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An Introduction to the Vortex Theory of Propellers*

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The purpose of this lecture is to present the fundamental ideas on which the vortex theory is based and to discuss their physical interpretation. The Vortex Theory has led to the rapid growth of many branches of theoretical hydrodynamics and aerodynamics and the modern theory has been highly developed mathematically. The results obtained, after suitable modifications to the theory, usually give good agreement with practice, and in the field of aerodynamics the lift and induced drag of aeroplane wings, performance of airscrews, etc., can now be calculated fairly accurately. In applying the theory to marine propellers however, the problem becomes much more difficult due to the influence of factors which do not affect the performance of airscrews.

The theory was first put forward by Lanchester in 1907, but little or no use was made of it until about 1919 when Prandtl successfully developed from it a theory for aerofoils of finite aspect ratio. Since then the theory has been extensively applied and extended by Betz, Helmboldt, Glauert, Kawada, Pistolesi, von Kármán and others.

In the field of propeller calculations, the theory could at first only be applied to propellers with an infinite number of blades and thus gave results of limited value. As recently as 1929 Goldstein improved on an approximate method introduced by Betz, and the results he obtained enabled the calculations to be applied to a finite number of blades with closer agreement than before.

Vortices and Circulation

As the title implies, the theory is based on the properties associated with a simple vortex or eddy. In fact any mass of fluid rotating or spinning round can be termed a vortex, but for the development of any theory a broad description of a vortex, such as this, will not suffice and the properties of the vortex used in the mathematical theory are rigorously defined. At this stage however, it is sufficient to define only one of these properties. For this purpose consider an infinite length of fluid spinning around a straight axis AB—an infinitely long vortex, or in more precise terms a line vortex. Then the velocity of the fluid at a point P, a perpendicular distance r from the line vortex is inversely proportioned to r i.e. $v_P \propto \frac{1}{r}$. The velocity distribution across a section XX is shown in Fig. 1. This is the most important property of the vortex as used in theoretical calculations. The idea of such a vortex is completely analogous to that of a long straight wire carrying an electric current i and around this wire a magnetic field exists, the strength of which at any point is inversely proportional to the perpendicular distance from the wire. In the same way a velocity field is said to exist around a line vortex, with similar properties.

Another way of considering the velocity field of a vortex leads to the idea of circulation. First, for the line vortex above, consider a plane section of the vortex by XX in Fig. 1. With the intersection of the axis AB of the vortex and the plane as centre draw a circle passing through the point P i.e. of radius r (see Fig. 2). Now the velocity at any point on the circumference of this circle is equal to v_P and tangential to the circle. Then the quantity obtained by the product $v_P \times$ circumference of the circle i.e., $v_P \times 2\pi r$ is termed the circulation round the vortex.

Now $$v_P \propto \frac{1}{r}$$

or $$v_P = \frac{K}{r}$$

Then the circulation around the vortex

$$= \frac{K}{r} \times 2\pi r = 2\pi K$$

or the circulation $\Gamma = 2\pi K$ which is therefore constant round the vortex—this is an alternative definition of the property of this type of vortex, and is a convenient quantitative measure of the amount of vorticity or the strength of the vortex.

The definition of circulation however is more general than is implied above. Consider any closed curve ABC (Fig. 2), surrounding the axis of the vortex. At a point P on this curve let the velocity of the fluid at P be q_P in a direction making an angle θ with the tangent to the curve at P.

Then the circulation, Γ, around the vortex is defined as $\Gamma = \int_{ABC} q_P \cos \theta \, ds$ and for a vortex with the property described above it can be shown that $\Gamma = 2\pi K$ no matter what shape path is taken round the vortex.

Thus the concept of circulation implies a flow of fluid around a point or axis in a fluid.

To illustrate the use of this consider one or two common examples.

(1) *Rotating Cylinder (Magnus effect).* Consider first a long cylinder (Fig. 3) inserted in a stream of fluid whose velocity is V, then if the effect of viscosity is assumed to be small the streamlines will be

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as shown, and the cylinder will have no forces acting on it except the frictional drag. If, in the same fluid now at rest the cylinder is inserted and rotated about its axis, it will drag the fluid around with it and set up a vortex i.e. the cylinder acts as a "stirrer" and the fluid rotates with the cylinder. Finally, the rotating cylinder is inserted into the stream of fluid whose velocity is V so that at the point X the resultant velocity at X will be $v+w$, and at Y, $v-w$ i.e., the velocity on one side of the cylinder will be increased and on the other side decreased. Applying Bernoulli's theorem to this flow, where the velocity is decreased the pressure will be increased and where the velocity is increased the pressure will be decreased; the net effect on the cylinder will be a force F as shown. This principle was used in the Flettner rotor ships one of which, the "Barbara" of 3,000 tons was fitted with three rotating towers 13½ feet diameter and 56 feet in height, revolving at 150 r.p.m. (35 h.p. each). With a favourable wind the ship could attain a speed of 10½ knots.

