference that need be mentioned is the disappearance of the name of the bishop from the first clause. The reason of this omission is obvious. The see of the diocese of Uriel had been transferred from Louth to Clogher; and the canons of St. Mary's Priory had in consequence ceased to be the chapter of the diocese, and the bishop was no longer their abbot. It is not improbable that the secular chapter of Clogher had already been founded. It was certainly in existence a quarter of a century later, and by that time had a Dean, a Precentor, and a Chancellor.[1] The bishop, accordingly, is not the principal member of the body which makes the grant. He acts as a witness, and by so doing, according to a usage of which there are many examples in deeds of this period, signifies his assent to the alienation which was being made by the Priory.

It must not be assumed, however, that because the canons of Louth had ceased to be the chapter of the diocese, they had renounced all the privileges which were usually regarded as belonging to a cathedral chapter. They almost certainly elected the bishop who transferred the see, and it is at least possible that they claimed the right to elect his successors. On the promotion of the Bishop of Clogher to the Primacy in 1227,[2] there was a dispute about the election of his successor.[3] At the Roman curia the charge was brought against Nehemias O'Bragan—the Bishop who eventually got possession of the see—that he had been elected by some married clerks and one regular canon, in contempt of the three dignitaries of Clogher Cathedral. His counter-statement, that he had been elected by the Dean and clergy, involves the admission that he was not the nominee of the majority of the chapter of Clogher; and the mention by his opponents of the "one regular canon" gives plausibility to the suggestion that the canons of Louth had taken part in or exercised an influence on the election. The significance of the charge against him may even lie in the word "one": only one canon, and not a majority of the body, had voted for him. It would appear, therefore, that for a considerable time after the removal of the see from Louth, the Augustinians of that place, if they did not elect the bishops, claimed the right to take part in the election with the new chapter.[4]

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[1] Theiner, *Monumenta*, p. 35ff. [2] *Cal. of Close Rolls*, 1224, p. 201. [3] Theiner, *l.c.*

[4] Similarly the Augustinian canons of Holy Trinity and the secular canons of St. Patrick's made a joint election of the Archbishops of Dublin. And a similar custom was maintained in the diocese of Bath and Wells

I mention this because it may help us to answer a question which will naturally be asked, Do we know anything about this Thomas, Bishop of Clogher, for whose episcopate our Charter is at present the only available evidence? I would suggest that he was no other than the Prior Thomas whose name follows that of Bishop Cristin in the charter of 1188, and that he was elected bishop by his own canons. It is at least a curious coincidence that eighteen or twenty years after the date of our Charter there was another election to the bishopric of Clogher, and that the bishop elected again bore the name of a Prior of St. Mary's. Donat, or Donough, O'Fury became bishop, it seems, in 1218; and the prior whose name stands at the head of our Charter was also called Donat. If we assume that they were the same person, we can give a reasonable explanation of an otherwise puzzling incident in the history of the diocese of Clogher. Not long after the departure of the Bishop of Uriel from Louth to Clogher,[1] the Archbishop of Armagh laid claim to that part of his diocese which now constitutes the county of Louth. Shortly after his appointment as Bishop, Donat entered the lists against the Primate, Luke Neterville, in defence of his jurisdiction over the disputed area.[2] But in 1227 he himself became Archbishop. He at once obtained from the Crown a union of his new with his old diocese, and refused confirmation and consecration to his successor at Clogher.[3] But when the union proved ineffective, he incontinently revised his opinions on the question of jurisdiction, and claimed "the Priory of Louth and the other churches situated between Carlingford Lough and the midst of the waters of the Boyne" as belonging to the see of Armagh. Ambition may in part account for this sudden change; but both it and the ultimate success of Armagh in the contest are more intelligible if Donat was a former Prior of Louth, anxious to maintain his old connexion with the canons, and sure of their support in his designs. The words quoted above from a contemporary document prove that the question really at issue was to which see the Priory of Louth owed allegiance. The Priory was, in fact, the principal religious establishment of the district, and its canons formed the bulk of the parochial clergy.[4] Their wishes as to the bishop under whose jurisdiction they should serve must have had a considerable influence in determining the result of the contest. This being granted, it is instructive to note the course of the long struggle.

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[1] For this note of time I can only claim antecedent probability; for a document quoted by Father Gogarty to prove that the controversy between Armagh and Clogher began before the end of the twelfth century (*Irish Theological Quarterly*, iv, 297) does not seem to me relevant to his purpose.

[2] Theiner, *l.c.*

[3] *Cal. of Patent Rolls*, 1225, p. 166.

[4] *Proceedings*, *l.c.*, p. 35f.

The claim of Armagh to jurisdiction over the Priory was apparently put forth at the very beginning of the episcopate of Thomas, or a few years earlier. But he seems to have been able to maintain his position against the Primate. It was in the time of his successor, Gilla Tighernaigh MacKilronan, that Archbishop Eugenius MacGillaweer so far succeeded in asserting his claim as to hold a synod at St. Peter's Church, Drogheda.[1] Even after this Bishop Donat was able to renew the contest, and to keep Archbishop Neterville at bay. And, on the other hand, it was this same Donat who, as Archbishop, achieved the final victory for Armagh.[2] In every case where a former Prior of Louth was one of the disputing prelates, he was the more successful of the two.

My hypothesis, that Priors Thomas and Donat were successively promoted to the Bishopric of Clogher, is of course not established. But it is, perhaps, sufficiently plausible to be worthy of consideration. It may be proved or disproved as further evidence comes to light.

But in another respect the Charter throws welcome light on the early history of the diocese. A register of Clogher, quoted by Mr. Goddard H. Orpen, tells an interesting story about the building of Donaghmoyne Castle. In Mr. Orpen's translation it runs thus:—

"About the year 1200 Richard Pipard, baron of Ardee, at the coming of the English to Ireland began to build a castle on the lands of the Bishop at Donaghmajdeaden, where now his castle is; and when the Bishop heard this, he came and denounced the new work. When the baron would not give up his undertaking, the Bishop robed himself in his pontificals, entered the ditch, and, lying on the ground, threw himself in the way of the diggers. When they were unable to work—for none of them would lay hands on the bishop—the baron himself came, and with his own hands dragged the bishop out of the ditch. The bishop crying aloud cursed the baron, so that the baron was in the first place struck with leprosy, and afterwards died, and on account of this, as is believed, none of his posterity possess, or ever shall possess, the said lands."[3]

This story in its details is unhistorical. But for our purpose it is most

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[1] Gilbert, *op. cit.*, p. 155.

[2] I cannot find any document after his death which proves that the contest was still proceeding. A mandate of 1243, ordering an inquiry into the demand of Archbishop Albert for restitution of the vill of Drogheda and the manor of Nobber (*Cal. of Docs. relating to Ireland*, i, 2618), cited by Father Gogarty (*l.c.*, p. 301), has surely nothing to do with it.

[3] *Jour. of R.S.A.I.*, xxxviii, 263, from Brit. Mus. Add. MS. 4789, p. 109.

interesting to note that it preserves a tradition that the castle stood on land which originally belonged to the Bishop. Our Charter, on the contrary, represents the advowsons of the churches of Donaghmoyne as the property of the Priory of Louth. The tradition embodied in the story and the evidence of our Charter are nevertheless consistent with each other. For a study of the documents, and especially of Cristin's Charter of 1188, has led us to the conclusion that the chapter of the Bishop of Louth consisted of the Augustinian canons of St. Mary's. This, as I have already shown, involves the supposition that the Bishop, as long as he remained at Louth, had no separate property. The possessions of the Bishop were the possessions of the Priory. When in the story which I have quoted we are told that Donaghmoyne was episcopal property, we are given to understand that it was the property of the Bishop as head of the Priory, or, in other words, of the Priory itself. But when the Bishop retired from Louth to Clogher, he ceased to have a direct interest in the possessions of the Priory. Hence we are not surprised to learn from Donat's Charter that the Prior and canons, with the assent of the Bishop of Clogher, dealt with the advowsons of Donaghmoyne as though they belonged absolutely to themselves. Donat's Charter confirms the theory which was in the main based upon the Charter of Cristin.

I may conclude this paper by correcting an error into which I fell in my account of the Charter of 1188. By that Charter the Bishop, Prior, and Convent granted certain presentations with the assent and counsel of the Chapter. Assuming that the Convent and the Chapter were the same body, I found this difficult to understand; and I offered as a solution of the difficulty the suggestion that the form of the Charter was imperfectly adapted from that used by a Bishop whose Chapter was not constituted on the Augustinian model.[1] That explanation, inasmuch as it is inapplicable to the Charter now under consideration, in which a similar assent clause is found, is plainly incorrect. A communication from my friend, Dr. James Wilson, who has made a special study of Augustinian foundations, enables me to substitute for it the true account of the matter. The Convent and the Chapter were not the same body. The former consisted of those canons who were in residence at the Priory; the latter included those who were in charge of churches outside the Priory. An instrument ran in the name of the Prior and Convent; but it was ineffective without the assent of the entire Chapter.

