THE AUSTRALIAN EXPERIENCE OF GERMANY

Proceedings of the Fifth Biennial Conference of the Australian Association of von Humboldt Fellows

Trevor R. Finlayson and Gabrielle L. McMullen (Editors)
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Editors:
Finlayson T.R. and McMullen G.L.

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PREFACE

The Australian Experience of Germany is a collection of papers presented at the Fifth Biennial Conference of the Australian Association of von Humboldt Fellows (AAvHF), held at Mannix College, Monash University, Clayton, Victoria, from Friday, 3rd to Sunday, 5th at December, 1993. The AAvHF evolved from the first conference of this kind, held in Sydney in 1973, to provide a focus to reciprocate the generous hospitality afforded many in 1973, to provide a focus to reciprocate the generous hospitality afforded many Australian scholars visiting Germany under the auspices of the Alexander von Humboldt Foundation. Following the 1987 conference held in Adelaide, a volume entitled The German Experience of Australia 1833-1938 was published. The title of this previous publication by the AAvHF provided the idea for the title of the present volume.

At least for professional scientists whose agendas at national and international conferences grow more narrow with the information explosion, the conference provides a most unique forum to exchange cultural and scientific ideas from many areas of scholarly activity. The scope of the papers presented here attests to this. They range from a critical review of the influence of reunification on German science and technology; with particular reference to opportunities for Australian-German collaboration, through the contributions of specific German settlers to Australian development, to some in-depth, but none-the-less understandable for the non-scientist, presentations of scientific research by authors with established German connections.

The conference wishes to acknowledge the support and encouragement afforded to it with the attendance of the Consul-General, Hans-Georg Fein and Mrs. Fein. Herr Fein’s opening remarks, which examined some aspects of Germany in the aftermath of reunification in 1991, are presented as the introduction to this volume.

The cultural aspects of this biennial conference were enhanced by a short programme of music by German masters presented by three Monash University identities—Marianne Deacon, Soprano and University Ceremonial Organist, Trevor Finlayson, Tenor and Associate Professor, Department of Physics, and Bruce Steele, Pianist, Associate Professor, Department of English and University Ceremonial Organist, during the opening session, and by a Saturday afternoon tour to some of the Yarra Valley wineries.

De Bortoli’s winery and restaurant at Dixon’s Creek provided an ideal setting for the conference dinner and we acknowledge de Bortoli winery for the photograph reproduced on the front cover. Attendees at the conference were grateful for the hospitality of the Master and Staff of Mannix College. We also acknowledge the clerical assistance of Mrs. Julia Barnes, Department of Physics, Monash University, in preparing both the conference material and this volume, and the computer graphics done by Mr. Steve McCausland, Department of Physics, Monash University, in relation to some figures included in this publication.

Trevor R. Finlayson and Gabrielle L. McMullen (Editors)
INTRODUCTION

One Germany - 1993

Hans-Georg Fein
Consult-General of the
Federal Republic of Germany in Melbourne

Being here in my capacity as German Consul-General, you certainly expect me to say a few words about the most pressing problem we face in Germany, that is, about reunification, its problems as well as its chances. Given the time limit I should like to concentrate mainly on the economic situation. I am very well aware that the process of Wetties and Ozzies (not Aussies) finding each other and becoming one people once more, or the problem of right wing extremism in Germany, would be very worthwhile to deal with, too. However, the economic problems are arguably the most pressing ones.

What we have to achieve is a complete reconstruction of East Germany. An entire economic system had to be transformed according to the principles of the social market economy. The socialist-planned economy had made it almost entirely impossible for anybody in the former GDR to develop his/her own initiative and responsibility; small and medium-sized businesses as generators of economic work had been eliminated almost entirely; creativity and willingness to achieve were paralysed to a great extent. Productivity of the economy was comparatively low - it was, measured by western standards, in 1970, only 40% of the West German level, and declined even further to approximately 30 to 40% until 1989.

This reconstruction process demands all our energy and can only succeed if the relatively rich western part of Germany shares its wealth with the relatively poor eastern part. This sharing has begun - although opinions as to whether the amount of financial transfers is necessary or big enough, differ widely. Let us have a look at the numbers involved. Until the end of this year, it is expected that the state and private sectors together will have transferred ca. 350 billion Deutsche Mark to East Germany, i.e., 300 billion Dollars. As a consequence, the economy in East Germany grew by 6% in 1992 and 6.2% in the first half of this year - higher than the 5% first-half GDP growth expected by economists. This is not very much if we take into account the low starting level. But it is a beginning. It proves that industrial production in East Germany is expanding. Significant progress has indeed been made in the building sector, in the manual trades sector, in large parts of the services sector as well as in individual areas of industry.

Problems continue, however, to exist in important sectors of industry faced with strong international competition or strong dependency on trade with Eastern Europe, as this eastern market simply broke away, the newly independent states of the former Soviet Union not being able to pay in hard currency. Overall, a self-sustaining recovery process has not yet materialized in the new states.
The worst problem in East Germany is the number of people out of work. Officially we count 1.1 million, i.e., 15.3% (as opposed to 7.8% in West Germany), but if we add those who are going into early retirement or have to work short-time or who are being subsidised in one way or another, we get a figure of 2.7 million jobless, that is, approximately 35%. What are the reasons? Apart from the economic motives just mentioned, the proportion of the working population with 83% was much higher in the former GDR than in the former West Germany with, only 70%. The GDR tried in the past to compensate her low productivity with the employment of a very large percentage of her workforce. Far more women worked in the former GDR, for instance, than in the old Federal Republic and these women would now like to continue working.

As long as the living standard in East Germany is much lower than that in West Germany the Federal Government will have to continue its policy of massive support. This is the only way to help effectively the development of new and visible economic structures as well as to create jobs in East Germany. This support has to be given at a time when, unfortunately, West Germany is in the middle of a recession. Germany is therefore the only country in the world having to cope with the problems of East and West simultaneously, or as one well-known German author wrote,

_We must simultaneously reform the old Federal Republic's market economy and transform the defunct centrally planned economy of the old GDR; we are having to adopt one system and overcome another._

What are our problems of adaptation in the West? We are, as pointed out already, in the middle of a recession and our competitiveness is in danger. We will need to accustomed ourselves to the fact that strong competitors and important trading partners are emerging, not only in Asia but also right in front of our own doorstep, in the democracies of central, eastern and south-eastern Europe, as well as in the successor states of the former Soviet Union. These countries are populated by nearly 400 million people who are just as intelligent and industrious as the people in Germany and they produce at far cheaper costs. Many German entrepreneurs therefore decided to set up new production facilities in these countries - thereby exporting jobs and, to an extent, contributing towards our jobless problem. At the same time the employed in Germany have the shortest weekly and life working times, and internationally are among the leaders in vacations and public holidays. We have - on average - six weeks holidays and 12 public holidays annually. Taking the weekly working time, we are on an average working less than all our competitors, i.e., 37.5 hours per week. At the same time, we allow ourselves the shortest machine running times. In spite of all this it seemed - as Chancellor Kohl remarked a few weeks ago - as if we have no more pressing issues than contemplating how we could possibly extend our holidays.

However, that was a few weeks ago. In the meantime, VW for instance has introduced a four-day week accompanied by a 20% cut in wages and salaries. It looks as if the "collective holiday park mood", of which Chancellor Kohl was also speaking, is receding. But also, university courses are too long in Germany. Our graduates are entering their professional lives much too late, compared to the international scene. Our young people are thus at a great disadvantage on the large European labour market. In philosophical, economic and social sciences, the rate of persons not completing their courses has risen to a staggering 30%. Finally, one quarter of graduates can today not find employment adequate to their training. Especially alarming is the trend that has developed in relation to the number of students compared with the numbers of apprentices, more than 1.8 million students compared with only 1.6 million apprentices. The "academisation" of our society leads to a loss of importance of vocational training and serious problems in finding trainees for many thousands of small to medium sized businesses.