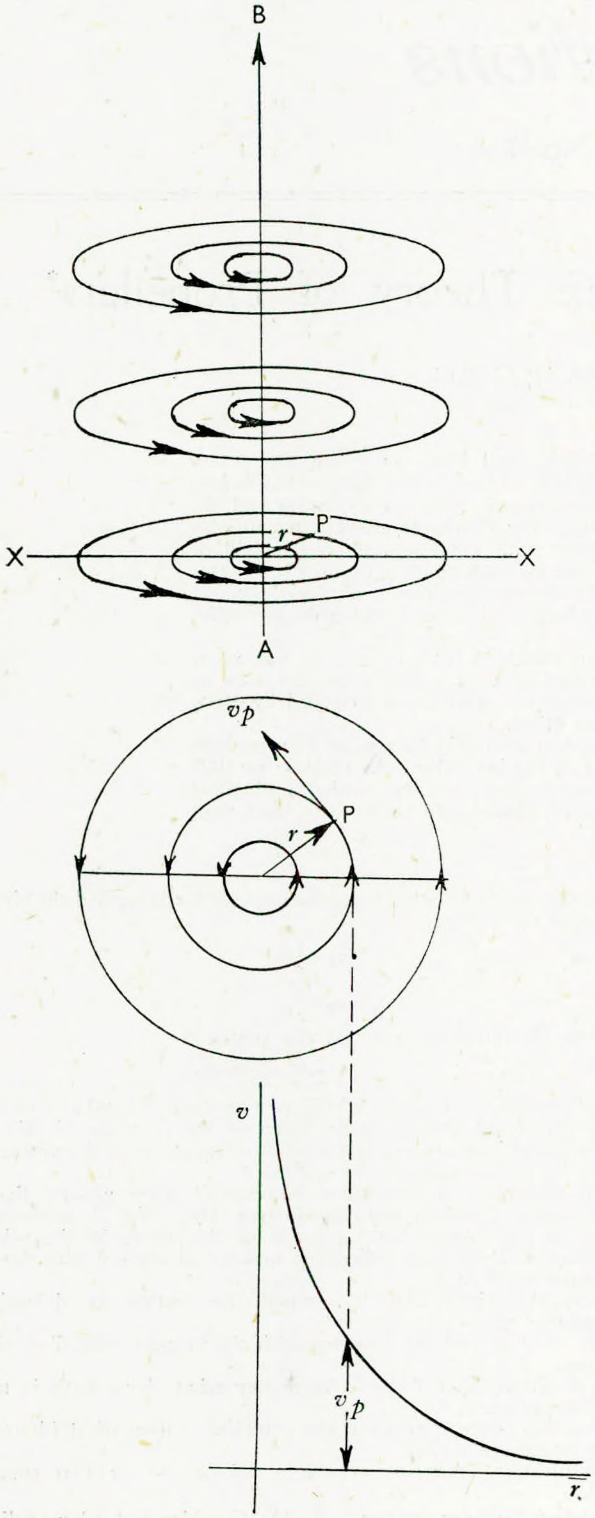


FIG. 1.—*Velocity distribution across a section XX*

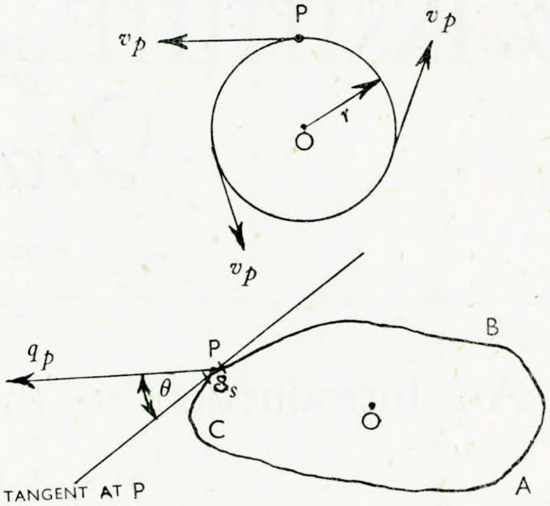
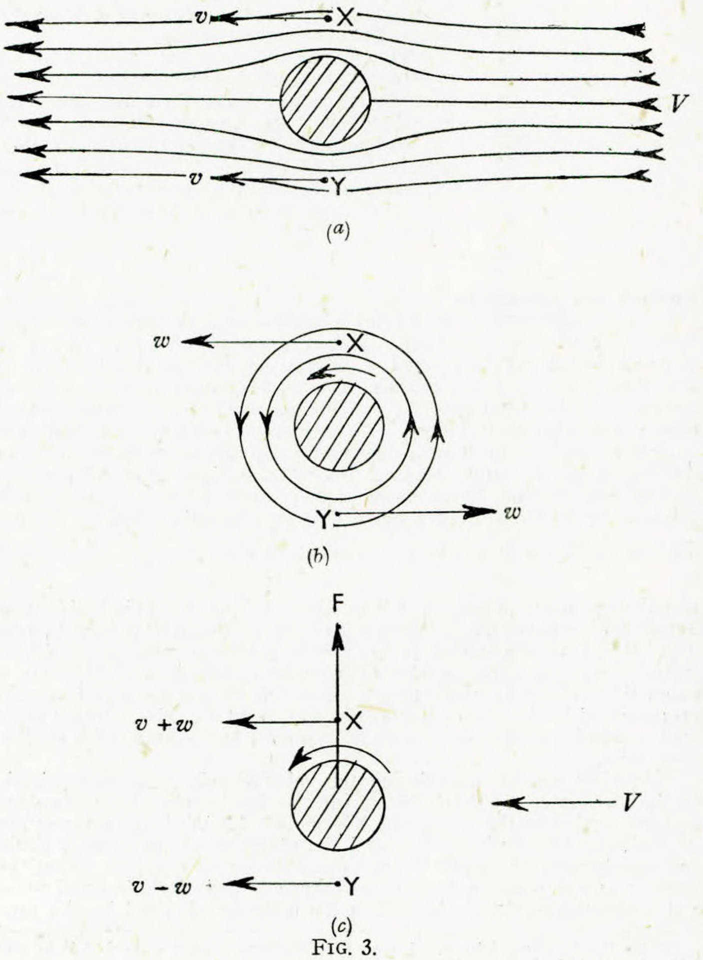


FIG. 2.

(2) *Aerofoils.* The combination of "straight" flow with "circulating" flow imposed on it can explain the lift produced on an aerofoil.



(*a*)

(*b*)

(*c*)

FIG. 3.

In this case the "stirring" of the fluid is produced not by a rotating body but by the "peculiar" shape of the section as will be explained later.

Consider first the simplified state shown in Fig. 4. In Fig. 4*a* an aerofoil section is inserted in a stream of non-viscous fluid and the streamlines are as shown*.

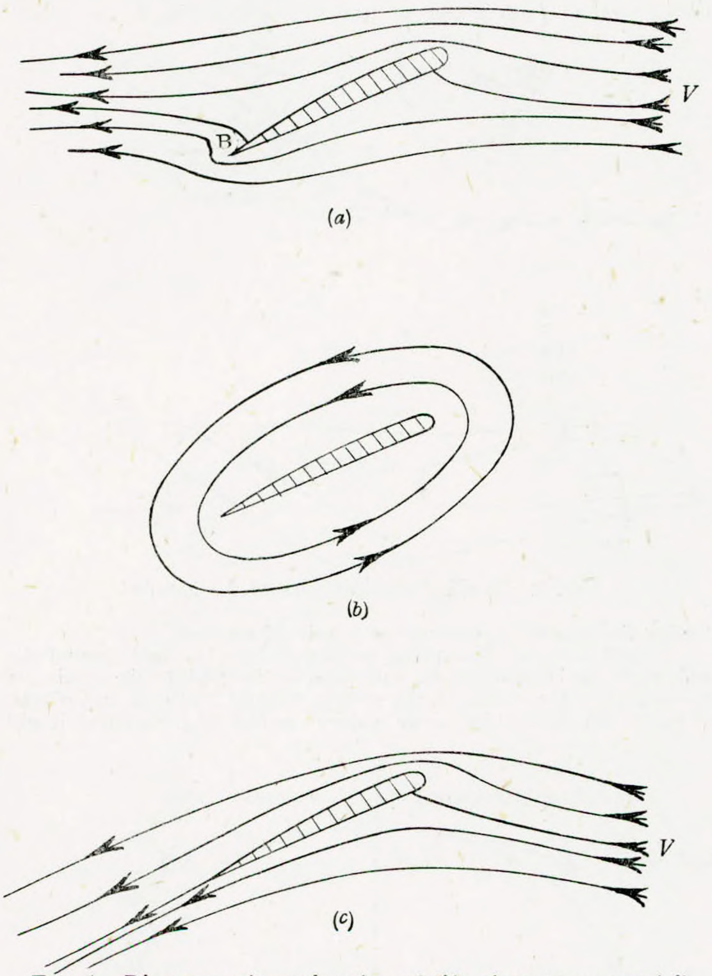


FIG. 4.—*Diagrammatic explanation of lift given to an aerofoil*

Suppose that by some action a flow around the body in the same non-viscous fluid can be produced as in Fig. 4*b* of circulation Γ.