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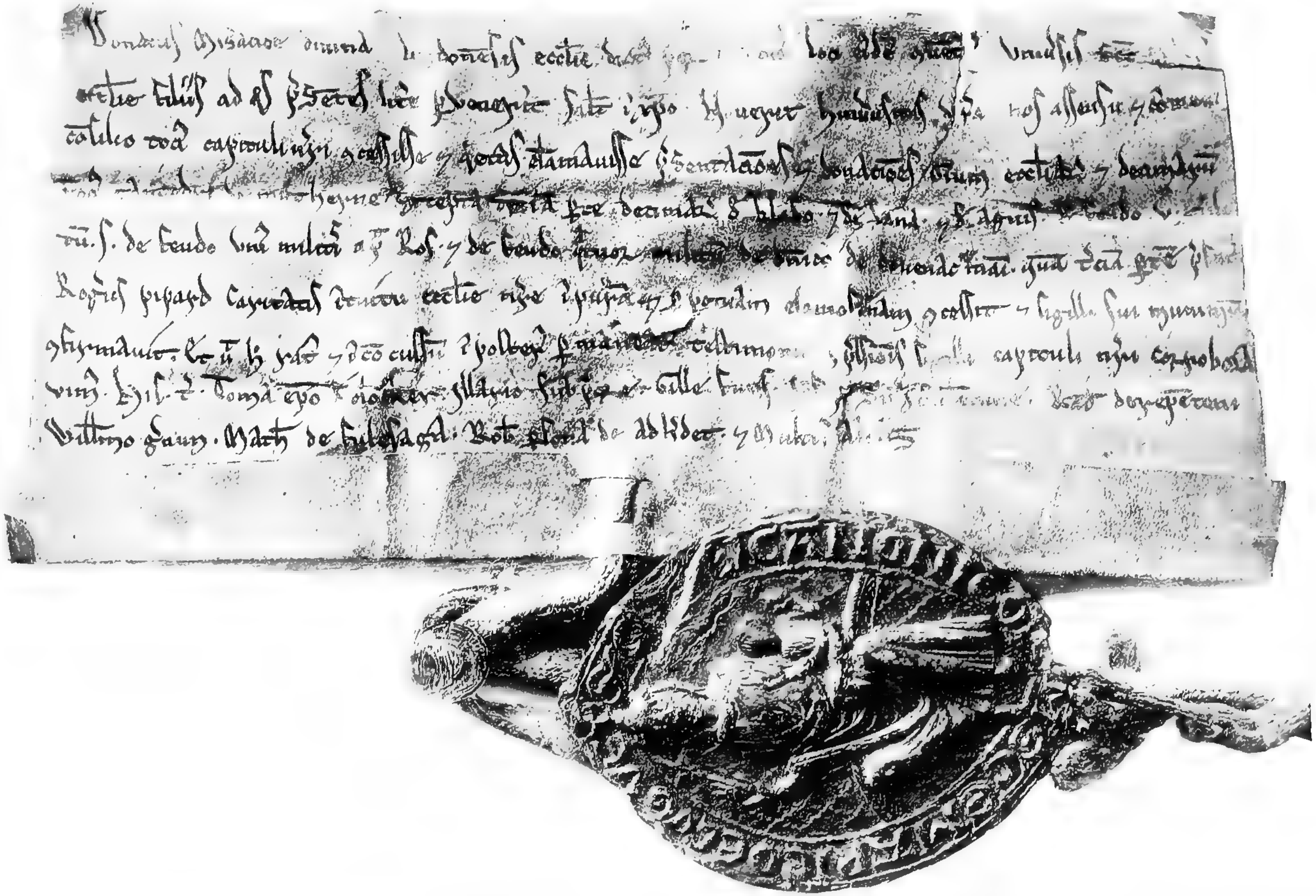
[1] *Proceedings, l. c.*, p. 35.



LAWLOR—CHARTER OF DONATUS, PRIOR OF LOUTH.

In this connexion it may be observed that the seal attached to Donat's Charter is described, both on the seal itself and in the text of the document, as the seal, not of the Convent, but of the Chapter of the Church of St. Mary. The seal of Bishop Cristin's Charter is lost, but in the text it is described as "sigillum nostrum," which is naturally construed to mean the seal of the Bishop, Prior, and Convent. Whether this difference of form should be regarded as significant, I do not know.

I have to thank the Marquis of Ormonde for permitting me to publish the Charter, and to have the photograph taken, a reproduction of which illustrates this paper.

NOTE ADDED IN THE PRESS.

Mucherne is possibly Cremorne (Crich Mughdhorna), if we may assume that that territory was as extensive in the twelfth as in the seventh century. See Reeves, *Adamnan*, p. 81, note *d*. But the identification suggested above, p. 315, seems more probable.

XX.

THE DUN OF DRUMSNA.

A FRONTIER FORTIFICATION BETWEEN THE KINGDOMS OF AILEAGH AND CRUAGHAN.

BY W. F. DE V. KANE, M.A.

Read DECEMBER 14, 1914. Published AUGUST 17, 1915.

PLATE XXIX.

THE earliest historical or quasi-historical literature referring to the centuries immediately preceding the arrival of St. Patrick, after whose advent the extant oral traditions and bardic tales were collected and preserved to posterity by scribes, testifies to long-continued struggles for supremacy between the kingdom of Uladh, with its two royal residences of Aileach in Derry and Emania (Armagh), against the kingdom of Connacht, ruled from Cruaghan in Roscommon, often allied with the rulers of Laighen (Leinster). Until the fourth century, when the Milesians of Tara are said to have successfully encroached northward over the Boyne frontier of Uladh, the northern kingdom had held its own successfully against all comers, even when the other four-fifths of Ireland were leagued together against it.

But in the year A.D. 332, if the annals are correct, just 100 years before the advent of St. Patrick, Emania was captured, and the military power of Uladh broken.

The defensive works which I purpose to describe are situated on the old frontier between the territory of Aileach and that of Cruachan. They were evidently designed to prevent incursions into Roscommon from Leitrim at a point where the River Shannon was more or less fordable.

There are several Irish words, components of place-names, which indicate a ford. The most common is the prefix "Ath," and its wide distribution appears to indicate that in ancient days the water-ways were deeper, and more formidable obstacles to the traveller, than they are at present. Where a river intervened, as Dr. Joyce has pointed out, the most suitable crossing-places were well known, and a deep ford was called "snamh" (snave) or "swimming-place." The village of Drumsna in the Co. Leitrim thus derives its name, and in the "Post-chaise Companion," published about the year 1800, is given as "Drumsnave," which well preserved the old Irish designation; and its position on the bank of the Shannon marks the locality where the river was known to be fordable by wading or swimming according to the volume of the water passing down at the season of the year.

The great river, with Lough Allen at its head, constitutes a natural frontier of about thirty miles in length as far as Roosky, between ancient Ulster and Connaught, and must have been impassable except at this place to a hosting in prehistoric times. From Carrick-on-Shannon it rolls its slow, deep flood easterly till it reaches Jamestown, where it diverges at right angles to the north, and, describing a narrow loop, encircles the present demesne of Sir Gilbert King, Bart., of Charlestown, and returns south again to within a mile of the point of departure, forming a peninsula, and here at Drumsna again reverts to its easterly course, expanding into broad lagoons and the lake-like expanses of Lough Boderg. This peninsula of Roscommon, so formed by the loop of the river, is accessible by wading from the Leitrim bank (except at time of floods), at the falls where the bed of the river changes its level, and at other places by swimming or wading when the river is low. Across the neck of this peninsula accordingly we find a massive earth-work has been raised with a steep slope facing Leitrim, and a gentler one on the Roscommon side, which stretches for a mile from one bend of the Shannon to the other; then turns and follows the elbow of the stream for about another 1200 feet to the mouth of the modern canal. Thence, bordering the banks up stream for 5000 feet (just 93 yards short of a mile), a series of lesser subsidiary earth-works stretch, which are proportionally of larger size opposite any shallow reaches of the river. Though in portions much defaced and levelled by the farmer, all the salient features of construction are readily perceptible to an antiquary. No traditions, however, seem to have survived as to its origin. Its local name, "the dûn," gives no clue except that it was a defensive work, reminding one of those at Granard called Duncladh, the fortified ditch. The surrounding country on both sides of the Shannon was wasted by war for long periods of time, which culminated in the reign of Queen Elizabeth, when the native owners were expatriated from their patrimony, and the common people extirpated under the cruel rule of Sir Charles Coote, Governor of Connaught. In connexion with this I am told that old people remember the remains of an old tree called "The Bilé," which was said to have served as a gallows for Sir Charles Coote's victims, when any of the forays by his soldiers proved successful in the neighbourhood. None seem to have survived or returned in later days to hand down any traditions referring to the builders of these remains. They are not said to be the work of the Black Pig, like those at Roosky and Granard. But one thing is unquestionable. The designers of these vast entrenchments were no tyros in the art of defence at that epoch, when spears, swords, and sling-stones were probably the weapons chiefly in use. Their careful economy of labour is evident where invaders could cross over the shallow parts of the river. At such places up stream a breastwork of stone close to the water's edge, of about (at present) 3 feet to 4 feet high, enabled the defenders in safety to assail their enemies when struggling through the current, while a sufficient double rampart and fosse, more inland, enabled them to contest the further advance of such survivors as gained the shore. But the works erected across the neck of the peninsula, which I may call the Dun proper, were of far greater size and importance: for the foemen here, having crossed on to the peninsula by wading or swimming, advanced in masses to the attack on firm ground, and the fury of a sudden onset had to be checked before they reached the defenders, lest they should by valour or strength of numbers force their way across the frontier southward. Here, therefore, for about a mile we find, as I have stated, a great vallum or rampart raised, stretching across the isthmus, still in parts 16 feet to 17 feet high, and 30 feet wide at top, with a base of about 100 feet through. The slope facing north is very steep, that facing Roscommon of an easier gradient. This, with two other lines of entrenchment parallel to it, one in front and one in the rear, here completes the scheme of defence. At the eastern end the one in front is separated by only about 12 feet from the foot of the vallum; the other larger one in the rear runs at an interval of about 105 feet, leaving ample room for a camp, and consists of an inner bank with a base of 15 feet, then a paved fosse or sunk causeway 25 feet wide, and an outer bank perhaps 8 feet high originally, with a base of 35 feet. This causeway seems to have been originally stoned, and similarly the flat space or causeway at foot of the vallum on its north side. The works there are of smaller proportions, but otherwise correspond in design. (See Plate XXIX, Fig. 2.)