We therefore are facing huge problems in East and West Germany, but the outlook is nevertheless not totally gloomy. I already pointed out that the economy in the East is starting to pick up, although from a very low level. As to the West - we are beginning to cut back on our budget by reductions in the public service sector, putting a squeeze on such generous and sacrosanct programmes as national health care and unemployment compensation and also by a new willingness of employers to stand up to powerful unions, e.g., the metal workers, or by introducing a four-day-working week without full compensation, as recently realized by VW. Further, the majority of our economic institutions predict an upswing as of 1994. We have a stable currency, we are one of the leading export nations, we have an overall infra-structure which is second to none in Europe and we have an excellent vocational training system. Also our share market, as is yours here in Australia, is overall showing an upward trend, meaning that investors are optimistic.

Concluding, we should take into consideration that as a result of the huge transformation or reconstruction process - East Germany is today Europe's largest construction site - we will have created in East Germany, when the process is completed, Europe's industrially most advanced location, as the reconstruction is being realized according to the state of the art. It will therefore be a competitive location. It will become - as soon as the economy of the former communist states picks up - a very important springboard to the east, given its traditional bonds with that region and its strategic place in Europe. Australians who rightly look to their country's springboard function vis-a-vis Asia, should bear this factor in mind, when they are planning investments abroad. There is, or will be shortly, also a springboard to eastern Europe, called East Germany.

Ladies and gentlemen, I take great pleasure in opening this Biennial Conference of the Australian Association of von Humboldt Fellows.
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GERMAN SCIENCE AND TECHNOLOGY
SINCE REUNIFICATION

Opportunities for Collaboration with Australia

Ditta Bartels

The 1980s - The Golden Era for R&D in Germany

Throughout the 1980s German industry increased its expenditure on R&D every year. By the end of the decade West Germany was carrying out DM 70 billion worth of research, and two thirds of that was performed in industry laboratories. Quite a lot of this industrial research was long term and strategic, and the German government contributed substantially to it, paying for about 12% of it, or around DM 5 billion.

Indeed, it can be argued that the Ministry for Research and Technology (BMFT) had as its primary objective to ensure a high level of productivity and innovation in the German industrial R&D sector.

All this industrial R&D paid good dividends, so that virtually all of the German export surpluses in the late 1980s, and extending to 1990 and 1991, could be attributed to research-intensive goods. In 1991 this surplus was around DM 90 billion. Indeed, in this year more research-intensive goods were exported from Germany than from the US or from Japan.

But these two trends of the 1980s - increasing industry investment in R&D every year, and world leadership in the export of research-intensive goods-- came to an abrupt end in 1991. Reunification was of course the most significant factor to bring this about, but there was also the effect of the world-wide recession which was hitting Germany by then too. A third, less well understood factor is that of a change in the complexity of innovative systems, with a concomitant change in patterns of international, high-technology trade.

Thus in the 1990s the shortcomings which were already there in the 1980s have become far more acute. The recognition cannot be escaped that German innovation is definitely lagging behind in consumer electronics, in computers, in communications and in biotechnology. As a result of all these factors, Germany has lost its world leadership in the export of research-intensive goods, and industry R&D investments have declined since the high of 1991.

R&D in East Germany

As a direct result of reunification, German science and technology policy switched its orientation around in 1991. From a focus on the health of industrial R&D, the new focus became to build up research strengths in East Germany. Within a very short time, the powerful BMFT, which had evolved to do one thing, and to do it well, had to be turned
around to do something quite different.

The BMFT set upon its new task with great vigour, and now there are almost 100 new research institutes in East Germany, employing over 7,000 staff. These institutes are modelled on, and part of the following four German R&D-systems:

- Fraunhofer Institutes
- Max Planck Institutes
- Großforschungseinrichtungen (National Research Centres)
- Blue Line Institutes.

The BMFT is spending DM 1 billion on the new East German institutes.

In addition, the BMFT is also working hard to enhance industrial R&D in East Germany, and is pouring around DM 500 million into research conducted in companies in East Germany. The claim is that this has created 9,000 research jobs in East German companies. Nevertheless, in terms of the export of research-intensive goods, there is not much coming out of East Germany yet - only 2.5% of the German total.

In regard to German-Australian research collaborations, I believe that joint projects with the new East German research institutes would be particularly well received by the two governments. However to set up such joint projects will not be easy. The new East German institutes have not yet stabilised in regard to the scientists they employ at the various levels, in terms of the projects they will undertake, in regard to their industrial partners, or their sources of project funding.

At the University of New South Wales (UNSW) we are trying to do something along these lines with one of the new East German National Research Centres, the Geoforschungszentrum at Potsdam. The UNSW scientist involved is Dr Chris Bizos, a former von Humboldt Fellow.

BMFT

Let me say something more about this organisation. The budget of the Ministry in 1993 is almost DM 10 billion. There is a new Minister in place who started in May this year, Dr. Paul Kroger, aged 43, from East Germany. His predecessor, Wissmann, became Minister for Transport after less than a year in the R&D portfolio. Before that there was the long rule of the legendary Riesenhuber, who dominated the German science scene for ten years.

The BMFT is organised around funding programs for specific technologies - space, energy (nuclear, fossil, renewable), communications, transport, environment, biotechnology, and so on. The funding programs for these technologies generally run for four years, and amount to hundreds of millions of DM.

But a lot of the funds that show up very impressively in the BMFT program budget are actually already committed to the National Research Centres. Almost a quarter of the BMFT Budget goes to them. The remaining funds are more genuine project funds, and in many program areas about half of the money goes to German companies, along a cost-share formula. The rest goes to research groups at the Fraunhofer Institutes and at universities.

In regard to Australian-German collaboration, I have often recommended that we should look more closely at working with research groups at the National Research Centres. The is not all that great, since the National Research Centres still have a concentration on nuclear energy and on space technologies. But over the years they have been pushed by political will into environmental technologies and biotechnology, so there should be more opportunities for joint work. At UNSW we have just commenced a joint project on scientific instruments with the National Research Centre GRF for Biotechnology at Braunschweig.

Here I should mention the BMFT Projekträger. These are the offices where the BMFT program funds are handed out, and where the proposals for BMFT funding are evaluated. Projekträger offices for the BMFT program Waste Water Technologies and for the program Work and Technology, are both located at the National Research Centre KIT in Karlsruhe.

If an Australian-German collaborative project is being considered, with German funding to come from the BMFT, then it is absolutely vital that the German partner should have a good working relationship with the relevant Projekträger. Without this the joint research project will not even get off the ground. Some German university professors are quite good relevant Projekträger and the Australian Department of Industry, Technology and Regional Development, DITARD.

In many ways BMFT is like DITARD, namely, interested primarily in commercializable R&D. However as I have said, a joint high priority for the BMFT is to foster high quality research in East Germany. So the various Projekträger would be quite favourably disposed towards joint projects involving the new research institutes in East Germany.

Like DITARD, the BMFT also handles a lot of the international aspects of German research, for example all the bilateral Science and Technology Agreements, of which there are 50 at a country-to-country level. Back in the time of Minister Riesenhuber, the bilateral S&T Agreement with Australia was regarded as rather low priority, but this has changed in our favour over the last few years. I would like to emphasise that as far as DITARD priorities are concerned, Germany is a high priority, right up there with Korea and Indonesia.