If *b* is superimposed on *a* the flow will then be as shown in *c* and, by the same reasoning as used for the rotating cylinder, it will be seen that on the top of the section the pressure will be reduced, whilst on the underside the pressure will be increased and the aerofoil will be acted upon by a lift force *L*. This is the basis of the method used in theoretical calculations where it can be shown that the lift force is given by the simple formula $L=\rho v\Gamma$. (This formula applies for all bodies including the rotating circular cylinder).

Comparing the assumptions made above to explain the lift of the aerofoil with what actually happens in a real fluid, two discrepancies arise—(1) all real fluids, air included, have some viscosity and (2) there is no immediately apparent means of producing the circulation necessary for the lift. How then does the lift on say an aeroplane wing arise? The key to the answer to this question is that all real fluids have some viscosity i.e. for an aerofoil in a uniform stream of any real fluid, a circulation exists which is wholly dependent on the shape of the body and on the presence of viscosity in the fluid. There are various ways of considering the flow set up, and two of them will be discussed below.

Consider the aerofoil initially at rest in fluid at rest. If, then either the fluid be given a velocity *V* or the aerofoil be suddenly moved forward with velocity *V*, the immediate flow pattern will be as shown in Fig. 4*a* and fluid travelling on the underside of the aerofoil will flow around the sharp corner at B and common experience indicates that a strong vortex or eddy will be formed, with a corresponding circulation which will eventually break away downstream (Fig. 5*a* and 5*b*). This vortex arises because the velocity of the fluid at B tends to become very large and the forces which arise due to viscosity increase as the velocity increases until they are sufficiently large to prevent the flow represented in Fig. 4*a*, local breakdown of the flow then occurs with the formation of a vortex at the trailing edge. Since the fluid and aerofoil were initially at rest no circulation existed in the fluid around a path enclosing the aerofoil and since none has been introduced by any other means, the circulation must remain zero. Therefore, in order to balance the circulation around this starting vortex an equal and opposite circulation must exist around the aerofoil i.e. the law that action and reaction are equal and opposite applies.

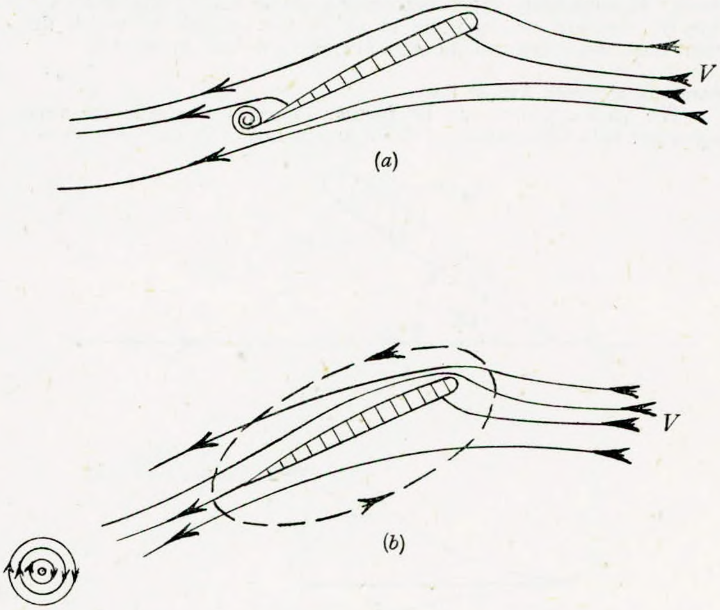


FIG. 5.—*Formation of vortex by aerofoil in a fluid stream*

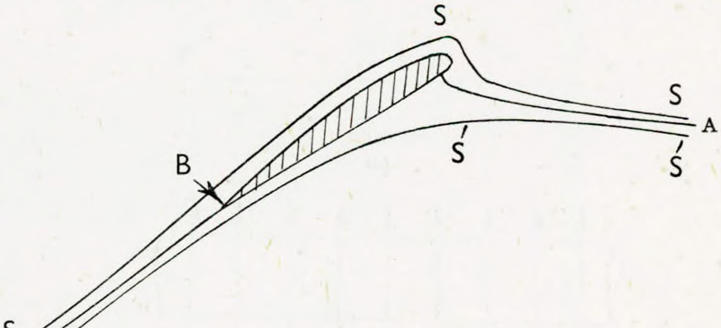


FIG. 6.—*Diagram illustrating different distances travelled over and under aerofoil by fluid particles.*

Another aspect of considering the flow round an aerofoil is to examine the flow round an aerofoil in steady motion Fig. 5*b*. It will be seen that the fluid does not flow round the sharp end at B (Fig. 6) but leaves the edge smoothly with no vortices forming. This means that two particles of fluid travelling along streamlines SSS and S′S′S′, starting from the same point A with approximately the same velocity separate when they reach the aerofoil, one travelling over the top of the aerofoil along SSS and the other under the aerofoil along S′S′S′ and they both meet again at B since the flow there is smooth. The particle that travelled along SSS, however, has covered a greater distance than the one moving along S′S′S′ and therefore its velocity must have been greater i.e. the velocity of the fluid moving over the top of the section is greater than that of the

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*At the trailing edge of the aerofoil, B, the velocity is infinite.

fluid moving along the underside for the attitude of aerofoil shown in Fig. 6 and, so exactly the same state of affairs exists as obtained by the super-position of circulation on a straight flow.

It will thus be realized that the lift on an aerofoil in a uniform stream is completely dependent on the properties of the fluid viz. density, viscosity etc., and the shape of the aerofoil of which the blunt nose and sharp trailing edge are characteristic properties.

Aerofoils of Finite Aspect Ratio

The vortex theory can be further extended to cover the very important field of aerofoils of finite aspect ratio. It has been shown that for an aerofoil moving in a uniform stream, pressure exists on one side and suction on the other—a typical distribution being shown in Fig. 7 for a foil at angle α. It will be seen that the suction contributes much more to the lift than does the pressure and this is a general characteristic of aerofoils.