Another important and very interesting feature which fortunately has been well preserved is that two level passages through the triple line of entrenchments have been provided. Measuring from the eastern end at the Drumsna bend of the river, the first is 280 yards distant, and the second is 727 yards further west, being somewhat more than half way toward the other bend of the Shannon, opposite Jamestown.[1] The question arises, for what purpose were they constructed? Now the Dun stretches across a peninsula of comparatively small extent. Unless there had been here at that epoch a bridge spanning the river connecting Roscommon and Leitrim, there could have been no wheeled traffic in time of peace. Whether a hurdle-ford could have been erected across the Shannon at this place may be doubted, since the width was considerable; and because the name Drumsna is evidence of a well-known swimming-place, it does not seem likely that in early times any better mode of crossing was available. But if for the sake of argument we grant that possibility, one opening would have sufficed. Obviously these two gaps must have been arranged to permit the defending force to deploy at first on the peninsula, and, after contesting the passage of the invaders across the river fords, to provide for their own rapid retreat behind their fortified barriers. But if war chariots were employed, these wide gaps through the more level eastern alignment would have been absolutely necessary. For the precipitous slope of the ground further west would be a natural obstacle for the passage of chariots. Hence none are found there or were required. Both gaps are made defensible by the provision of returns inward of the mound of the great rampart. Each gap is about 50 feet wide, and the flanking returns on both sides of the more easterly one are 47 yards long, and those of the more westerly gap about 63 yards. These side ramparts provide for attacking any entering foe on both flanks. It is to be noted that both of these gaps or passages appear to have been originally metalled with rough field stones, as can be easily discovered by the use of a spade, by removing the sward and accumulated clay for from a foot to eighteen inches. Also opposite and corresponding to the more easterly gap in the great vallum we find similar openings (but without returned ends) left in the outer defensive works, through both that in front and the one in the rear, so providing a complete thoroughfare.

We cannot doubt that similar openings in the outer defences also existed in the case of the more westerly gap, but there all these subsidiary earthworks have been levelled. It seems to me also probable that the main central vallum was rendered more impregnable to attack by the use of stockades, and this supposition has been strengthened by the discovery of some decayed remains of the ends of wooden stakes shod with iron points, dug up at the eastern portion of the Doon. These could have served no other purpose.

The provision of inwardly returned ends of entrances is found both in British and Scottish hill forts, and Mr. Westropp has kindly informed me

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[1] See Ground-plan, Pl. XXIX.

that at Castle O'er, Dumfriesshire, they appear both inside and outside of the principal vallum, and at Chester Rigs Fort in Peebles a good example returned inwards occurs. A remarkable one is found also at Pen-y-Corddyn, near Abergele, but he cannot cite any examples of the kind in the gaps of Irish promontory forts. These defensible entrances into hill forts are, of course, narrow, 6 feet to 10 feet wide, but the gaps through the linear entrenchments at Drumsna are nearly 50 feet wide, which is inexplicable to me, except on the hypothesis above suggested. They appear to be part and parcel of the original construction of the vallum, and are for the most part evenly tapered. Had they been modern breaches for the passage of a cart, a width of 12 feet would have been ample, and the material would have been disposed on both sides of the vallum to save labour. But the returns are only inward, and are about three times as long as the width of the gap, requiring much additional material to the amount provided by the mere excavation of the opening through the vallum. Moreover, the existence of two, both approximately of similar size and construction, indicates a plan not likely to have been followed in a work of demolition for farm requirements.[1]

I am indebted to the Right Hon. Michael F. Cox, whose family lived in the neighbourhood, for information that some wooden frame-work has been dug up, apparently the relics of shelters or sentry-boxes. I have recorded in a former paper that oaken beams and frame-work of the sides and flooring of sheds were similarly dug up out of trenches on the defensive side of the rampart of the Black Pig in the Co. of Monaghan.

During the war that followed upon the insurrection of 1641 down to 1652, Jamestown was captured by Sarsfield for the King, and a Parliamentary army is said to have encamped hereabouts and cannonaded its walls from the height of Ardanaffrin.[2] I have also been told of guns and other weapons having been found in the neighbourhood of the Dun, referable perhaps to this period.

I shall now revert to the plan of the works at the eastern end. Here I have pointed out that a fosse, bordered by two banks of no great size, runs close along the foot of the great vallum on its northern face, divided from it by a stoned causeway of about 12 feet wide, but increasing to 30 feet wide further west. This line of frontal defences persists throughout the length of

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[1] I have consulted several publications descriptive of the Wansdyke, an early frontier fortification, whose earthworks extend from Somerset to Berkshire. The charts and maps show a few thoroughfares that were left in the vallum. None of them, however, have any defensive returns similar to those of the Drumsna Dun, but there are always camps constructed alongside.

[2] Cf. "The Battle of the Boyne" (Boulger), p. 127.

the Dun proper (that is to say, the main work across the neck of the peninsula), though in some parts it has been demolished, as also parts of the vallum. But with regard to the line of the outer works at the rear, which enclosed a large space or camping-ground behind the vallum, these can only be now traced for about 440 yards from the Drumsna bend of the Shannon. All the rest is levelled. There can be little doubt, however, that the line continued west past the second gap, and on to where the high levels of Ardanaffrin commence, which would make a further extension of about 850 yards, something short of three-quarters of a mile altogether. At about this distance the land rises gradually till it reaches the westerly bend of the river, and here attains a height of about 75 feet above the water-level. All along its northern face this high ground falls steeply, facing Leitrim. As the Doon approaches this natural escarpment, which retains traces of having been terraced, as indicated on diagram, it is led up to the foot of it with a height of from 12 feet to 20 feet, and a width across the top of from 60 feet to 70 feet. In front, the outer line of fosse and banks runs along its base with an intermediate causeway of about 20 feet to 30 feet wide. I have now completed my survey of what I may call the Dun proper, but will add one or two particulars as regards its construction.

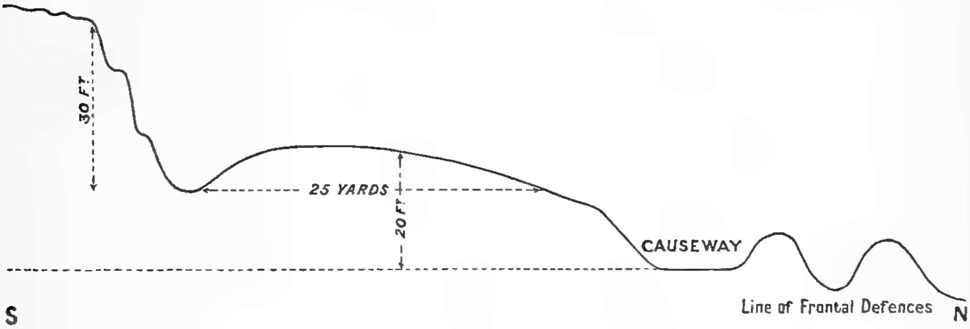

FIG. 2.—Diagrammatic Section at Ardanaffrin.

At the eastern terminal, clay was plentiful, and apparently all the mounds are wholly composed of it; but as we approach a higher level where the modern road from Charlestown to the railway station crosses the line of entrenchments, we find an outcrop of limestone strata which presents a bare surface almost devoid of soil. Across this stony tract, which has given to that locality the name of Leacach na Dun (the stony place of the Dun), the great mound was carried on with quarried stones. These in modern times have been carted off for road-making, leaving here scarcely a vestige of the original pile. Further west on the far side of the modern road less demolition was effected, because as soil became more abundant the vallum was raised in alternate sections of perhaps 12 feet in length, of earth and stones. The search for the latter by road-makers has exposed this peculiarity of construction. Here also I noticed two funnel-shaped pits dug in the surface of the top of the vallum. They are at present about 8 feet deep and about 9 feet wide at the mouth. They were filled with briers and bushes, and I had no opportunity of exploring them.