Of all the aspects of the German S&T landscape, the Fraunhofer Institutes are the ones most highly acclaimed internationally. Even Prince Charles has mentioned them, saying that British industry would be better off if Britain too had a system as good as the Fraunhofer Institutes.

In many ways the Fraunhofer Society is like CSIRO, though the range of R&D is far more restricted. For example, it does not include plant or animal research, or marine environmental management either.
Altogether there are 46 Fraunhofer Institutes, of which 15 are in East Germany. This number will grow up to 22. When new Institutes are set up, the State Governments contribute to the capital costs. But then the Federal Government, namely the BMBF, and industry take over the funding. In total, the current annual budget for all the Institutes is DM 1 billion. Of this, one third is recurrent institutional funding directly from the BMBF, a fifth or DM 200 million comes in from industry contracts; and the rest, about DM 400 million, comes from BMBF program grants, the Commission of the European Community in Brussels, and occasionally from the DFG. (These funds are referred to as Drittmittel.)

In my view, the real strength of the Fraunhofer Institutes is to work jointly with companies on projects which are supported by various Government schemes for matched funding. For this reason, I should say that the closest Australian equivalents are the Cooperative Research Centres (CRCs), rather than CSIRO Divisions themselves. My feeling is that since the Fraunhofer Institutes are 'enveloped' in the huge German industrial environment which is committed to high levels of R&D, the extent of industry contracts obtained by the Institutes is not really so outstanding. If we were to do the comparison properly, CSIRO and the CRCs would come out quite favourably.

For research collaborations with Australia, the Fraunhofer Institutes should be really high priority. It is there that we could learn most about German industrial R&D, and about the markets in Europe for research-intensive products. I have argued before that we should send young Australian scientists to the Fraunhofer Institutes as short-term or longer-term visitors - in a sense as scouts. To my knowledge not much has yet happened along these lines. The closest we come to it is that UNSW and the University of Wollongong participate in a DITARD project on smart manufacturing techniques, which also has some German involvement from the Fraunhofer Institute IAO in Stuttgart. The chief investigator on the project is Dr Richard Badham, a von Humboldt Fellow.

Other German S&T Organisations

I shall leave the DFG, the DAAD and the Max Planck Society out of this overview, but I should be pleased to reply to questions about them.

On the Alexander von Humboldt-Stiftung, you know quite a lot about it already. But I should like to draw to your attention the agreement signed in June 1991 by the von Humboldt-Stiftung and the Australian Research Council (ARC). The agreement stipulates that the ARC will fund five visiting researchers from Germany every year, and that the von Humboldt-Stiftung will fund five visiting Australians. In each case, applications have to be made by the local colleagues of the proposed visiting scientists.

The first round of ARC proposals was dealt with in 1991, and the third round is just about to be announced. This means that funds have been paid or allocated to 15 visiting German scientists. Unfortunately, the von Humboldt-Stiftung has not allocated 15 additional Fellowships to Australians since signature of the agreement, over and above the long-standing Alexander von Humboldt Fellowship scheme. In part, this relates to the operation of the Stiftung in not having clearly defined yearly deadlines. But I believe that there are other factors involved, and I can take up these issues further in discussion.

University Student-Exchange Programs

The most extensive of the Australian-German student-exchange programs is that between the UNSW and the University of Bonn, negotiated in 1990. The main feature of this program is that the funds for the German students come from the DAAD, and the funds for eight UNSW students have participated in the program. The interesting thing is that even get away form the fact that the demand by German students to study in Australia is much, words about the agreement between the Australian Vice-Chancellors' Committee (AVCC) and the German Hochschulekontorierungstreffen later.

Conclusion

I hope that I have provided you with a rounded overview of the current German R&D scene, of its political priorities, and also given you a picture of how best to promote further the research collaboration between Australia and Germany.
COMPLETING THE EVOLUTIONARY SYNTHESIS

Rolf G. Beilharz

Introduction

Brief History

In 1859 Charles Darwin published his book *On the Origin of Species*. In this he argued that the fascinating diversity of life as it now exists on earth could have developed because the environment favoured those individuals that most easily coped with its difficulties. Such individuals would have survived to breed and, if their progeny inherited whatever made the parents suitable for the environment, the population would gradually come to contain only such individuals as were most fit for the environment. Given a long history of the earth, as suggested by geology, there was enough time for this natural selection to have produced life as we now know it. The explanation that, as recently as about 5,000 years ago, a designer God had fashioned each species individually to cope with its environment was no longer necessary.

Most biologists readily accepted Darwin’s natural selection, even though it had no explanation for biological inheritance (the passing of a particular characteristic [phenotype] of a parent to its progeny). People had been fascinated for a long time by this problem of biological inheritance. Early breeders of livestock, and many people using dogs for hunting or herding, successfully selected and bred with the animals that were best for their purposes and finished up changing their animals also without understanding the mechanisms involved. Darwin had used such changes produced by breeders as evidence for evolution by selection in action. Breeders selected on complex phenotypic characters (the abilities and features that made their animals desirable) and they spoke in terms of blood as the carrier of hereditary information.

The key to understanding the mechanism of inheritance came from Gregor Mendel, who was doing his work at the time Darwin finalised publication of his book. Mendel read his paper on experiments in plant hybridisation in 1865. Mendel’s genius, or luck, lay in choosing for his studies simply-inherited characters. He recognised how genes (factors) moved from parents to offspring because he worked with traits where genotypes (the genes present in an organism), could be inferred directly from the phenotypes of the plants.

In the early part of the twentieth century, Mendel’s factors were located onto the chromosomes, intracellular strands seen under the microscope, by cytologists¹. The importance of Mendel’s understanding was readily grasped by practical breeders and the first part of the twentieth century saw the direct application of Mendelian genetics, in animals particularly, in the selection and fixation of the characters that differentiate the various breeds.

At the same time geneticists investigated what happens to alleles in populations. Population genetics describes this field and is generally considered to start with the
independent recognition by Hardy and by Weinberg (both published in 1908) that, in an infinitely large population, if there are no forces acting, there is no tendency for allele frequencies to change. The mathematical proof is very simple. If no force is allowed to act and if each individual must leave equal numbers of progeny, the frequencies of the particular variants (alleles) of each gene present must recur in the following generation. The effect of each force (change, mutation, migration and selection) can then be evaluated independently, using the "Hardy-Weinberg equilibrium" as the starting point. Population genetics continued by evaluating the effects of the forces jointly. Population geneticists also went on to apply their science to understanding evolution. From early on, fitness was recognized as the most important character in evolution. This is the overall character that comprises the reproduction of an animal and the survival of its progeny. The genetics of fitness in natural populations was described. As population genetics focused on genes and the frequencies of alleles, their explanations of evolution did not seriously discuss how the environment actually selects the fittest animals. The environment clearly does influence the success of alleles. Yet, effects of environment were dealt with by specifying differential selective fitness for each allele or genotype, without defining how the environment actually caused the relative fitness to vary.

Breeders had to face the fact that, for many traits they wished to improve, simple Mendelian inheritance was inadequate. For traits with quantitatively varying phenotypes, which in commercial livestock are by far the most numerous of the traits that are worth improving, a new method of explanation was needed. Already by 1910, Nilsen-Elle and East had shown that the "bell-shaped" curve of phenotypic variation typically seen in many traits can result from the joint action of many genes, each with two or more alleles. With enough number of traits where no major Mendelian gene is viable, and where, therefore, an unknown number of genes with small effects must be active, it is not possible to separate the effects of any one gene. It is, therefore, also not possible to separate the effect of environment from the action of the genes. Researchers trained in statistics developed quantitative genetics to overcome this problem.