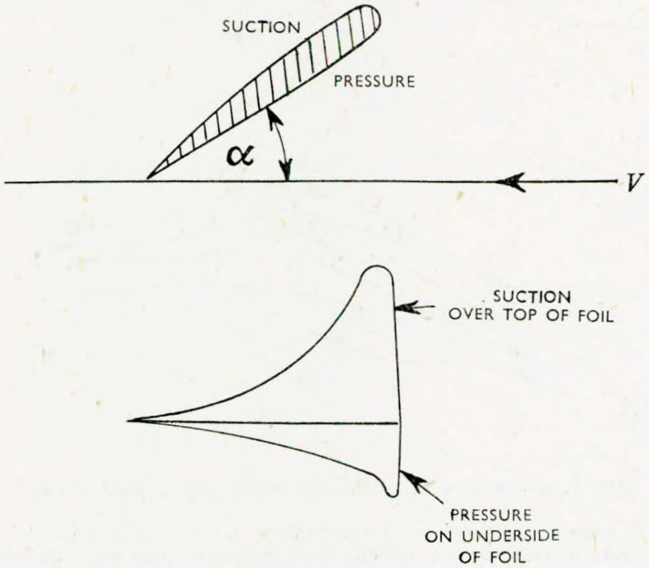
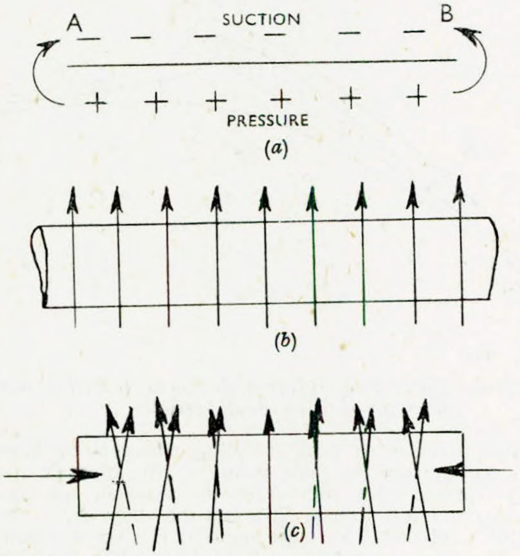


FIG. 7.—*Distribution of pressure and suction over aerofoil*

Consider now an aerofoil of finite length and constant section moving forward in a real fluid with velocity *V*, then on the upper surface a suction will exist, and on the under surface a pressure will exist across the span. However, at each end A and B the tendency will be for the pressure to force the fluid around the end from the underside to the upper surface as shown in Fig. 8 (*a*), aided also by the suction which exists over the upper surface; that is the fluid will spill over the ends and tend to equalize the pressure. This will impart a circulation to the fluid perpendicular to the span and instead of the fluid leaving the aerofoil in straight streamlines as shown, the cross flow will make it leave as a system of trailing vortices known as a vortex sheet. These vortices combine a short distance behind the aerofoil to form a pair of trailing vortices Fig. 9, the system having the general appearance of a pair of trousers.

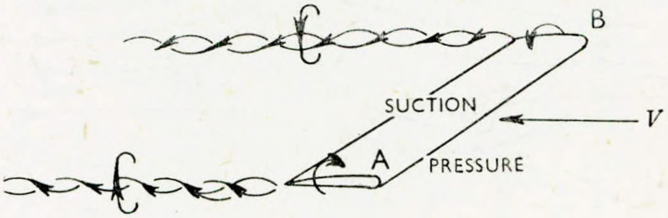


(*a*)

(*b*)

(*c*)

FIG. 8.—*Equalizing of pressure and suction around ends of aerofoil*
(*b*) *Flow over aerofoil of infinite length*
(*c*) *Flow over aerofoil of finite length*



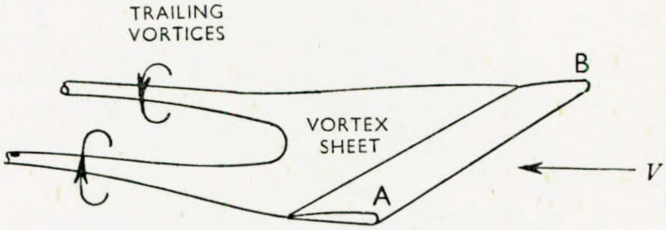
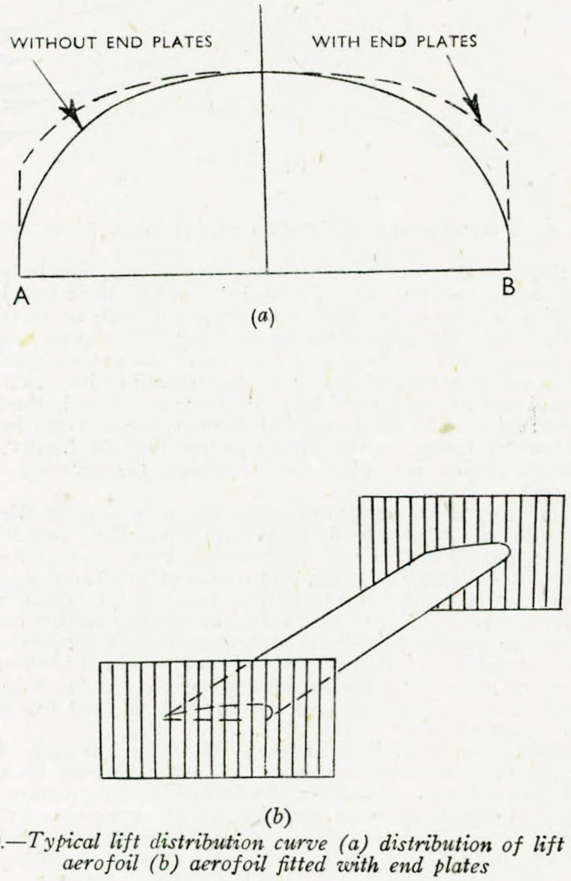


FIG. 9.—*Trailing vortices formed by aerofoil*

It will be seen that owing to this spilling of fluid around the ends there can be no lift at the outermost sections, whilst the maximum lift occurs at the centre i.e. the section furthest from the end effects. A typical lift distribution curve is shown in Fig. 10 from which it will



(*a*)

(*b*)

FIG. 10.—*Typical lift distribution curve (a) distribution of lift along aerofoil (b) aerofoil fitted with end plates*

be seen that the effect is more or less localized at the ends.

This "end effect" or "tip effect" can be partially overcome by fitting end plates to the aerofoil which reduce the tendency of the pressure and suction to equalize at the ends to an extent dependent on the size of the plates.

From the above discussion the general picture of the vortices associated with an aerofoil in a steady fluid stream can be pieced together (Fig. 11):—

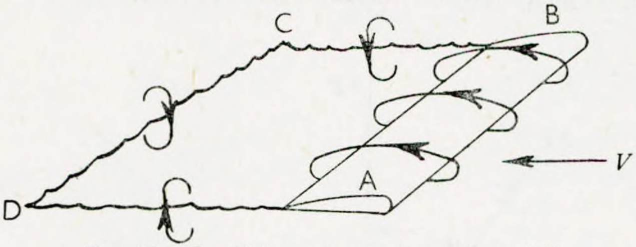


FIG. 11.—*Complete vortex system of aerofoil*

(a) Across the span of the aerofoil a circulation exists in the direction shown.

