Fourier Analysis of the Flow of Electricity in Flat Plates

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scattering material and the ionization chamber limits the angle of
divergence of the rays and yet permits a wide beam to enter the
ionization chamber. Thus a large sample of material could be
used thereby increasing the intensity without any sacrifice of re-
solving power.

The following spacings were found for camphor:

<table>
<thead>
<tr>
<th>Material Description</th>
<th>Spacing 1</th>
<th>Spacing 2</th>
<th>Spacing 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crystalline camphor at room temperature</td>
<td>10.2 A.U.</td>
<td>6.0 A.U.</td>
<td>5.6 A.U.</td>
</tr>
<tr>
<td>Crystalline camphor above 100°C</td>
<td>10.2 A.U.</td>
<td>6.0 A.U.</td>
<td></td>
</tr>
<tr>
<td>Liquid camphor</td>
<td>11.6 A.U.</td>
<td>6.4 A.U.</td>
<td></td>
</tr>
</tbody>
</table>

The change in structure found for crystalline camphor agrees
with crystallographic data. The change in spacing from solid to
liquid agrees with that calculated from the densities of the two
states. The scattering curve for the liquid state is strikingly sim­
ilar to that for the crystalline state. It seems that the structure
responsible for the scattering of x-rays is the same in both states.

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FOURIER ANALYSIS OF THE FLOW OF ELECTRICITY
IN FLAT PLATES

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A Fourier analysis of the flow of electricity in a two-dimen­
sional plate depends upon the solution of Laplace's equation in
two dimensions. The problem considered in this paper is that
of a rectangular plate, the potential being applied at two adjacent
sides. The results of the experiment depended upon the finding
of the equipotential lines. This was done by means of a dish
forty centimeters wide and fifty centimeters long. Copper strips
were placed on two adjacent sides. An ordinary storage battery
was used as a source. The lines were then found by exploring
the dish with the terminals of a D'Arsonval galvanometer. The
lines of flow are then found to be at right angles to these equi­
potential lines.

In order to check on these equipotential lines and thus locate
the lines of flow, a Fourier integral was set up under the condi­
tions of the problem and then integrated. The result is an equa­
tion for the equipotential lines. This is,

\[ V = \frac{b}{\pi} \left[ \tan^{-1} \frac{b - y}{x} - \tan^{-1} \frac{b + y}{x} + 2 \tan^{-1} \frac{x}{y} \right] + \frac{a}{\pi} \left[ \tan^{-1} \frac{y - x}{y} - \tan^{-1} \frac{y + x}{y} + 2 \tan^{-1} \frac{y}{x} \right] \]
The flow lines are then found by solving this equation for the conjugate function.

A number of experiments were performed by varying the size of the dish. The equipotential lines were found in all cases. It was found upon application of the equation that the experimental data checked with the theoretical data.

There were many difficulties which presented themselves during the course of the experiment. Non-uniform conductivity of the conducting liquid, non-homogeneous copper strips, and the sensitivity of the galvanometer were three of the sources to be removed.

![Diagram of lines formed by two conductors at right angles](https://scholarworks.uni.edu/pias/vol33/iss1/78)

**Fig. 1.** Lines formed by two conductors at right angles

A representation of some of the typical results are to be found in the curves shown in the figure. The curves appear to follow hyperbolas asymptotic to a diagonal. The curves found in the case of a square plate are equilateral hyperbolas asymptotic to a diagonal.

The equation derived for the equipotential lines could be solved for \( x \) and \( y \), but it is found upon doing so that each term of the right hand member contains a multiple angle. These multiple angles can be found only by means of a tangent series. So we see, then, that each term would involve a tangent series, which
would greatly complicate matters. To get around all this work and to show that the theory really holds, we substitute points on some particular equipotential line, say the diagonal of the square plate, in the equation. It is found upon doing so that the diagonal turns out to be a line of zero potential, just what we would expect. All points between this line and the positive side of the plate will be at positive potential; and all points between this line and the negative side of the plate will be at negative potential. Since the lines of equipotential are just what the name infers, we know that if a succession of points is substituted in the equation, the resulting potentials would be the same.

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EFFICIENCY OF DIFFUSING BOWLS AS A FUNCTION OF THE LAMP WATTAGE

E. C. McCracken

(ABSTRACT)

It has been generally assumed that the efficiency of a diffusing bowl is independent of the intensity of the source of light providing the color is kept constant. As preliminary experiments indicated that this conclusion was not justified, a special photometer was constructed and measurements were made by eleven independent observers on different types of diffusing bowls and lamps. The results show (1) that the efficiency of a bowl is a function of the lamp wattage, the color of the lamp remaining the same; and (2) that the shape of the efficiency-wattage curve depends upon the color of the source.

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