Quantitative genetics describes phenotype as a sum of genetic and environmental effects. The genetic effect is partitioned into three independent factors, related to average action of alleles (additive action), and dominance and epistasis (non-additive action of alleles within and between loci, respectively). Environmental effects are divided into permanent and temporary effects. Total phenotypic variance is partitioned into components associated with each of these causes and appropriate ratios (proportions of the total phenotypic variance) define concepts such as heritability and repeatability. Heritability (narrow sense) describes the degree to which a particular deviation in a parent's character from population average is passed to its offspring. Repeatability indicates the degree to which a single measurement of a character represents further values of the same character. That single genes may have a character represents further values of the same character. Total phenotypic correlations, the total correlations between phenotypic characters, are defined as the sum of genetic and environmental correlations.

In the 1930s and 40s Darwin's idea of natural selection on fitness and the developing understanding of the mechanisms of inheritance were combined to produce the modern synthetic theory of evolution. This has become the central paradigm of biology. Yet two major variant theories have recently been discussed. One is that, at least at the molecular level, evolutionary change seems to be random (neutral) rather than the result of selection. The other notes that the fossil record comprises long periods when nothing is happening, punctuated by short bursts (on an evolutionary scale) of rapid evolution in many species. The explanation is in terms of homoeostatic equilibria, disturbed only "rarely" by rapid and episodic events of speciation. The debate about these variant theories suggests that the evolutionary synthesis is not complete. Quantitative genetics itself and its application to animal breeding have been elaborated enormously with the computing power now available. However, as in all applications of mathematics, simplifying assumptions have often been used. In the brilliance of the mathematical achievements, the dependence on assumptions tends to be overlooked. Evolution is included as a term in the formulae. But, as with Mendelian and population genetics, which are incorporated as fully active within the wider scope, the focus in quantitative genetics is firmly on genes. Modern breeding programs select not on phenotypic superiority but on highest estimated breeding values.

Before leaving this very brief historical sketch, I make one important comment. The "Hardy-Weinberg equilibrium" is appropriate only to a theoretical situation which does not exist anywhere in the real world. As soon as geneticists consider the joint action of two forces, e.g., selection and mutation, they encounter equilibria that are of a different kind from that of Hardy-Weinberg. Movement of gene frequencies, e.g., by selection, away from an equilibrium that is the result of two or more forces, involves effort both in moving and in maintaining a new position away from the earlier equilibrium. Stopping selection will result in a return to that earlier equilibrium. Only in the purely theoretical situation of Hardy-Weinberg, where there are no forces acting, will cessation of selection leave a population's gene frequencies where they were when selection stopped.

Problems Raised by the New Theories

Evolution by punctuated equilibria was proposed to replace "phyletic gradualism", a view long held by paleontologists. Punctuated evolution may be seen as being in conflict with the gradual nature of evolution as Darwin saw it. However, Darwin was emphasizing the slow nature of evolution over very long periods of time as a contrast to the then prevailing idea that all life on earth had been created in an immutable form by God in a very short time, only several thousand years ago. Still, it is valid to ask 1) has evolution stopped, is natural selection inactive, when nothing is happening? and 2) must we postulate mechanisms more powerful than genetic response to natural selection when bursts of evolution are occurring?

Neutral evolution is a more direct challenge for evolution by natural selection. Are the evolutionary changes at the molecular level, i.e., among the genetic instructions that carry biological inheritance, just random, chance events? Where then does this leave the natural selection proposed by Darwin?

Background to our Interest

Brian Luxford and Julie Wilkinson were Ph.D. students studying with me the following inconsistency in quantitative genetics. All geneticists know that the total character fitness
cannot be improved in any population that is adapted to its environment. Geneticists say that fitness has a heritability (narrow sense) of zero (selection for it brings no response). Yet, Australian sheep breeders were being urged to select merino sheep to produce twins, rather than put up with the normal single lamb per year. Similarly, throughout all aspects of animal production, there was, and still largely is today, an unquestioned assumption virtually amounting to certainty that breeding for larger litter sizes, and treating animals generally to raise production and reproduction, will quickly bring results. How can one raise major components of fitness if fitness itself cannot be improved? Must there not be deleterious side-effects?

In our work we selected mice for various aspects of reproduction. We had consistent results showing that if we raised litter sizes at the first birth our mice would have fewer litters when allowed to breed continuously and to raise their young to weaning at three weeks of age. The same was true for other people’s mice that had responded successfully to selection for large litter size, when we allowed these to breed continuously and to raise the young they produced. Obviously the deleterious side effects are there, if you pause to look for them. We also have curious results about genetic correlations, i.e., about getting associated characters to change in sympathy with our selected traits, sometimes but not at other times. We then put all our thoughts together into a new theory. Actually, most of what we have written has been recognised by others already. But there are some points that have not been appreciated. After some difficulties in getting our new theory taken seriously, we finally succeeded in publishing it in 1931. The rest of this paper describes our theory and how this theory harmonises the variant evolutionary theories into the existing evolutionary synthesis, thus completing it. We also make some comments about why geneticists have missed seeing the importance of our theory, particularly when genetics is applied in the real world to the genetic improvement of animals.

Theory

Measurement of Fitness

The essence of evolution is how many genes of each type pass into future generations. Genes are carried in organisms, i.e. in phenotypes which develop and have life histories. These phenotypes pass genes into future generations by producing offspring, which must survive to breed in their turn. It is phenotypes, not genes, that are subjected to selection, whether in nature or by man. Both the number of offspring produced and the quality of each offspring (its survival and future breeding) are important and, like other aspects of living things, are influenced by genes. All evolutionary changes in allele frequency must funnel through the reproduction achieved by phenotypes and the survival of their progeny, i.e., fitness. Hence, one must expect all traits that are important to organisms to have some interaction with fitness.

It is not easy to measure fitness. A complete measure should include how many progeny are produced over the whole life of the animal, as well as the fate of the progeny. The inclusion of related animals that are not progeny, though they share similar genes (kin selection), increases the complexity of the quantification. There should also be a denominator related to the rate of turnover of generations (generation length). The faster a parent produces surviving young, all else being equal, the faster its genes can spread. In practice, most measures of reproduction that have been studied in both wild and domestic animals are only very small components of total fitness. Although the full relationship of fitness and the environment is complex, the equantons that follow demonstrate the key features of our theory in a simple way.

Equations

\[ F = A \times B \times C \times \ldots \]  

Fitness (F) is a product of several components (A,B,C,...) such as number of parities (=length of life), average litter size and survival of progeny. The relationship of fitness components is multiplicative.

\[ R = a + b + c + \ldots + m + \ldots + x + y + z + \ldots \]  

Each component \( a,b,c,... \) uses metabolic resources which we can label \( a,b,c,... \), respectively. \( R \) is the total of metabolic resources able to be used by the animal. Some resources (say \( m \)) are taken up from the environment and used in the process of metabolism itself. Others (say \( x,y,z, \ldots \)) are resources consumed in stress reactions and other phenotypic features used by the animal to cope and survive. Typically, resources consumed by one function are not available for others. For example, resources used for growth, or fighting off a predator, are not available to produce milk to feed young. Hence, resources are related additively.

Equation 2 is appropriate for resource allocation at any moment in time. However, it also serves to describe resource allocation over a period of time, such as a season, or a lifetime.

Consequences

The consequences of these two equations are powerful. Let us start by assuming a completely unrestricted state, i.e., \( R \) can rise. By definition, fitness is always under selection upwards. \( F \) will respond to selection by rising in absolute value while there is additive genetic variation available in any of the components \( A,B,C, \ldots \). As any component (say \( A \)) rises, it will consume more resources \( a \). Hence \( R \) must rise. This can continue until \( R \) reaches its maximum value, the total resources available from the environment for any animal.