We will now follow the river up stream, west from the Dun proper. From the point of Ardanaffrin we can recognize fragmentary continuations of earth-works round the bend of the river, but much defaced by the excavations and other works at the embouchure of the canal which here enters the Shannon, as well as by the carrying of the Kilmore road over a portion of the ancient embankments. But behind the deer-park wall a series of entrenchments in fair preservation recommences, following the river-bank up stream for about 1200 yards (nearly three quarters of a mile). Their ground-plan and size is much simpler than that of those we have been considering, and consists of two parallel ramparts of moderate size, which run at a short distance from the shore bounding an intermediate roadway. Where an outcrop of natural rock intervenes, the sheltered roadway has been excavated through the strata, and the stones piled up to raise the frontal embankment. And where higher levels subtend the shore steep-to, an embankment 6 to 7 feet high leans against the base of the slope, which is scarped steeply, and a hollow or protective trench is left at the foot behind the embankment. At one or two points of the stream shallow reaches exist, no doubt more easily fordable before a deeper channel was excavated during the progress of the Shannon Navigation works. Wherever these shallows existed the earth-works opposite were of greater size and importance. I have already alluded to another interesting feature which is to be found at the east end of the deer-park where its wall runs down to the river-bank. It is the provision of a breast-work close to the water's edge, built of large, unhewn stones, raised about 4 feet high (where it is best preserved), and like a broad dwarf wall. This construction follows the contour of the margin of the water, at a little distance in front of the entrenchments, and was evidently designed to shelter the defenders while assailing waders or swimmers with sling-stones or spears during their passage through the ford. As above stated, these defences extend up stream for only about three quarters of a mile above the embouchure of the canal.

Thence for some two miles the water runs broader and deeper as far as the townland of Corry, where at the foot of the farm of Phil Conlan an extensive shallow existed, a channel through which was excavated by the Shannon Navigation Commissioners. Large boulders dredged from the river-bed strew the shore, and other softer material was dumped down on a low bank near, which might be mistaken for part of a defensive work. On the high ground facing the river a fine rampart about 34 feet from the shore extends about 260 yards. Its original length cannot be estimated, the extremities having been levelled. This detached ancillary earth-work testifies to the care and foresight exercised by the Military Engineering Corps of Cruachan in ancient times. Corry probably means a cauldron, and perhaps refers to the wide expanse above the rapids, where the sudden bend in the Shannon may have in high floods produced eddying currents. The point of high ground at this place goes by the name of Tonreevagh, "the grey back."

In connexion with the study of the defensible conditions of the kingdom of Connacht in ancient days, it may not be irrelevant to dwell a little on such natural features of the country which must have rendered an incursion especially from the north-east, an arduous task. In the west the River Erne was fordable at Ballyshannon, from which the locality derived its name of Ballyshanny Thence to Port-na-Snow, a swimming-place near Enniskillen, is some 25 miles. Thence the river and upper Lough Erne form a barrier for another 25 miles to the ford of Belturbet. Southwards the river together with Lough Oughter presents another impassable waterway of about 10 miles. I have already referred to Lough Allen and the Shannon, which with Lough Boderg protects Roscommon on the north and on the east, as far as Lanesborough on the north, and Athlone on the south of Lough Ree. The latter, we are told, was a dangerous crossing-place.[1] We have record of a hosting from Oriel to the south of Roscommon about the close of the fifth century.[2] It is told that Mainé Mor called an assembly of his tribe at Clogher, and decided that, their territory being too confined, they would migrate and take possession of some country occupied by Firbolgs in Connacht. Accordingly they collected their "flocks and herds," their objective being the district between Athlone and Athenry and southwards to the County Clare, a territory afterwards called "Hy Many," after the conquering chieftain. The direct route to Athlone from Clogher would seem to have been south by Clones, Cavan, and Granard, to either the ford at Lanesborough or Athlone. But, perhaps, the passage of the Shannon at Athlone might have been unsuitable for cattle and sheep. But if they went west, they must have crossed the Erne near Enniskillen, and thence made their way over the head waters of the Shannon near Dowra, and so past Lough Key and Lough Gara, then south by Ballaghaderreen—a great circuit in either case.

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[1] "Irish Names of Places" (Joyce), p. 325.

[2] MS. Life of St. Grellan. See "Tribes and Customs of Hy Many" (O'Donovan), p. 10.

There was, however, another considerable difficulty for the passage of an army across Leitrim and north Longford south-west from either Derry or Armagh. Anyone who has driven from Carrick-on-Shannon or Mohill in a north-easterly direction will not have forgotten crossing the heights and hollows of the discontinuous long ridges that form the feature of that country, with their intermediate furrows, formerly marsh, bog, and lakelet. This ridge and furrow formation runs south-east by east and north-west by west, and was the result of the ice stream that left glacial striæ radiating from the ice-cap at Slieveanierin across Ireland even so far as Howth. Add to this the absence of roads and the wide districts of forest, and it is unlikely that many forays in strength would be led from the north-east, if the Drumsna fords were made defensible. Even towards the close of the seventeenth century the following notes from a MS. of *circa* 1680[1] mention :—"Vast woods of excellent timber overspreading the Co. of Leitrim, which supply the iron works at Castlefour and elsewhere in great abundance. And generally throughout the county are many herds of red deer. Wolves were very numerous, but latterly much abated." Many eyries of eagles are mentioned, and ospreys said to be numerous, who nested in old ruined walls. Their remarkable method of catching fish when the sun was shining is also described. If this was the condition of the county some 240 years ago, what was it a thousand years earlier, with the drainage choked with vegetable débris, and the bogs and marshes largely filling all the low-lying hollow ground? No wonder that every lakelet was studded with crannoge dwellings, when few open spaces existed among the wide-spreading forests, except the intervening expanses of bog. My special thanks are due to Captain Cooke, R.E., who most kindly assisted in perfecting the Ordnance Survey map in some important particulars; to Mr. R. Devenish, of Drumsna, and to the Rt. Hon. M. F. Cox, who has an intimate knowledge of the Dun and its neighbourhood.

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[1] A description of Leitrim. In the Library of Trin. Coll., Dublin. Ref. 1. 4. 16.

NOTE.—Though many antique weapons have been dredged from the Shannon and presented to the National Museum by the Commissioners, I cannot find that any were found at the fords of Drumsna. The construction of the canal to Roosky precluded the necessity of deepening the river here. A sword was found in the river-bed at Carrick-on-Shannon, three socketed celts at Athlone, and a large number at Keelogue ford, and elsewhere, many bronze objects. At Belturbet ford a most interesting find of bronze weapons has been also discovered.

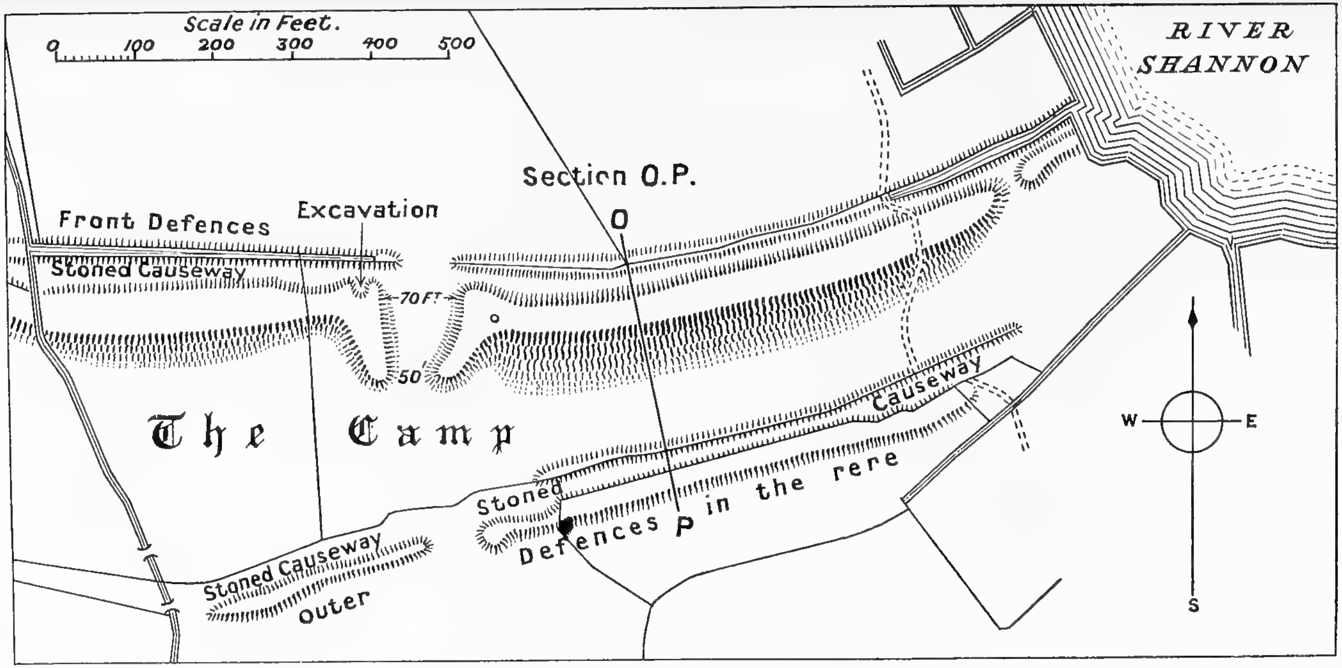

FIG. 1.—Plan of Eastern End of the Dun.