(b) Corresponding to the circulation around the span is the equal and opposite circulation around the starting vortex C D which has been washed away downstream.

(c) Connecting the two systems AB and CD are the two concentrated trailing vortices (neglecting the small portion of vortex sheet) and, as will be seen, a completely closed vortex system exists. In practice the starting vortex CD is carried away downstream and its effect can be neglected after a short interval of time once a steady state has been reached.

With this system it is then possible to calculate the velocity at any point in the stream not too close to the aerofoil. This velocity will be the vector sum of the stream velocity V and the velocity due to the vortex system which can be calculated in a similar manner to that used in calculating the magnetic field due to a system of wires carrying electric current. This method of calculating the velocities around an aerofoil is one of the most useful results obtained from the vortex theory. Approximations can be obtained by further simplification of the vortex system as indicated below (see Fig. 12).

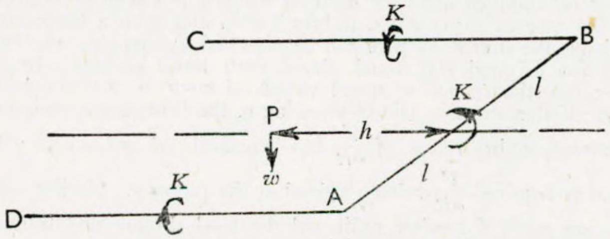


FIG. 12.—*Simplified vortex system*

The aerofoil is assumed to have constant circulation along its span and if of large aspect ratio the aerofoil can be replaced by a line vortex AB of the same length and of constant circulation K called the "bound vortex". The system is completed by the two trailing vortices represented by the two line vortices AD and BC, also having constant circulation K. In this simple horseshoe vortex the velocity w at some point P equidistant from A and B due to the vortex system is given by the simple relation $w=\frac{K}{2\pi l}\left\{1+\frac{\sqrt{l^2+h^2}}{h}\right\}$

Application to Propeller Theory

The application of the vortex theory to propeller calculations is based primarily on William Froude's blade element theory. For this purpose the propeller can be described as a system of rotating aerofoils or "wings" and the forces are estimated by considering blade elements obtained by annular sections as shown in Fig. 13(a). It is sufficient to consider one such section AA. The developed velocity diagram for this section is as shown in Fig. 13(b). (The propeller is assumed to be rotating with angular velocity ω and advancing with uniform velocity V). It will be seen from this diagram that the section is operating as a similar section in a stream of velocity $V^1=\sqrt{V^2+\omega^2r^2}$ at an angle of incidence α_i.

If it is assumed that this section has the same properties as an infinitely long aerofoil of the same constant section the lift and drag coefficients for the section at incidence α_i can be readily obtained from experiment curves, and the lift and drag calculated. By resolving L and D along the axes OX and OY, i.e., in the direction of translation and rotation of the screw the thrust and torque due to this element can be obtained thus:—

$$\delta T=(\delta L\cos\phi-\delta D\sin\phi)z$$
$$\delta Q=(\delta L\sin\phi+\delta D\cos\phi)zr$$

where z=number of blades.

These calculations can be performed for a number of annular elements across the propeller and the total effect obtained by integrating radially across the propeller blade from the boss to the tip.

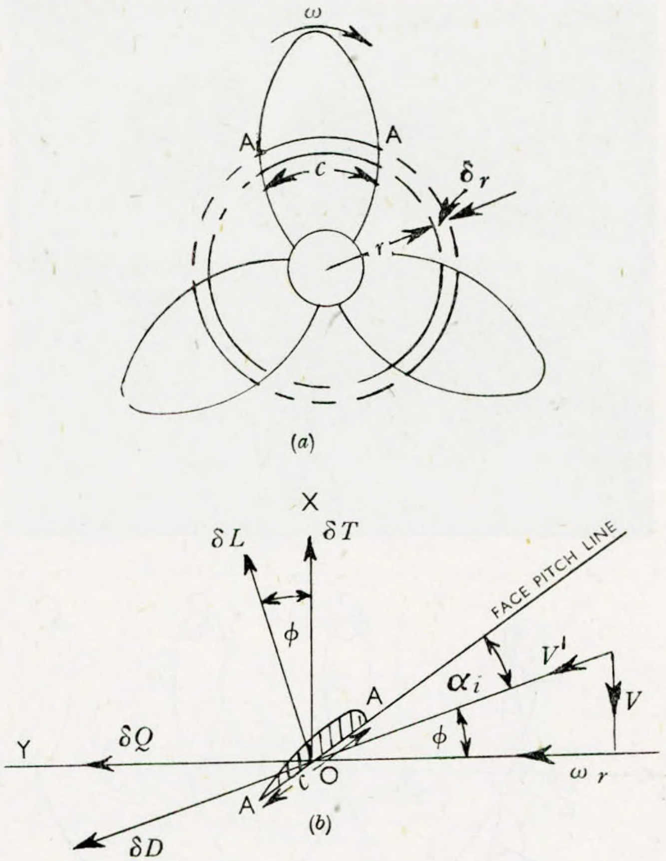


FIG. 13.

$$\delta L=C_L\tfrac{1}{2}\rho V^{1^2}c\delta r$$
$$\delta D=C_D\tfrac{1}{2}\rho V^{1^2}c\delta r$$

The results of applying this theory however do not give good agreement with the results obtained from experiments with propellers for the following reason. The propeller has been described above as a system of rotating aerofoils and from the previous discussion it has been shown that for aerofoils in motion there is a system of vortices set up which alter the velocity distribution in the fluid. Applying the same reasoning to propeller blades a corresponding system of vortices in the flow around the propeller would be expected. The existence of this system is clearly illustrated by a typical photograph taken in a cavitation tunnel where the trailing vortices are usually clearly visible (Fig 14). The general form of this system is readily seen and consists of a helical trailing vortex from each blade. Each of these trailing vortices will "induce" a velocity at any point in the fluid and the simple velocity diagram in Fig. 13(b) will have to be modified to include the induced velocity from not only the trailing vortex system of its associated propeller blade but the induced velocities of the systems of the other blades—these will be smaller than the former. It is the neglect of these induced velocities which has accounted for most of the large discrepancies arising when the simple blade element theory is used.

The velocity diagram for the element can now be modified as shown in Fig. 15 by adding a velocity v, which is the velocity due to the system of trailing vertices and which is practically perpendicular to the resultant velocity W. This velocity v is termed the inflow and for convenience it is usually resolved into two components (1) an axial inflow component parallel to the propeller axis and therefore to V. This is given the value aV (2) a rotational inflow component parallel to ωr of magnitude $a^1\omega r$. a and a^1 are termed the axial and rotational inflow factors respectively.