Even with \( R \) at its maximum value, \( F \) can still rise a little further, because genetic mechanisms, e.g., sexual recombination, will realign genetic variation, leading to changing allocation of the same total resources \( R \) among the components \( A,B,C, \ldots \) to make more efficient use of them. Continuing selection for high \( F \) will lead eventually to all animals in the population having optimal values for \( A,B,C, \ldots \), defined as those values which, in combination, give the highest product \( F \). As a consequence there will be an optimal allocation of resources to \( a,b,c, \ldots \). Note that optimal values are not the highest values. If trait A lies below optimum, \( F \) will be a product lower than the maximum. Similarly, if \( A \) lies above its optimum, \( F \) will be lower than its maximum because at least one of the other
traits (B, C, etc. or another trait or function) must then be below optimum. A simple analogy is to find the maximal product of two positive numbers constrained to add to a total that is no greater than 1. The answer is 0.25, when each of the numbers is 0.5. Moving either number away from 0.5 in either direction lowers the product. Our theory thus demands that, when environmental resources are limiting, all major components of fitness are selected towards intermediate optimal values. What about other characters?

All morphological features of a phenotype, its development and growth, and all actions and movements, require environmental resources. These features need not multiply their effects with fitness components. They may simply use up resources (i.e., increase x, y, z, etc.) and so leave fewer resources (a, b, c, etc.) available to maximize fitness. For example, hair covering is not a direct component of fitness, yet interacts with it as follows. Animals with insufficient hair tend to die from cold, leading to a selection for adequate hair cover. However, animals that invest many resources in growing a dense coat, quite apart from problems they may have from heat, reduce the total pool of resources remaining available for maximizing fitness. Thus, when the environment is limiting, there will be a selection for just the right amount of hair cover that balances survival of the individual animal with its own maximal fitness. In other words, in environmentally limited situations there will be a selection toward an intermediate optimal value. This situation thus applies to all characters of phenotypes that use resources, not only to components of fitness. Metabolism itself will be selected towards greatest possible efficiency, so that the least possible resources (m) will be utilized most effectively. It is difficult to think of any phenotypic characters that do not use resources as they develop and are maintained.

If there are traits that do not influence fitness at all, they will vary in allele frequencies simply by chance. This is called genetic drift and it normally results in increasing fixation and homozygosity, i.e., the elimination of alleles from the population leaving only genetic uniformity in the population for a cumulatively increasing number of genetic loci. Such characters will, therefore, generally not contribute to presently existing phenotypic variation. They will show allelic variation whenever new mutations arise, and may show such variation even by another as a result of chance fixation of new alleles. Such allelic substitutions are, by definition, unaffected by any selective effects on fitness and will then in the long term occur at rates related to their intrinsic mutation rates.

Is the Environment Limiting?

Fitness has been under selection for higher values since life began on earth. We must therefore expect that, in general, each species is now exploiting its niche as well as this is possible. In other words, species are being limited in their fitness by the environmental resources of their niches. This must be the case for all wild animal species that have adapted to their environment, i.e., that have reached maximal F for the R available in their niche. For all of these species, therefore, it necessarily follows from our theory that, except for traits not related to fitness, all traits are being selected towards intermediate optimal values. The geneticist, Crow, who has spent much time thinking about evolution, adds that selection for intermediate optima, i.e., stabilizing selection, is accompanied by traits maintaining additive variance, the kind of genetic variance which allows organisms to change rapidly (at least in evolutionary time scales) if the conditions of their niche alter. Crow confirms from empirical knowledge that what we say is indeed the situation when he writes about natural selection (the emphasis is his):

The conclusion is inescapable: A great deal of natural selection is directed against those individuals that deviate from the mean.

(p 144)

The overall picture that emerges from this discussion is that almost every quantitative trait in any species has an intermediate optimum. Natural selection keeps the population mean near this optimum. ... The phenotype contains a great deal of additive genetic variance. This feature allows the population mean to move quickly to a new optimum whenever the environment changes. The slow change of the horse from an animal the size of a fox to its present size is not the result of directional selection, as the animal breeder thinks of it, but the continual stabilizing selection toward a slowly changing optimum.

(p 147)

Consequences of Environmental Limitation and the Place of the New Evolutionary Theories

Conditions in environmental niches rarely alter from within. Usually it is external agents such as cosmic, geological or climatic changes which change niches. Niches can also be influenced by changes in conditions wrought by other species. Man's during their evolution have had a steady increasing effect on the environment of other species (and on their own). Nevertheless, for the overwhelmingly largest part of the earth's evolutionary history, conditions seem to have been stable and natural selection towards higher fitness has been holding each species at optimal intermediate values in each trait. This leads to one of the ideas people seem to have missed to date. For most of evolutionary time, natural selection together with environmental limitation has actively prevented change. An evolutionary record showing long periods of stasis punctuated by relatively short periods of rapid evolutionary change, simultaneously in many species, i.e., punctuated equilibria, is therefore an expected consequence of strong and continuing natural selection on fitness, given that the resources of the earth are finite and that catastrophic events occur rarely. Thus, we now see that evolution by punctuated equilibria is exactly what must follow from Darwin's natural selection under the conditions that have prevailed on earth. We do not need to search either for missing or ineffectual natural selection when the fossil record shows no change; for it is when the mechanisms more powerful than response to natural selection when the fossil record shows rapid bursts of evolution.

We then turn to Crow to demonstrate that the neutral theory of evolution is also completely compatible with the consequences of our theory. He writes about evolution at the molecular level (again the emphasis is Crow):

One of the biggest surprises ... the rates of molecular evolution are much less variable than the rates of change of body form and function.

(p 179)

The principle that emerges is that those proteins that have the fewest constraints evolve the fastest. ... Intervening sequences (regions of the gene
Why Have Geneticists Overlooked the Importance of Environmental Limitations?

As discussed above, geneticists have viewed evolution in terms of allele frequencies, which are the subject matter of population genetics. Similarly, they have proceeded to apply genetics to animal breeding programs as if the environment were not an important limiting factor. The clue explaining this inappropriate attitude is found in the last chapter of Falconer's widely used textbook. There we read that in the development of population and quantitative genetics

the absence of differential viability and fertility was specified as a condition of the theoretical development of the subject: that is to say natural selection was assumed to be absent.

The discussion following this quote implies that ignoring natural selection has no serious effects in many cases. Falconer discusses the effects of natural selection so that a complete understanding of metric traits can be achieved. Thus, geneticists during their training rarely confront the fact that in the real world, especially of wild animals, all traits are usually selected towards intermediate values because natural selection on fitness forces this when environments are limiting.

In our paper we present the cases under which environmental limitation need not be severe. These are the situations when extra resources have recently been added to the environment, or when resources previously necessary for combating stresses in the environment or for meeting an earlier production aim are no longer necessary in a changed animal production system. Domestic animals have benefited from such environmental changes as a result of their association with man. When geneticists have researched breeding programs with laboratory or farm animals, the environments need not have been as severely limiting as in the case of wild animals or most farm animals. Breeders and scientists set out to apply their science in the real world in breeding programs and to the modern, high-tech variations including the making of transgenic animals. But, natural selection can never be eliminated from the real world and it has been acting without interruption since life began. Thus, because what is applied was developed using the assumption that natural selection was absent, it is very likely that many present animal breeding programs will not achieve their goals. Our theory challenges geneticists to rethink critically the relationship between genes and the usually constraining environment.