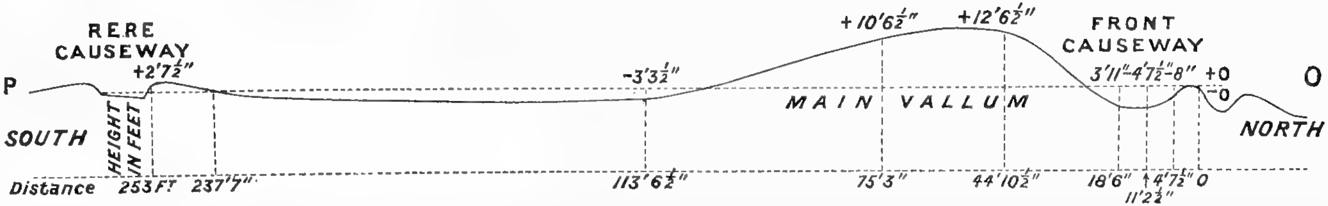

FIG. 2.—Section O–P on Plan.

KANE—THE DUN OF DRUMSNA.

XXI.

PRINTING IN THE CITY OF WATERFORD IN THE SEVENTEENTH CENTURY.

By E. R. M'CLINTOCK DIX.

[Read November 8, 1915. Published January 27, 1916.]

In my communication to the Academy, read on the 10th of November, 1913, upon the subject of Printing in the City of Kilkenny in the seventeenth century, I promised a communication dealing with the same subject in connexion with the city of Waterford; and I now present a similar list for that city for the like period.

In both places printing, as far as is certainly known, originated with, or arose from, the organization of the Confederate Catholics of Ireland. It is on record that, finding the need of a press, their Council procured one from the Continent and engaged, as printer, Thomas Bourke. (*Vide* Sir J. T. Gilbert's "History of Irish Confederation," vol. iii, p. xi, &c.) This press was started in Waterford city in 1643. Printing there would thus seem to have preceded that in Kilkenny, at least as far as the Council of the Confederate Catholics is concerned. The press of the Jesuits in Kilkenny may have been in use for some years earlier, and the two or three items of alleged printing under date 1642 in the Kilkenny List may have been printed by them.

Who Thomas Bourke, the printer, was I have not been able to ascertain. There appears often a "Thomas Bourke" (nephew of Lord Clanricarde) amongst the names signed to official documents of the Confederate Catholics; but there is not any identification of him as the printer, nor does Sir J. T. Gilbert suggest anything of the kind.

The following list contains *thirty* items, some of which are doubtful. Some of the later items may have been printed in Kilkenny, or *vice versa,* as I indicated in my former communication. Indeed, the proper way to deal with the seventeenth-century printing of these two towns would be to treat them *as one,* and, following the chronological order, to present all in one list as the output of the press or presses of the Council of the Confederate Catholics and of their successors in occupation of these cities. Then the historical value and importance of the whole output would be perceived and appreciated, as it cannot properly be when dealt with in piecemeal and disconnected fashion.

In each city, as will be noticed upon a careful perusal of the lists, the press of the Confederate Catholics was succeeded by a hostile press, or their own was made use of by their opponents. In the case of Waterford such press was that of the Cromwellian party, who captured the city in August, 1649, and either took possession of the press there or brought in one of their own, and the few items from 1651 on are the extant output after the Cromwellian occupation of the city.

A very careful examination, and comparison, of the respective outputs of the presses of Kilkenny and Waterford are desirable, and would probably lead to a correct decision as to the place of printing of doubtful items, and other uncertain points concerning the different presses in each city.

Some of the items in this list are of great historical interest, and are well known; others are not so familiar to the student of Irish history, and so merit his attention.

It is right here to allude for a moment to the allegation that a Sermon was printed in Waterford in 1618. No copy of it, if so, exists, while a copy of the *London* edition of the Sermon is to be found in the Bodleian Library at Oxford. It is a mistake, as a rule, to allege that there was no early printing in a town. Again and again has the alleged first year of printing been proved an error, and much earlier printing has been found. In a seaport city like Waterford a press might have been imported for a while, and then removed elsewhere. Presses in 1618 were comparatively small, and easily moved about as required.

Peter de Pienne, who printed for the Cromwellian authorities in Waterford, had printed in Cork previously while it was in the hands of the royalists.

This list is restricted to printing in the city of Waterford in the seventeenth century, and leaves untouched the controverted printing there in the sixth decade of the sixteenth century. It will be seen on perusal of the list that the items in it are either political or religious in character and aim, but are all or nearly all of considerable value historically.

A few facsimiles of title-pages and ornaments are given.

1. 1643. An/Argument/Delivered/By/Patricke Darcy Esquire,/ By The

expresse order of the House of / Commons in the Parliament of / Ireland, *9 Iunii*, 1641. *Thomas Bourke.* 4to. 144 pp. ($7\frac{7}{10} \times 5\frac{3}{10}$.)

[Brit. Mus.[1] / G. 5563 ; Bodleian Library, 226 ; j. 62 ; The Franciscan Library,[2] Dublin.]

Note.—The Royal Arms are on the title-page. Bourke is described as "Printer to the Confederate Catholicks of Ireland."

2. 1643. A Remonstrance of the Right Honourable Iames Earle of Castlehaven and Lord Audley, *Concerning his Imprisonment in* Dublin *and escape from thence. Laquens contritus est & nos liberati sumus.* Reviewed, Corrected augmented. *Thomas Bourke.* 4to. ($7\frac{6}{10} \times 5\frac{8}{10}$.) 23 pp. + 1 p. blank. Sigs A–C, in fours: A1 blank.

[Brit. Mus. / C. 21. b. 1/14. The Franciscan Library, Dublin, 2 copies.]

N.B.—On title-page is a device of a heart pierced by four arrows, and surrounding it as a square border are these words: "Sagittae Tuae | acutae in | Corda inimi | Corum regis. | "

3. 1643. A Remonstrance of Grievances presented to his most Excellent Majestie, in the behalfe of the Catholicks of Ireland. (17th March 1642/3.) *Thomas Bourke.* 4to. 32 pp. Sigs. A–D4. (See pp. 336, 337.)

[T.C.D. / Gall. 3. o. 30. No. 27 ; Brit. Mus. / 601. d. 57 ; University Library, Cambridge ; Hib. 7. 643. 86 (No. 5308) ; Dublin Municipal Library ; National Library.]

Note.—The Royal Arms on the title-page.

4. 1643. Admonition / by the Supreame / Councell / of the Confederat / Catholicks / of Iready [*sic*] . / To all His Majesties . . . Subjects . . . Against a Solemne League and Covenant framed . . . in the Parliament of England. As also against a Declaration of the . . . English Parliament. *Thomas Bourke.* 4to. 22 pp. Sigs A–C4 (last leaf gone).

[University Library, Cambridge, / Hib. 7. 643. 1 (No. 5309).]

Note.—Containing a reprint of "A Solemne League," &c. See a full description in the forthcoming Cambridge Catalogue, No. 5309.

5. 1643. Lawes and Orders of Warre, M.DC.XLIII. Established for the conduct of the Armie designed for the Expedition of Ulster. *Thomas Bourke,* Printer to the Confederate Catholics of Ireland. 4to. ($7 \times 5\frac{6}{10}$.) 11 pp. + 1 p. blank.

[The Franciscan Library : Dublin, 2 copies.]

Note.—*Vide* also in Gilbert's "History of Confederation," vol. iii, p. xiv, and p. 74.

On title-page is a cross with "In hoc signi vincu" over it, and "Castlehaven Audley" below it.