It is of interest to note that the axial inflow velocity was obtained by Froude from simple momentum considerations of the flow through a propeller with infinite number of blades. He deduced that the inflow velocity at the screw, which is designated aV in Fig. 15, is one half of the ultimate wake velocity. This can also be shown by the vortex theory for the same case.

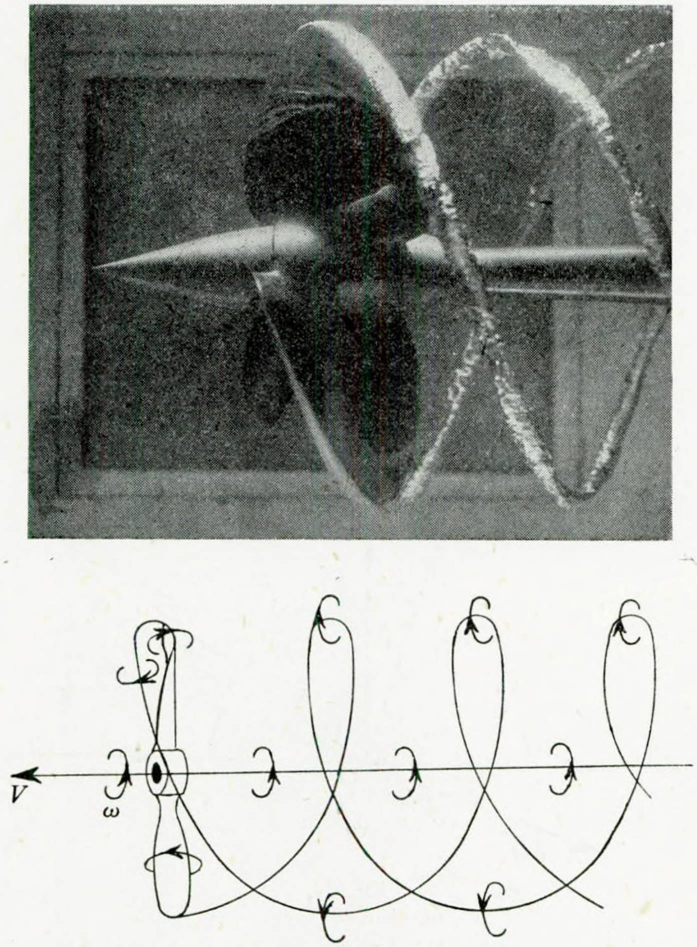


Fig. 14.—*Photograph of propeller showing trailing vortices.*

The general effect of this velocity due to the trailing vortex system is to reduce the effective incidence of the section α_i by an angle β and hence, in general, to reduce the lift and drag coefficients. The resultant velocity $W=\sqrt{(1+a)^2V^2+(1-a^1)^2\omega^2r^2}$ is little altered. Resolving as before

$$\delta T=(\delta L\cos\phi-\delta D\sin\phi)z$$
$$\delta Q=(\delta L\sin\phi+\delta D\cos\ )zr$$

But by definition $\delta L=C_L\tfrac{1}{2}\rho W^2c\delta r$ *and* $\delta D=C_D\tfrac{1}{2}\rho W^2c\delta r$

$$W=\frac{(1+a)V}{\sin\phi}=\frac{(1-a^1)\omega r}{\cos\phi}$$

Substituting, $\delta T=\tfrac{1}{2}zc\rho V^2\dfrac{(1+a)^2}{\sin^2\phi}(C_L\cos\phi-C_D\sin\phi)\delta r$

and similarly $\delta Q=\tfrac{1}{2}zc\rho r^3\omega^2\dfrac{(1-a^1)^2}{\cos^2\phi}(C_L\sin\phi+C_D\cos\phi)\delta r$

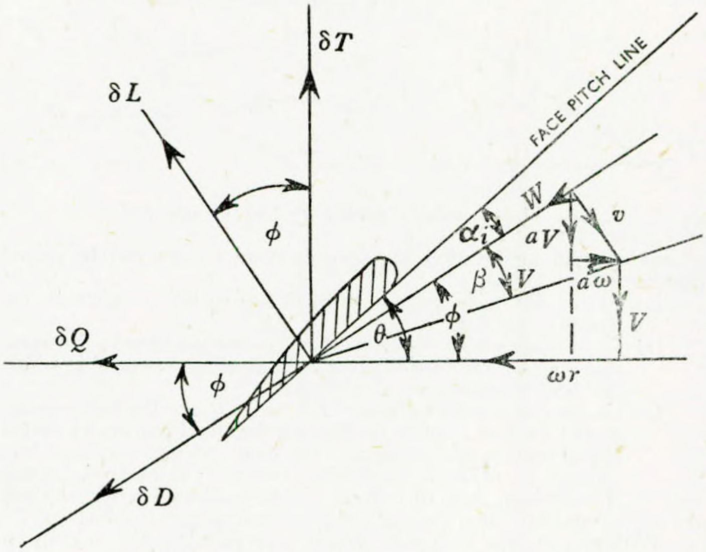


Fig. 15.

Hence provided a and a^1 are known the total thrust and torque can be obtained by integration radially.

Unfortunately the determination of v or a and a^1 is a difficult problem, partly due to the complicated nature of the flow and to the fact that the induced velocity depends on the lift coefficient which cannot be obtained until the induced velocity v has been determined. For the case of a propeller, lightly loaded and with a large number of blades the inflow factors can be obtained by equating the expressions for δT and δQ found above with those obtained from the momentum theory, for assumed values of $\alpha_i=\theta-\phi$ (θ is fixed by the design of the screw). Hence knowing ϕ, the thrusts and torques and the corresponding ratios of $\dfrac{V}{\omega R}$ can be calculated and the thrust and torque at required $\dfrac{V}{\omega R}$ value obtained at the radius r. Similar calculations are made for other radii and the total thrusts and torque for the propeller obtained by radial integration.

In the case of a propeller with a small number of blades this method cannot be used and the general method is one of successive approximation. By a slightly different but more complex approach than the above Goldstein has investigated the flow for propellers of two or more blades and the results he obtained can be used to calculate the inflow velocities and therefore the propeller thrust and torque fairly accurately for most propellers including wide bladed marine propellers.

Swansea Local Section

Inaugural Visit of Council

At the invitation of the Local Committee a party of Members of Council, headed by the Chairman, Mr. R. K. Craig, paid a week-end visit to Swansea on the 18th-20th June 1948. In addition to the Chairman, the party included Messrs. W. Sampson (Past-Chairman), F. W. Youldon (Vice-President), J. Calderwood (Chairman, General Purposes Committee), A. F. C. Timpson (Chairman, Papers and Transactions Committee), W. J. Ferguson and W. R. Harvey (Members of Council), A. C. Hardy, H. S. W. Jones and F. D. Clark (Associate Members of Council), C. Moffatt (deputising for I. J. Thomas, Vice-President, Cardiff), G. R. Hutchinson (Member, Papers and Transactions Committee and Publicity Committee), and B. C. Curling (Secretary). Mrs. R. K. Craig and Mrs. A. F. C. Timpson also participated in the proceedings.