Our earlier quotations show that some geneticists have recognized the ubiquitous presence of stabilising selection in wild animals as an empirical fact. But even Crow did not fully complete the bridge we have now made between what he knew empirically and environmental limitation. Through this bridge we have incorporated the neutral theory and the theory of evolution by punctuated equilibria into Darwin's theory of evolution by natural selection. In this way we have completed the modern synthetic theory of evolution.

Summary

I can think of no better way to summarise the thoughts of this paper than to quote the very concise summary of the paper my graduate students and I wrote.
We have provided a bridge between geneticists, who concentrate on genes and their frequencies, and other biologists, who are much more aware of how severely the environment constrains and limits life. This bridge is the recognition that
a) fitness is a product of important component traits,
b) these and most other traits consume environmental resources and these resources are additively related and can sum to no more than the total resources an animal can obtain from the environment,
c) allele frequencies can alter only to the degree that the phenotypes that carry the alleles reproduce themselves successfully, i.e., are fit,
d) fitness must rise, because it is never free from natural selection upwards, to the point where it can rise no further, because all environmental resources available to an animal are being used most efficiently,
e) in this state of adaptation, fitness is completely limited by the environment and all other traits important to the animal are constrained to a greater or lesser degree at intermediate, "optimal" values, and
f) traits or molecules unimportant to animals, so that they are completely neutral with respect to fitness, are free to drift genetically and hence gene substitutions can occur at rates related to their mutation rates.

This bridge between genetics and other parts of biology shows that the various theories apparently causing concern for the modern synthetic theory of evolution are entirely compatible with it. Bursts of rapid evolutionary change between long periods of evolutionary stability are the necessary consequences of strong natural selection acting on fitness, its ecosystems that are stable until external forces cause them to change. Neutral (random) evolution describes the fate of genetic material that is unimportant for organisms, i.e., material that is neutral with respect to fitness.

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ALEXANDER VON HUMBOLDT
AND THE CASIQUIARE

Harald R. Graze

Preamble

During history lessons at school students are taught that Christopher Columbus (1451 - 1506) discovered America in 1492. From this the implication arises that from this date onwards the rest of the world, especially Europe, was aware of the further development of this large continent. Furthermore, students are also taught that the Pilgrim Fathers had arrived at Massachusetts in North America in 1620 on board the ‘Mayflower’. Thus it would appear that the American continent was a well-known quantity since the seventeenth century. In fact this was not the case and the landing of Columbus in 1492 in the Caribbean signalled only ‘The First Discovery of South America’.

![Map of South America](image)

**Fig. 1 La Condamine’s Journey, 1735 - 1745**

Columbus was a Genoese navigator who prevailed upon Ferdinand and Isabella of Spain to bear his expenses for expeditions of discovery. He set out on his first expedition in 1492 and discovered the Bahamas and Cuba. On his third expedition in 1498 he landed near the mouth of the Orinoco River in South America (Figure 1). A few years later Hernando Cortez (1485 - 1547), a Spanish adventurer, conquered Mexico for Spain. Spain continued with its conquests in that region, and overthrew the Incas in 1533. At the time of the
Spanish expeditions the Incas had a highly developed civilization and, with their centre at Cusco (13°32'S, 72°0'W) in the high Andes, ruled a large region of South America. The Incas were in possession of large quantities of gold which obviously attracted the attention of Spain. To safeguard this precious metal as well as other valuable commodities from other European nations, Spain ‘closed’ its part of South America to the rest of the world.

The defeat of the Spanish Armada by England in 1588 highlighted the strength of the English navy on the high seas and encouraged many of their ship captains to carry out acts of piracy - especially if it meant capturing Spanish galleons laden with gold. Examples of this are Sir Walter Raleigh (1552 - 1618) who fought his way up the Orinoco River in 1595 and Sir Francis Drake (1540 - 1596) who attacked the Spaniards near Portobello (9°35'N, 79°42'W) in South America and lost his life there. However on the whole the South American continent was closed to the rest of the world for nearly 250 years.

In the eighteenth century scientific impetus encouraged Spain to loosen its grip on the continent. The consequences of this had profound effects for the whole civilised world and led to ‘The Second Discovery of South America’.

The present article describes aspects of Charles-Marie de La Condamine’s epic journey through South America to determine the true shape of the earth. The outcome of this journey provided the impetus for Alexander von Humboldt to search for and discover the ‘mysterious’ bifurcation of the Casiquiare River. Much of the material included herein is based on information from Joachim Leitlüber’s book, entitled: Ufer hinter dem Horizont. (Since this article is of a geographical and of an historical nature, for ease of location, the latitude and longitude reference points of places mentioned as well as pertinent dates are included).

Introduction

Professor Wilibald Snel v. Roijen (1580 - 1626), who called himself ‘Snellius’, is well-known in the scientific world for his discoveries on the laws of light. Thus the term ‘Snel’s Law’ appears in every physics text book. In 1615 Snel also devised a very accurate method for land measurement. Instead of measuring lengths only he proposed the ‘triangulation’ method wherein angles are measured, since in general these can be determined more accurately than lengths. In this method a piece of land is sub-divided into numerous triangles. From both ends of a very precisely determined baseline of one triangle, the two angles are measured to the apex of the triangle, thus obtaining the other two lengths of the triangle very accurately. This process is then repeated for the whole piece of land - a method still used in surveying today.

Jean Baptiste Colbert (1619 - 1683), a French statesman under King Louis XIV (1638 - 1715), reformed the French financial administration, developed industry by tariffs and established the French Academy of Science. Through his efforts, Paris (48°50'N, 2°20'E) became the centre of the scientific world in the seventeenth and eighteen centuries. In his endeavours to obtain an accurate map of France, he engaged Jean Picard in 1671 and later the Italian astronomer Cassini to survey France. They completed their triangulation measurements in 1682 with the following result - France was smaller than King Louis XIV had assumed, by two degrees in longitude and three-quarters of a degree in latitude. This led King Louis XIV to respond in terms similar to the following: “Gentlemen, with regret I notice that your achievements have cost me a fair size of my kingdom”.

This precise method of measurement was then applied right around the civilised world. It was to prove especially useful to settle an argument between two leading scientific groups. The group supporting the Englishman Sir Isaac Newton (1642 - 1727) stated that the earth was not a perfect sphere but was slightly squashed at the poles. The other group agreed with the theory of the Italian astronomer Cassini. As we know nowadays Newton was correct - the diameter of the earth is 12,756 kilometres and the bulging of the globe at the equator amounts to 21.5 kilometres. But how could this be proved?

As all students of trigonometry know if the earth is a perfect sphere, the length measurement of one degree of latitude has to be the same anywhere on the globe. In France, Picard had already made the one degree measurement between the townships of Corbeil (48°36'N, 2°26'E) and Amiens (49°54'N, 2°16'E) during his mapping of France. Would the same result be obtained at different latitudes?

The establishment of the French Academy of Science had initiated a new period of discovery. No longer were expeditions planned for seeking trade routes, for adventure, for gold and spices, for religious pursuits, etc. Expeditions were now organised for gaining additional scientific knowledge, resulting in a new generation of explorers. Thus, to settle the ‘Newton versus Cassini’ argument in the eighteenth century, the Academy decided to send out two expeditions to measure the distance between one degree of latitude at two greatly latitude-separated locations. One expedition was to go to the high north of the globe, Lapland, while the other expedition was to carry out its measurements at the equator. Pierre Moreau de Maupertius (1698 - 1759) was nominated as the leader of the Lapland expedition, while Charles-Marie de La Condamine (1701 - 1774) was nominated to be included in the equator expedition.