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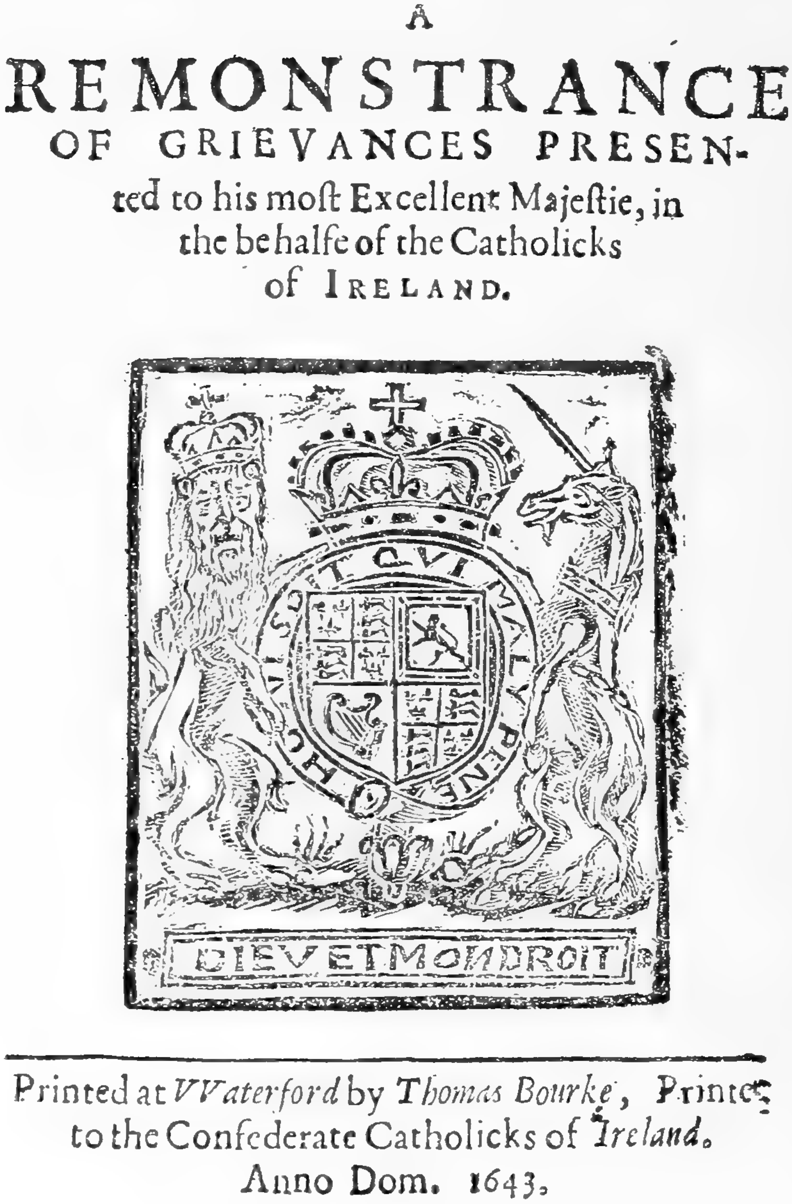
[1] The copy in the British Museum measures $7\frac{1}{6} \times 5\frac{1}{3}$. There are 26 lines to a full page.

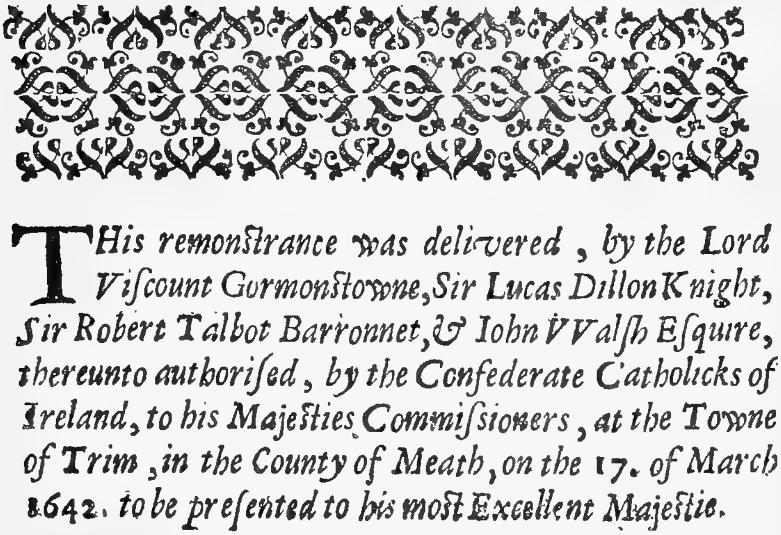
[2] The Franciscan copy is bound in parchment or vellum. Between pp. 10 and 11 are inset two unpaged leaves of "The Speech of Sir Richard Blake, Knight," &c.



A
REMONSTRANCE
OF GRIEVANCES PRESENted to his moſt Excellent Majeſtie, in
the behalfe of the Catholicks
of IRELAND.

Printed at *VVaterford* by *Thomas Bourke*, Printer
to the Confederate Catholicks of *Ireland*.
Anno Dom. 1643.

Title-page of No. 3 in foregoing list.



THis remonſtrance was delivered , by the Lord Viſcount Gormonſtowne, Sir Lucas Dillon Knight, Sir Robert Talbot Barronnet, & Iohn VValſh Eſquire, thereunto authoriſed, by the Confederate Catholicks of Ireland, to his Majeſties Commiſsioners, at the Towne of Trim, in the County of Meath, on the 17. of March 1642. to be preſented to his moſt Excellent Majeſtie.

VERSO OF TITLE-LEAF OF NO. 3.

(3)

TO THE KINGS MOST
EXCELLENT MAIESTIE.

MOſt gracious Soveraigne, Wee your Majeſties moſt dutifull, & loyall ſubjects, the Catholicks of your Highneſſe kingdome of *Ireland*, being neceſſitated to take armes for the preſervation of our Religion, the mayntenance of your Majeſties rights, & prero-

TOP OF P. 3 OF NO. 3.

6. 1643. A Declaration of the Supreme Council of the Confederate Catholicks of Ireland ratifying a cessation of arms for a year with the Marquis of Ormonde, and against any acts of hostility, &c. Dated (at Cashel) 21st Septr. 1643. *Thomas Bourke,* Printer to the Confederate Catholicks of Ireland. A Broadside. 11$\frac{3}{4}$ × 8$\frac{1}{2}$: Text, 10$\frac{1}{8}$ × 6$\frac{7}{8}$. Roman letter.

[Bodleian, MS.—Carte, 6. Fol. 511.]

7. 1644. Titus, or the Palme of Christian Covrage : To be exhibited by the Schollars of the Society of Iesus, at Kilkenny, Anno Domini 1644 . . .
Thomas Bourke. 4to. 2 leaves.

University Library, Cambridge /Hib. 7-644/33 : (No. 5311). See W. C. Hazlitt's Bibliographical Collections and Notes. Third Series : 1887 : p. 248.

Note :—A Dramatic piece.

A copy appeared for sale at one of Sotheby's auctions in 1885.

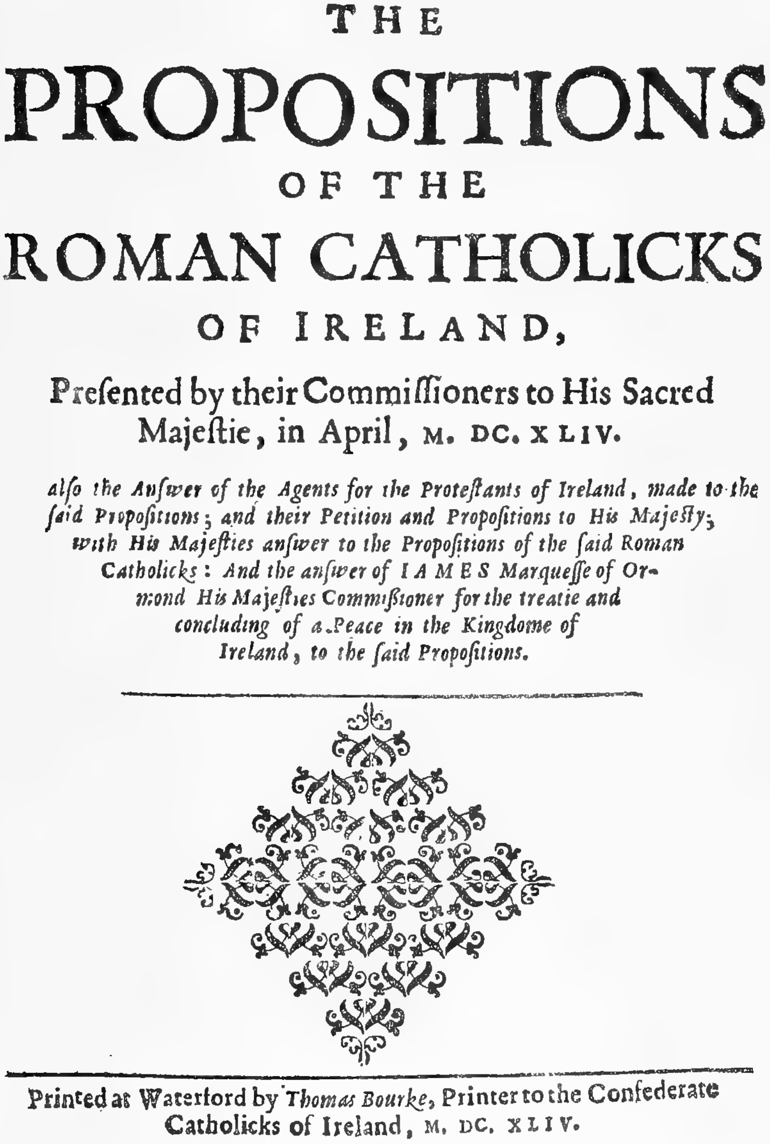
8. 1644. Alexipharmicon, or a Sovreigne Antidote against a Virulent Cordiall, composed 22 June 1644 by two Druggists: the one an Apostata, called Iohn Loghan, a titular Doctor of Physicke: the other a Doctor of divinity of the pretended reformed Gospel, called Ed. Parrey. Wherein the Cordiall is proved to be a contagious drugge of pestilent Ingredients, and the motives inducing the Apostata unto revolt to bee damnable and heretical. Walter Enos, Dublinian, Priest, and Doctor of Divinity.
Thomas Bourke. 4to. 118 pp. + 3 leaves (Table).

