fect exploit its variation with frequency to discriminate against rotations origina-
ting in other ways.

There are detailed variations in the ex-
perimential methods adopted, but the
principle is always the same; the atomic
vapour is contained in an oven between
nearly crossed polarizers. The light
source is a tunable laser. The optical
rotation is found from the intensity
transmitted through the system which
depends on the laser frequency and on
the number of atoms in the line of sight.
The latter is found from the Faraday ef-
effect, the rotation induced by an applied
axial $B$-field.

The method is very sensitive but it is
difficult to discriminate against spurious
effects. It is amusing to reflect that a
measurement accurate to about 10%
could be carried out in less than a minute
if one were limited only by noise in the
signal. In fact, some of the optical rota-
tion experiments have been going for
well over $10^6$ minutes and this accuracy
has still not been reached. So far,
measurements have been made at 848
nm and 876 nm in bismuth and 1.28 μm
in lead; all groups involved have found
optical rotations of the order of magni-
tude predicted, the quoted experimental
uncertainty ranging from 15% to 30%.

The bismuth 648 nm transition is of par-
ticular interest since it is the only atomic
PNC experiment for which results have
been reported from different laborato-
ries, at Oxford, Moscow and Novosir-
birk. Until quite recently, all three dis-
agreed completely. The latest data from
Moscow and Oxford are consistent while
the Novosibirsk group still quotes an
effect of about a factor of two larger.

Whatevver the final outcome, this shows
the importance of cross-checks be-
 tween different laboratories when such
small effects are being measured and
the possibility of significant systematic
error is so difficult to exclude. A further
useful comparison will be possible when
the Oxford group obtain a result for the
876 nm transition in bismuth, already
studied in Seattle. Checks of the fluores-
cence experiments are provided by the
consistent results obtained when tech-
niques have been varied and when diffe-
tent hyperfine transitions have been stud-
ed. However, even here confirmation of the results from other laboratories
would be valuable.

At the same time, it does now seem
likely that the major problems in the
various experiments have been recogni-
sed, and that before long the atomic
physics data will be accurate to 10% or
better. We therefore turn again to the
question of the motivation for all this
effort.

From the elementary particle point of
view, the interest is in the measurement
of the coupling constants. As mentioned
before, the heavy atom results depend
mainly on one component of the neu-
tron-electron interaction, but one can
write down the exact combination of
quark-lepton coupling constants which
determines the PNC effect in any given
case. The first point to make is that the
combinations measured in the heavy
atom experiments are almost orthogo-
nal to that obtained in the electron scat-
tering work at SLAC. The various me-
thods of studying the electro-weak in-
teraction are complementary, and taken
together can in principle distinguish be-
 tween different gauge models.

How far "in principle" can become "in
practice" depends critically on the ac-
curacy of the atomic experiments. For
example, if the combined uncertainties in
the experiments and atomic theory
can be brought below 10%, one can
derive a value of the $Z^0$ mass with a
precision comparable with that of the
existing CERN result. If it is possible
to reach the level of a few percent, the
 experiments even become sensitive to
radiative corrections to the theory. Fur-
thermore, one may eventually hope to
observe nucleon spin-dependent effects
and even perhaps the electron-electron
interaction. However, there is one major
difficulty to be overcome, which is to
solve the atomic problem well enough to
derive the coupling constants from the
measured PNC effects to a precision
comparable with the expected experi-
mental accuracy. Even for the compara-
tively simple systems of caesium and
thallium, the accuracy of the calcula-
tions is hard to assess, though errors
below 15% have been quoted. This
theoretical work, is now being pursued
vigorously, one object being to compare
the results of several different approa-
ches to the same problem. This should
give some feeling for the reliability of the
calculations and how best to go about
them. One may look for significant im-
provements over the next few years so
the prospect of a critical comparison
between high and low energy data looks
promising.

Nevertheless, it is important to stress
that the interest of the field is more
general than this. Naturally, atomic phy-
sicists hope that their measurements of
PNC effects will contribute to our
understanding of the basic physical
laws; it is reassuring to find that the
atom still maintains its role as a natural
testing ground for new theoretical con-
cepts. The theories developed to ac-
count for high energy phenomena often
seem to have little relevance outside the
domain of giant accelerators, and it is
striking that the familiar atom, which is
often said these days to be completely
understood in principle, should be so
profoundly affected by the existence of
the weak neutral current. However,
quite apart from these fundamental con-
siderations there have already been ma-
 jor benefits from this field of study. New
experimental techniques have been de-
veloped which have applications in quite
different fields. Also, as already remark-
ed, the need for theoretical progress has
stimulated considerable activity which
will give insights into the description of
many other atomic phenomena. There is
something of a temptation to assume
that PNC effects are only interesting in
so far as they might influence elemen-
tary particle theory. This is nonsense;
the fascination of the great majority of
atomic phenomena depends not at all on
their capacity to change our views on
fundamental interactions. The idea of
atoms without reflection symmetry is a
strange and beautiful one in its own
right, and must surely rank as one of the
most striking developments in the dis-
tinguished tradition of atomic physics.

Further Reading

The field has been reviewed by Fortson E.N.
and Wilets L. in Advances in Molecular Phy-
 sic s 16 (1980) 319.

A shorter account containing references to
more recent work is given by the present
4, 377.

Bouchiat M.A. and Pottier L. have given an
account for non-specialists in Scientific
American 250 (June 1984) 6, 76.

Europhysics Letters

Editor-in-Chief

Following discussions throughout the
European Physical Society — the Divi-
sions, the national societies, members
of Council and the partners investing in the
journal — Nicholas Kurti of Oxford has
been invited by the Executive Com-
mittee to become the first Editor-in-
Chief of the EPS general physics letters
journal to be launched in January 1986.

He has accepted and with characte-
ristic energy and enthusiasm begun to
grapple with the questions raised by the
implementation of the structure that has
been agreed. Readers will recall that this
comprises a body of Co-editors each
directly responsible for accepting or re-
jecting submitted letters in a given sub-
ject area, supported by a group of Ad-
visory Editors with wide geographical
and subject background.