While the location for the measurement by the Lapland expedition was in no doubt, the equivalent location for the equator expedition was initially problematic. Equatorial Africa at that time was unexplored, equatorial Borneo had not been opened up, and the lower Amazon region in South America tended to be swampy. Thus, only the ‘Audiencia de Quito’ (now part of Ecuador) was suitable for the proposed scientific study. However this region had been under Spanish control for 250 years and closed to the rest of the world. In the interest of science in this new era of scientific expeditions, Spain relented on its ‘closed-door’ policy and gave permission for a scientific team to enter the Quito region.

Charles-Marie de La Condamine (1701 - 1774)

During the war between France and Spain in the early eighteenth century, the French forces laid siege in 1719 to the Spanish border town, Rosas (42°19'N, 3°10'E), near the Mediterranean coast. While guarding a Spanish prisoner of war who had recently returned from the Spanish South American colonies, the French soldier Charles-Marie de La Condamine listened with awe to the tales which the Spaniard related. The prisoner spoke of the enormously high mountains (The Andes), of exceedingly large rivers (e.g., Orinoco and
Amazon Rivers), of impenetrable forests, of fabulous Inca palaces, and of the immensely diverse flora and fauna. These anecdotes were to influence the young La Condamine for the remainder of his life.

At a very early age La Condamine showed that he was a very able mathematician who applied his knowledge in a very practical way - surveying of land. At the age of 29 he became a member of the French Academy of Science and on expeditions to the African coast on the Red Sea, he demonstrated his mathematical and astronomical knowledge. These abilities were influential in Voltaire strongly recommending to the Academy that he take a leading role in the equator expedition. In the context of this article it is interesting to note that Voltaire believed in Newton's theory.

On 16th May, 1735 a small group of astronomers, botanists and mathematicians, amongst them La Condamine, left for Quito (2°15'S, 78°35'W) in South America near the equator, on board the French warship 'La Rochelle' (see Figure 1). This group was to 'rediscover' South America nearly 250 years after Columbus had landed there. From this time onwards, South America became part of the known world.

Their first landfall beyond the European horizon was at Cartagena (10°25'N, 75°33'W). There the Spanish government provided them with two Spanish scientists, Don Jorge Juan y Santacilia and Don Antonio Ulloa, to assist the French with their scientific mission (or perhaps to keep a watchful eye on their activities). Besides marvelling at the wonders of this new exotic world the French were also astonished at the lack of personal freedom allowed the local inhabitants. It appeared to them as if time had stood still for 250 years - a situation which subsequently astonished Simon Bolívar (1783 - 1830) in his thrust for an independent republic of Colombia in 1819.

To protect their sensitive instruments on their journey to Quito, the party minimised the use of pack animals and chose water transport wherever possible. Initially their route of 400 kilometres took them along the coast to Portobelo (9°35'N, 79°42'W), the launching place for the Spanish colonies on the Pacific coast. Portobelo is also the location where the Spaniards were frequently attacked by English pirates such as Sir John Hawkins (1532 - 1596), Sir Francis Drake (1540 - 1596) and Sir Henry Morgan (1635 - 1688).

From Portobelo the expedition crossed the narrow isthmus to reach Panama on the Pacific Ocean and then travelled by ship to Manta (1°0'S, 80°40'W). While the main party continued to Guayaquil (2°15'S, 79°52'W) to reach Quito by the standard route, La Condamine and Pierre Bouger disembarked at Manta. There, on the plains of Mamabi, they undertook numerous scientific measurements. On the night of the lunar eclipse, 26th March, 1736, they accurately recorded the most westerly point of South America with their astronomical observations (or so they thought). Their measurements were so precise that all maps of South America in the eighteenth century were henceforth based on their observations.

During his time in Manta, La Condamine was fortunate in making the acquaintance of the Spanish Pedro Vicente Maldonado. The latter was born in the Spanish colonies in 1704, was educated in the Jesuit school in Quito, and had a considerable knowledge of the local environment. While Bouger subsequently journeyed to Guayaquil with the heavy scientific instruments and took the standard route to Quito, La Condamine and Maldonado opened up a more direct route to Quito by following the Emerald River upstream. On this trip La Condamine re-discovered the 'funny' substance called rubber, and used it to protect his instruments from the constant moisture. The Spaniard Cortez had been aware of the bouncing rubber balls which the locals used as playthings, however no practical use had been made of rubber during the subsequent two centuries. (Following La Condamine's report on this valuable commodity, an Englishman smuggled some rubber seeds out of South America in 1789, and rubber trees were subsequently grown in the English colony of India. The introduction of rubber to the western world had a pronounced effect on the development of equipment during the Industrial Revolution in the late eighteenth and the early nineteenth centuries).

In the course of this exceedingly arduous and difficult journey up the Andes mountains, during which the local porters turned back due to the intense cold, La Condamine discovered another valuable commodity which the locals called platea. Subsequently, European scientists identified it as a rare metal element and named it 'platinum'.

Having crossed the crest of the mountain range La Condamine and Maldonado found numerous local villages. In the vicinity of Quito, La Condamine was overawed by the view which he termed the finest scene in his life. It consisted of fifteen, snow-covered, volcanic peaks, amongst them being the Antisana (5,703m), the Cayambe (5,870m), the Cotopaxi (5,896m), the Pichincha (4,267m) and the mighty Chimborazo (6,267m). In the valley of Anaquito between towering Cotopaxi and Pichincha lay their destination. It had taken La Condamine over one year to reach Quito.

The arrival of the French party in Quito in 1736 created as great a sensation for the locals as the appearance of a white woman in 1566. Thus, all their subsequent actions were closely observed by the inhabitants.

To commence their triangulation measurements the scientists required a sufficiently long, straight baseline. This was very difficult to find in the mountainous terrain. Finally an eight-kilometre-long baseline was located and surveyed in the Yacqui plain north-east of Quito, between the settlements of Camburo and Aymara. Using their calibrated metal rods, this vitally accurate measurement was personally carried out by La Condamine, Maldonado and the two Spaniards Juan and Ulloa. This was a very tedious and arduous undertaking, especially since it was exceedingly hot during the day and freezing at night.

During the measurements a Spanish delegation from Quito arrived and could not be convinced that this 'strange' behaviour with theodolites and measuring tapes under conditions of hardship was for the purpose of science. They were suspicious that maps were being made to search for gold, and consequently the governor of Quito ordered a cessation of the measurements. To overcome this impasse, La Condamine and Juan decided to go to Lima to explain to the regal representative of the Spanish King the true nature of their 'strange' behaviour. This journey involving 1,500 kilometres along the Andes, provided La Condamine with an opportunity to record other extensive scientific data of the region. Fortunately the regal representative gave the French party permission to continue with their original measurements and the two travellers returned to Quito in July 1737 after an absence of eight months.
After another two years of back-breaking work they finally completed their mission. They had "triangulated" more than three degrees of latitude between Ibarra (0°21'N, 78°51'W) and Cuenca (2°50'S, 79°59'W). Thus, in June 1739, four years after leaving France, their observations permitted them to calculate the distance between one degree of latitude at the equator and to compare this with measurement obtained years earlier by Picard near Paris (48°50'N, 2°20'E). Their calculations revealed that Sir Isaac Newton was correct with his statement that the globe was slightly flattened at the poles.

This conclusion was of great scientific importance and the French party already imagined their triumphant return to Paris and the glory that would be bestowed on them. They were not long to appreciate their extreme disappointment - after four years of very hard labour - on being informed by a dispatch from Paris that the Lapland expedition under Maupertius had already come to the same conclusion and had returned to Paris after an absence of only 18 months. (It is of historical interest that this Lapland expedition included the Swedish astronomer Anders Celsius (1701 - 1744) who is the inventor of the centigrade temperature scale).