The visitors were met and welcomed on arrival on Friday evening by a deputation of the Local Committee, including Major E. W. B. Kidby (Vice-President), Messrs. G. Thompson (Chairman), M. W. Henderson (Honorary Secretary), and D. H. Sword (Member), the ladies being received by Mrs. E. W. B. Kidby and Mrs. Johnson.

The party assembled at 9.30 on Saturday morning outside Swansea Station, whence they were conveyed to the Dry Docks. Here they were received by Mr. D. H. Sword, general manager of the Prince of Wales Dry Dock Co., Ltd., afterwards making a tour of the Docks with Mr. A. R. Edmiston as guide.

The party next proceeded to the Guildhall, where they were received by His Worship the Mayor, Sir William A. Jenkins, J.P. and were enabled to inspect the noble civic building and the famous Brangwyn mural paintings in the main hall.

From the Guildhall the party was taken to Langland Court, Langland Bay, where luncheon was provided by courtesy of the Prince of Wales and Palmers Dry Dock Companies. Mr. Sword presided and welcomed the guests, among whom were the Mayor and Mayoress. In reply, the Mayor and Mr. Craig in turn expressed to Mr. Sword the thanks of the visitors for his company's kind hospitality.

The afternoon was spent, according to individual inclination, in golf, bathing and other recreations in the delightful environment of Langland Bay, the weather being at its best.

Leaving Langland Bay at 6.30 p.m., the party, with the exception of the ladies, returned to Swansea and reassembled at 8 p.m. at the Mackworth Hotel, where they were entertained to dinner as guests of the Committee and members of the Local Section. Also present as guests were the Deputy-Mayor, Mr. W. T. Mainwaring Hughes, and the Members of Parliament for the Borough, Alderman Percy Morris and Mr. D. L. Mort. Mr. George Thompson was in the chair. After the Loyal Toast had been drunk, the Chairman proposed the toast of the Institute. He referred to the important part the Institute was playing in the reconstruction and development of the British shipping industry. He pleaded for closer co-ordination of the various units of the industry, and particularly for a better understanding by workers and technicians of the problems of management.

Mr. A. C. Hardy, responding, recalled his previous visit to Swansea in his war-time capacity as Constructor Commander, R.N., when "Pluto" was laid across the channel to Devon. He said that Swansea would go down in history as the place where the new technique which was to a great extent responsible for the success of D-Day was started. Swansea should keep the Pluto pump and the little piece of Pluto which still remained on the quayside as a kind of national memorial. When the history of the war was written Swansea would be mentioned as the town from which one of the major projects was started.

Britain had a difficult political situation today and a difficult internal problem, but there was one thing which kept the nation alive —its shipping. Marine engineers were dealing with a vital life-line, and, while aircraft would take a certain part of their lines from them, they had to carry on with the transport across the ocean.

He believed that in the propulsion of ships they were on the footstool of a new era. All kinds of things were going to happen in the propulsion and the driving of ships and in the methods of repairing them.

Swansea was one of the best equipped ports for repairing ships in the world. Whatever happened to coal and politics, ship-repairing would always matter, and Swansea would be safe from this point of view.

Mr. R. K. Craig also responding, thanked the local members for the hospitality the visitors had received during their short visit to Swansea.

Mr. A. F. C. Timpson, submitting the toast of the Port of Swansea, suggested that the present rail facilities to Swansea, which he had experienced, might be the reason for the docks not getting a fair share of the import and export trade.

The Deputy Mayor, Mr. W. T. Mainwaring Hughes, said he would like to make it clear that they had an absolute faith in the future of the port of Swansea. They believed that better times were ahead, and there were signs now that things would be better.

There was slight improvement in coal shipments, while the National Oil Refineries had ambitions. They all recognized that the economic situation must affect the export and import trade, but they felt that the Government could have assisted Swansea more.

They could not understand why Swansea, one of the finest ports in the country, with all available facilities, should remain idle and empty when they heard of congestion of other ports and railway trucks being delayed because of it. However, they did not feel down and out, but had a grouse and were shouting it from the house-tops.

Mr. E. V. Swallow, dock manager, said that in the peak year at the docks there were 7¾ million tons of imports and exports, while last year they amounted to 2½ million, which was lower than any year since 1884. So far this year they had amounted to 1½ million.

"Here is a port replete with all the necessary equipment and facilities, and it is not being used", he said. "We have a dispatch record with which no other port can compare".

Alderman Percy Morris, M.P., said there were several ports with trade not much lower than that with which they dealt during the war, but he shared the optimism of the Deputy Mayor.

When the production of steel, tinplate and coal returned to normal again, Swansea would come back once more into her full pre-war prosperity, and the new light industries would be useful and additional. Swansea was not on her knees or bending.

Mr. D. L. Mort, M.P., said the Government could have done more for the port of Swansea.

Mr. J. Calderwood, speaking as Chairman of the General Purposes Committee which had been directly concerned in this local development, recounted briefly the history of the formation of the Swansea Local Section and its fellow Section at Cardiff. He suggested lines on which the Council would like to see the Local Committee plan their activities, particularly as regards the reading and discussion of papers, and he foresaw a valuable contribution from this source to the central activities of the Institute, which the Council would do all in their power to foster and reciprocate.

Major E. W. B. Kidby, Mr. D. H. Sword and Mr. B. C. Curling were other speakers who, on the impromptu invitation of the Chairman, exchanged felicitations between the local members and the visitors.

The proceedings ended at 11 p.m.

The lady visitors were entertained to dinner separately at the Langland Bay Hotel, Mrs. Kidby and Mrs. Thompson kindly acting as hostesses.

Visit to the Shell Refining and Marketing Co., at Shellhaven

On Thursday afternoon, 17th June, some thirty-three students and members paid a visit to Shellhaven.

Transport from the station was kindly arranged by the company, and the party was welcomed by Mr. Hadland on arrival.

A short lecture was given, explaining the general layout and working of the plant, after which the party split up into small groups, each being conducted by a chemist.

The tour proved very interesting and instructive, especially in the comparison between the methods used for the refining of high viscosity and low viscosity index oils.

Such processes as solvent extraction, distillation and methods of filtration were very well illustrated and explained.

It was observed that automatic control throughout the plant played an important part in maintaining efficiency of working, and this accounted in no small way for the fact that overall wastage during refining was less than 1½ per cent.

After the tour tea was served, and an appreciation of the excellent arrangements on behalf of the party was conveyed to Mr. Hadland by Mr. S. C. Gosling. Mr. Hadland stated that the company's only regret was that a whole day was necessary to cover the plant fully, and that in having only an afternoon with the party, the tour had been somewhat curtailed.