[T. C. D. /CC. 11. 9.]

9. 1644. The/Propositions/of the/Roman Catholicks/of Ireland,/Presented by their Commissioners to His Sacred / Majestie, in April, M.DC.XLIV. / *As also the Answer of the Agents for the Protestants of Ireland, made to the / said Propositions ; and their Petition and Propositions to his Majesty ; / with His Majesties answer to the Propositions of the said Roman / Catholicks : And the answer of Iames Marquesse of Or-mond His Majesties Commissioner for the treatie . . . of a Peace* in the Kingdome of / Ireland, *to the said Pro*-positions. *Thomas Bourke,* Printer to the Confederate / Catholicks of Ireland. 4to. T.l. (verso blank) + pages numbered 7–80. Sigs [A2], B-K4.

[E. R. McC. Dix ; Marsh's /Cashel Loan Collection ; University Library, Cambridge. /Hib. 7.644. 29 (No. 5310).]

Note.—In Mr. Dix's copy is an inset of 2 leaves (pp. 33–36) of some other Tract with Sig. " c." It begins : " The humble Propositions."



THE

PROPOSITIONS

OF THE

ROMAN CATHOLICKS

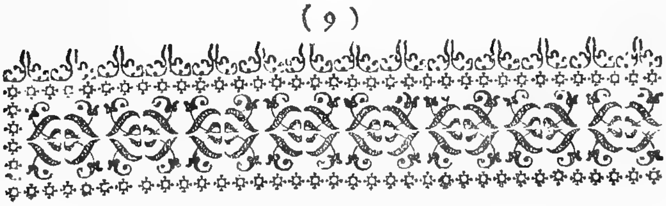
OF IRELAND,

Preſented by their Commiſſioners to His Sacred
Majeſtie, in April, M. DC. XLIV.

alſo the Anſwer of the Agents for the Proteſtants of Ireland, made to the
ſaid Propoſitions; and their Petition and Propoſitions to His Majeſty;
with His Majeſties anſwer to the Propoſitions of the ſaid Roman
Catholicks: And the anſwer of IAMES *Marqueſſe of Or-*
mond His Majeſties Commiſsioner for the treatie and
concluding of a Peace in the Kingdome of
Ireland, to the ſaid Propoſitions.

Printed at Waterford by *Thomas Bourke,* Printer to the Confederate
Catholicks of Ireland, M. DC. XLIV.

Title-page of No. 9 in foregoing list.



Ornament on p. 9 of No. 9.

10. 1644. Proclamation "By The Supreme Councell of the Confederat Catholicks of Ireland" (Calling upon those inhabitants of Ulster who had gone into other parts to avoid "the charge of the War" to return thereunto, &c., &c.) Given at *Kilkenny*, the 25 of May 1644.

Thomas Bourke, Printer to the Confederate Catholicks of Ireland.

Royal Arms. S.sh. Fol.

[R.I.A. /In glass case.]

11. 1644. List of Peers and other Members of the General Assembly of the Irish Confederates in 1644. *Thomas Bourke.*

[*Vide* Gilbert's "History of the Confederates": vol. iii, p. 214.]

12. 1644. Querees, Propounded by The Protestant Partie, Concerning The Peace In Generall, *Now treated of in Ireland, and the answers thereunto made in behalfe and name of the Irish Nation . . .*

Imprint: "Printed at Paris, by *Iohn Belier*, in the yeare, 1644." 4to. 24 pp., including t. p.

[University Library, Cambridge. /Hib. 7. 644. 31 (No. 6886); E. R. McC. Dix.]

QUERY:—Waterford-printed ?

N.B.—Appears to be identical with Bourke's printing.

13. 1644. The Inquisition of a Sermon Preached in the Cathedrall Church of the City of *Waterford* in *February*, 1617, etc., By *Robert Daborne,* Chancellor of the said Cathedrall, etc. Written by the R. F. P. C. of the Order of S. Augustin, & Doctor in Divinity.

Thomas Bourke. 4to. 254 pp. + 4 leaves (Table). Sigs. A–LL. 2.

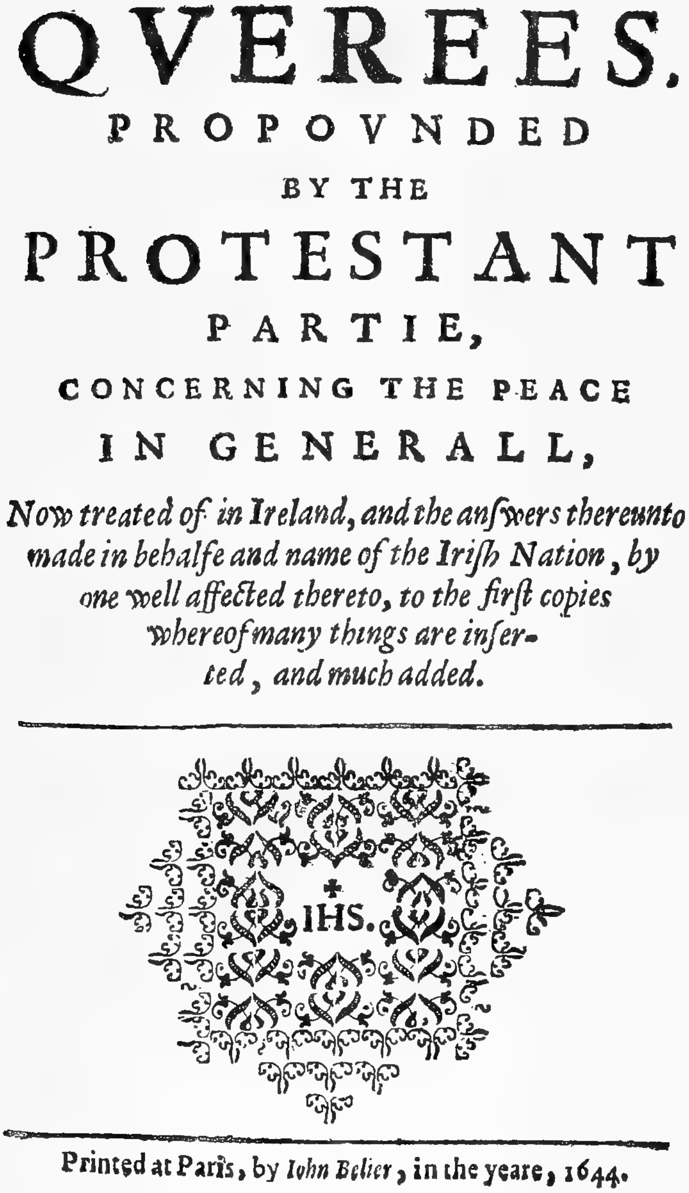
[Marsh's Library, Dublin. The Franciscan Library, Dublin.]

14. 1644. A Briefe Relation of the most remarkable Feates and Passages of what his most Gracious Majesties Commanders hath done in England against the Rebells and of His severall glorious Victories over them, sithence *January* 1641, till *December* 1643. And from the first of *May* 1644, till the fifth of this present *July*.

Thomas Bourke. Woodcut. 4to. 8 leaves. Verso of title-page and last pages blank. *Cropped.*

[Brit. Mus. /102. a. 23.]

15. 1644. A Declaration of the Lords, Gentry and others of Leinster and Munster, of their intentions towards English and Scottish Protestant inhabitants within this Kingdom. (n.d.) (AND)



QVEREES.
PROPOVNDED
BY THE
PROTESTANT
PARTIE,
CONCERNING THE PEACE
IN GENERALL,
Now treated of in Ireland, and the anſwers thereunto
made in behalfe and name of the Iriſh Nation, by
one well affected thereto, to the firſt copies
whereof many things are inſerted, and much added.

Printed at Paris, by *Iohn Belier*, in the yeare, 1644.

Title-page of No. 12 in foregoing list.

A General Proclamation by the Confederate Catholickes of the Supreme Councell against the Covenanters and for arming all Catholickes from 18 to 60. Dated 6th July, 1644.

Tho. Bourke.