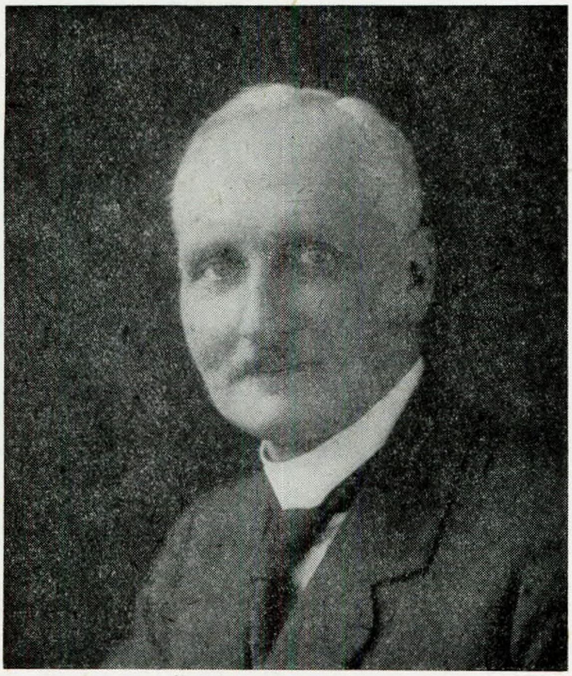
Cardiff Local Section

Through the courtesy of the South American Saint Line, an invitation was extended to a limited number of local members of the Institute, together with the Consulting Engineers and Marine Surveyors to visit the new M.V. "St. Essylt" on the 22nd June. Mr. Colin Moffatt, M.I.Mar.E., deputized for Mr. Ivor Thomas and with a representative number was received on board by Superintendent J. E. Church, M.I.Mar.E. who conducted the party over this luxurious freighter.

This visit was of great interest and thanks are due to the South American Saint Line for making it possible.

OBITUARY

Barton Proctor Fielden was born at Stoke, Devonport on the 24th April 1869 and was educated at Belfast, where his father, Mr. Immer Fielden was a Board of Trade Surveyor. He entered the fitting shop of Messrs. Harland and Wolff, Ltd., Belfast, in June 1884. At the end of that year he transferred to Earle's Shipbuilding and Engineering Co., Ltd., Hull, to serve his apprenticeship until May 1890. Shortly after this he joined the Harrison Line as 4th engineer of the S.S. "Governor" and served this company and the Wilson Line until August 1896, by which time he had become a chief engineer. Early in 1897 he was appointed by the Board of Trade as one of their engineer and ship surveyors for duty as an examiner of engineers, which position he held for three years. In 1900 he joined the Atlantic Transport Co. as assistant superintendent engineer and went to the U.S.A. in 1901 to supervise the building of ships for the International Mercantile Marine Co. and the Panama Pacific Line, returning to England in 1904. From then until 1st August 1912, when he was appointed chief superintendent engineer, he continued to serve the Atlantic Transport Co. until his retirement in 1926. Shortly after this he was recalled by the President of the International Mercantile Marine Co. to go once more to the U.S.A. to supervise the building of the "Manhattan" and other ships, finally retiring in 1928, although offered other appointments in the U.S.A. In retirement he lived at Padstow, North Cornwall where he took an active interest in local affairs. Largely through over-work, he suffered a heart attack in 1943 from which he appeared to recover, but his activities were curtailed and early in 1948 his heart became troublesome and during the months preceding his death he suffered considerably but with amazing patience and fortitude. He died on the 23rd July aged 79. He leaves a widow, two sons and three daughters. The funeral took place on the 27th July, when he was interred in the churchyard of the parish church of St. Merryn. Mr. Fielden had a long and outstanding record of association with and service to the Institute. He became a member in 1913; he held office as a Member of Council in 1915-17, 1919-20 and 1922-24, and was Chairman of Council in 1919 and 1925. He continued his active association with the work of the Council after his retirement and removal from London, and in recognition of his special services he was elected as a Vice President in 1925 and as an Honorary Vice President in 1935. He was held in the highest esteem by his fellow members of the Institute and by his numerous friends in shipping circles both in this country and the U.S.A., who will feel his passing as a personal loss.



George R. Ellis (Member 4776) was born in Wallasey in 1883 and served his apprenticeship with Messrs. Cammell Laird of Birkenhead. He served for a short time with Alfred Holt before entering the R.I.N. in 1906 as an engineer sub-lieutenant and spent most of his naval career in the Far East. He was wounded in the 1914-18 war and invalided out of the service in 1916 but was later recalled and served with the Grand Fleet in home waters until finally invalided out again in 1919. In 1920 he served on the North West Frontier with the Royal Engineers with the rank of Major and returned to this country in 1922.

In 1923 he was appointed to the Air Ministry Works Directorate of the R.A.F. and served with them until his retirement in 1945. After an illness of many months he died on 27th May 1948.

David Hedley (Member 9140) was born in Belfast in 1889 and served his apprenticeship with Messrs. Harland and Wolff, Ltd., Belfast, from 1905-10, following which he joined the Head Line in Belfast. He joined Elders and Fyffes in Liverpool in 1912 and was with this company until the outbreak of the 1914-18 war, when he was commissioned as an engineer lieutenant in the Royal Naval Reserve. He rejoined Elders and Fyffes in 1919 and relinquished his sea-going career in 1929. He was with the sales staff of Frigidaire, Ltd., and resigned in 1940 to accept an appointment with the Admiralty as Inspector in the Naval Ordnance Department. He was elected a Member of the Institute in September 1940. He served as ordnance inspector for five years in the Manchester area and later at Newcastle-on-Tyne (Vickers Armstrong). On his release from the Admiralty in March 1946 he was appointed representative North of England sales manager for Messrs. Smart and Brown (Engineers), Ltd., in whose employ he was up to the time of his death on the 24th July.

Lieut.(E) William Eric Riseborough, R.N. (Student 9866) was born in Sunderland in 1921 and served his apprenticeship in H.M. Dockyard, Keyham. Educated at Devonport High School he matriculated with honours and won a free entry to Dartmouth Naval College in May 1940. He was transferred to the Royal Naval Engineering College, Keyham, and passed out as Lieut.(E) in 1943, when he joined H.M.S. "Cumberland" and served in eastern waters until November 1945. He transferred to the Fleet Air Arm in February 1946 and obtained his pilot's wings in August 1947. He was a Graduate Member of the Institution of Mechanical Engineers. A few days after passing his examination qualifying him as a Student Member of the Royal Aeronautical Society, his promising career was brought to an end as the result of a flying accident at Long Sutton, near Yeovil, Somerset, on the 4th June 1948 while attached to H.M.S. "Heron", Yeovilton. He was cremated at Ilford on the 10th June 1948.