[*Vide* MS. copy (from a printed original) in Bodleian, /Carte 11, 217; *Vide* also: London reprint entitled—"A Declaration made By the Rebels in Ireland," in National Library—*Thorpe Collection*, vol. iii; Bodleian/G. Pamphlets, 2641 (42); *See also*: "Irish Rebellion," Dublin, 1723: pp. 206–8. Gilbert's "History of Irish Confederates"; vol. iii, pp. 205-8; R. R. Madden's "Irish Periodical Literature," vol. i, pp. 137, &c.; Also *vide*: London reprint by *R. Austin*, 1644, in Brit. Mus. (Thomason) E. 17 (14).]

16. 1644. Proceedings relative to oath of Association of Confederates, &c. *Thomas Bourke.*

[*Vide* Gilbert's "History of Confederation," vol. iii, p. 212.]

17. 1645. A Persuasive Letter / Exhorting the Natives / of Ireland / to stand in Defence / Of their Faith, King and Countrey against / Parliamentary intruders, their errors, and / temeritie, directed to Sir N. Th. *With a discovery of the Tyrannicall pollicie and / unfaithfull dealings of some English Gover-nors, adherents to the malignant partie, towards their Pardoned Ene-mies and surest friends in / Ireland. /* Printed at Wareford [*sic*] in the year, 1645. 4to. 4 leaves. A4.

[University Library, Cambridge. / Hib. 5. 645. 1. (No. 5312); *Vide* W. C. Hazlitt's "Bibliographical Collections and Notes," third series, 1887, p. 119.]

N.B.—No printer given, but ornament on title in style of (No. 8).

18. 1645. A Declaration of the General Assembly of the Confederate Catholicks of Ireland suppressing certain Declarations and Protestations. Dated at Kilkenny, 4th July, 1645.

[*Vide* Kilkenny reprint in Bodleian Library—Carte MSS. xviii, fol. 8.]

19. 1645. A Remonstrance of Grievances Presented to his most Excellent Majestie, in the behalfe of the Catholicks of Ireland. *Thomas Bourke.* 4to. 32 pp. Sig. A–D4.

[*Vide* W. C. Hazlitt's "Bibliographical Collections and Notes," third series, 1887, p. 119.]

QUERY: Second edition?

20. 1645. Declaration of the Councell and Congregation of Confederate Catholicks against Plundering Roman Catholicks dwelling in English quarters.

[Bodleian Library.]

NOTE.—This item is doubtful: the Kilkenny edition is in the Bodleian Library, and is dated 1646.

21. 1646. A Decree of Excommunication Against such as Adhere to the Late Peace. By Rinuccini, Archbishop of Firmo. Decr. 1.1646 (?) Folio.

NOTE.—This item is doubtful: the like Decrees of the 1st Sept. and 5th Oct., 1646, were printed in Kilkenny.

22. 1646. The Second Part of the Survey of the Articles of the late reiected Peace &c. Rev. Walter Enos, D.D.

[University Library, Cambridge. Hib. 7. 646.19 (No. 5217).]

N.B.—62 leaves. Leaves 1–22 were printed in Kilkenny. The last 40 leaves were printed in Waterford, with the type and ornaments used by *Bourke* in his press there. (H. Bradshaw's MS. Note on Irish Printing.)

23. 1646. Declaration of the Lord General of the Army of the Confederat Catholicks in the Province of Leinster, (Preston), explaining why he receded from Treaty with the Marquesse Clanrickard and withdrew his Forces, &c. Printed by Command of the Councell & Congregation. Dated at Waterford, 22nd Decr., 1646. A Broadside. (13⅝ × 10.) Roman Letter.

[Bodleian, Carte MSS. 71. Fol. 431; 65. Fol. 329 & 342; 19. Fol. 670.]

NOTE.—There is no imprint, but it must have been printed at Waterford (or Kilkenny).

24. 1646. A New Almanac for the yeare of Our Lord God 1646, being the second after Leap yeare, and since the Creation of the World 5595. Calculated for the Longitude and Latitude of the City of Waterford, and may serve generally for all Ireland. By a Manapian.

(Printed for the year MDCXLVI.)

[*Vide* John Booker's "Bloody Irish Almanack," E. R. McC. Dix.]

25. 1651. Monarchy/No Creature of Gods/making,&c./ Wherein is proved by Scripture and/Reason/that Monarchicall Go-verment [*sic*] is against the/minde of God. *And that the Execution of the late King was one of/the fattest sacrifices that ever Queen Iustice had . . . Principally intended for the undeceiving of some ho-nest hearts who like the poor Iewes cry, give us a/King, though they smart never so much for it.* By John Cooke . . . *Peter de Pienne.* 12mo. (6¼ × 3⅝ in.) 28 leaves + 134 pp. Sigs a-g4, h (one leaf), A-H8 I4. 31 lines to a full page.

[Brit. Mus. /G. 4774; National Library (2 copies.), imperfect; The late Robert Day, J.P., Cork; University Library, Cambridge. (2 copies.) Hib. 8.651.2.3. (No. 5313.) Imperfect.]

26. 1652. Monarchy/No Creature of Gods making,&c./ *Wherein*/ Is proved by Scripture and Reason,/That Monarchical Government is/against the mind of God./ And that the Execution of the late King was one of/the fattest Sacrifices that ever Queen Justice had. / Being / An Hue and Cry after Lady Liberty, which hath / been ravished and stoln away by the grand / Potentates of the Earth. / Principally intended for the undeceiving of some / honest hearts, who like the poor Jews cry, give us a King, / though they smart never so much for it. / *Together* With / A Preface to the Supream Authority of the three / Nations, the Parliament of *England* / Wherein amongst other remarkable particulars, / you have a character of the late incomparable Lord Deputy, The truly Honourable / Henry Ireton, *Esq.* / By John Cook, late of Gray's-Inn, Esq: Chief Ju-stice of the Province of *Munster* in *Ireland.* /

(Peter de Pienne.) 8vo. (6½″ × 3¾″) 28 leaves + 134 pp. + 1 leaf (errata). (Second Edition or Issue ?)

[Brit. Mus. /522. c. 29/2/& E. 1238 (has different t.p.) — 2 copies; University Library, Cambridge, Hib. 8. 652. 1. (No. 5314); Worcester College Liby., Oxford; Messrs. Pickering & Chatto, London.]

27. 1652. An Act for the Settling of Ireland. "Thursday, 12th, August, 1652: Ordered by the Parliament. That this Act be forthwith Printed and Published." *Peter de Pienne.* 4to. 8 leaves. Sigs. A–B4. No pagination.

[National Liby., Dublin/Thorpe Collection of Pamphlets, vol. v.]

28. 1652. Ordered that 40,000 passes be printed at Waterford, May 8th.

[*Vide* Order Book in Public Record Office, /42.]

29. 1654. A Copy of a Letter from an Officer in the Army of Ireland to the Protector concerning his changing of the Government. 4to.

[Brit. Mus. / E. 881. 4; *Vide* also J. O'Daly's Sale Catalogue, No. 45, 1876, item 13.]

Note.—With reference to the British Museum copy, the "Letter" is dated "Waterford, 24th June, 1654," but no place of printing is given.

30. 1654–5. Parthenissa, a Romance. 6 Tomes. The Earl of Orrery.

[University Library, Cambridge. Hib. 7.655. 4–6 (No. 5315); *Vide* also G. W. Prothero's "Memoir of Henry Bradshaw," 1888, p. 330.]

N.B.—Tomes 1-4 were printed in Waterford.

June, 1913 1

PROCEEDINGS
OF THE
ROYAL IRISH ACADEMY

VOLUME XXXII, SECTION A, NO. 1

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,, VI.	(1853–1857)	,,	,, VI.	,,	,,
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,, XXIII.	(1901)	,,	,, VII.	,,	,,

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Section A. Mathematical, Astronomical, and Physical Science

,, B. Biological, Geological, and Chemical Science.

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,, XXVI. (1906–7)	
,, XXVII. (1908–9)	
,, XXVIII. (1909–10)	
,, XXIX. (1910–11)	
,, XXX. (Current Volume)	

,, XXXI. (Clare Island Survey.) In progress.

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March, 1914

2

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,,	VI.	(1853-1857)	,,	,,	VI.	,,	,,
,,	VII.	(1857-1861)	,,	,,	VII.	,,	,,
,,	VIII.	(1861-1864)	,,	,,	VIII.	,,	,,
,,	IX.	(1864-1866)	,,	,,	IX.	,,	,,
,,	X.	(1866-1869)	,,	,,	X.	,,	,,
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,,	XII.	(1875-1877)	,,	,,	II.	,,	,,
,,	XIII.	(1883)	,,	,,	III.	,,	,,
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,,	XV.	(1870-1879)	,,	,,	I.	,,	Pol. Lit. & Antiqq.
,,	XVI.	(1879-1888)	,,	,,	II.	,,	,,
,,	XVII.	(1888-1891)	,,	,,	I.	3rd Ser.	Sci., Pol. Lit. & Antiqq.
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,,	XX.	(1896-1898)	,,	,,	IV.	,,	,,
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