Despite this disappointment La Condamine demonstrated his greatness of character by deciding to complete the objectives of the mission. The Academy of Science had stated that permanent markers should be erected at both ends of the baseline. This was quite a difficult task to achieve in the high mountainous region of Quito since a channel had to be constructed to convey water to the site, a furnace had to be built to fire the tiles and timber for the inscriptions had to be obtained from lower altitudes.

When the pyramid markers were finally completed the inscriptions unfortunately did not include the names of the two Spanish scientists, Juan and Ulloa, as had already been done in the King Louis XIV appeared on the inscriptions and the French flag flew on top of the pyramids. Throughout the long stay of the French party in the Quito region there had been suspicions regarding the purpose of the mission. According to Leithäuser one Spanish nobleman expressed his concerns as follows:

"Who would subject oneself to such extremely uncomfortable conditions for such a long time if it is not for gold or financial reward?"

Consequently the intensive construction of the pyramids further compounded the strains developing between the French and the Spaniards.

During the French party's stay in the Quito region war had broken out between Spain and England and the English scientists Janu and Ulloa were ordered back to Lima. In this period two English fleets were sent to attack South America. One fleet under the command of Vice-Admiral Anson captured the town of Paita (5°5'S, 81°0'W) in Peru but did not undertake further attacks on the mainland and returned to England with a large quantity of gold. The other fleet under the command of Admiral Vernon had intended to capture Cartagena. Although Vernon's fleet was much larger than the original Spanish Armada fleet of 1388, the relatively small defending force of Cartagena managed to decimate Vernon's fleet and he retreated after 56 days of battle. Although the English suffered severe losses during this particular episode it did not change their dominance on the high seas.

When Juan returned from Lima and saw with his own eyes the insensite 'decorations' on the pyramids, the dispute regarding the inscriptions went to court. After two years of the court in 1742 ruled that the names of the Spanish scientists, Juan and Ulloa, should be included on the inscriptions and that the French flag should be removed from the pyramids. Although this ruling was duly carried out, the pyramids were completely destroyed six years latter in 1748. (It is of historical interest that, after the establishment of the independence republic of Ecuador, the pyramids were re-built in 1836 but were nowhere as solid as those of La Condamine.)

Following the court settlement, Bouguer returned to France via Cartagena while La Condamine decided to undertake further scientific discoveries. With two porters who carried his five-and-one-half-meter-long telescope and with a few pack animals, La Condamine journeyed south past Cuenca. At Borja (2°40'S, 77°40'W) he reached the Maranon River, which forms part of the Amazon River system. While at Quito he had become aware of a secret map which showed the first drawing of the Amazon River. This map had been constructed by Jesuit Samuel Fritz who had lived along the Amazon River system for twenty years, especially along the lower region of the river. It was La Condamine's intention to record and map the whole length of the 5,300 kilometre-long Amazon River.

A few hundred kilometres downstream of Borja he again met up with Maldonado, and for two months they recorded the width, depth, fall and velocity of flow of the Amazon River. Their map was so accurate that it could be used with relative confidence today.

Near the region where the Negro River joins the Amazon River at Manaus (3°2'S, 60°28'W), the local inhabitants informed them of a connection between the Negro River and the Orinoco River. This was not believed by La Condamine's contemporaries on his return to Europe since the Negro River empties into the Atlantic Ocean near the equator while the Orinoco River drains into the Caribbean Sea at a latitude of approximately ten degrees. La Condamine believed the inhabitants and he searched for this connection between the river systems, but failed to find it. The answer to his question as to the interconnection between the Negro and the Orinoco Rivers, was provided over fifty years later by Alexander von Humboldt.

On the 19th September, 1744 La Condamine reached the mouth of the Amazon River and via Cayenne (5°0'N, 52°18'W) returned to Paris in the spring of 1745. He had been absent for ten years primarily to measure one degree latitude at the equator. However his greatest achievement was to re-discover a whole continent, opening South America again to the rest of the world.

In 1745, the year that La Condamine returned to Paris, a book which described the Orinoco River system was published. The author of this book, José Gumilla, categorically refuted an interconnection between the Orinoco River and the Negro River. Since this contrasted with La Condamine's recent experience in South America, Spain decided to clarify this contradiction by sending an expedition into the region in 1754. Unfortunately this expedition into the unknown wilderness of South America under the command of Captain Schonu struck disaster since only thirteen persons of the initial detachment of 325 men survived. This outcome highlighted the dangers of the region with its raging torrents, impenetrable jungle, intense rainfall, and fever-ridden climate. However these were the
same conditions which Alexander von Humboldt was to experience when he undertook his search for the ‘mysterious’ interconnection between the two river systems 46 years later.)

The ten years in South America had taken their toll on the health of La Condamine who had left France in 1735 as a handsome young man. By the year 1763 he was totally paralysed and deaf and had to dictate his scientific articles. La Condamine died in 1774 and is remembered as a mathematician, geographer and explorer.

Alexander von Humboldt (1769 - 1859)

On 14th September, 1769 Alexander von Humboldt was born into a highly regarded, Prussian military family. He had an elder brother, Wilhelm (1767 - 1832) who, like Alexander, had no inclination to follow a military career as their forebears had done. This is clearly illustrated by an anecdote of a conversation which Leithäuser describes following the visit of King Friedrich II of Prussia (1712 - 1786) to the von Humboldt household in 1777.

Addressing Wilhelm he asked him how old he was. When the boy replied: “Ten years, Your Majesty”, the King responded that this was a good age to join the military, and in reply Wilhelm informed the King that he would like to follow an academic career. As is well-known, Wilhelm von Humboldt in later years reformed the education system in Germany and a university in Berlin (52°32'N, 13°24'E) is named after him.

The conversation with the eight-year-old Alexander has been recorded as follows:

King: "What is your name?"

Alexander: "Alexander von Humboldt".

King: "Alexander - that is a nice name. It reminds me of a great conqueror. (obvious reference to Alexander the Great (356-323 BC)). Do you also want to conquer the world?"

Alexander: "Yes Your Majesty - but with my head."

Alexander von Humboldt is well-known in the scientific world and many excellent books have been written about him. Two of these by D. Botting and W. Feist are listed in the Reference section. Feist provides an excellent summary of his curriculum vitae and the data concerning his expedition in the Americas are re-produced in the attached Appendix.

Alexander von Humboldt’s year of birth was the same as those of Bonaparte Napoleon (1769 - 1821) and the Duke of Wellington (1769 - 1852). His lifespan covered a very turbulent political period in Europe and both of these men had an impact on his life. Although von Humboldt always had the urge to travel and to explore distant lands, financial constraints prevented this. (In those days these expeditions were generally funded by the individual.) Following an inheritance in 1796, this constraint was removed and von Humboldt made arrangements to participate in a voyage of exploration to the Antarctica and possibly Australia. However this did not take place on account of the outbreak of the Napoleonic Wars (1799-1815). It was not until 1815, when Napoleon was defeated by the Duke of Wellington at Waterloo, that some sort of sanity returned to Europe.

Following the outbreak of war, von Humboldt turned his attention to South America and was given a great degree of freedom for his exploration plans by the King of Spain. Following the disastrous outcome of Captain Solano’s foray into the South American jungle in 1754, he was fascinated by the ‘mysterious’ bifurcation reported by La Condamine and desired to follow-up La Condamine’s discoveries in the Andes.

Fig. 2. Von Humboldt’s Journey, 1799 - 1804

On 5th June, 1799 he left France with the Frenchman Aimé Bonpland and arrived on 19th July at Cumaná (10°30'S, 64°55'W). (Refer to Figure 2.) After due preparation they journeyed along the coast to Caracas (10°30'S, 66°55'W) and then travelled inland to San Fernando de Apure (7°54'N, 67°28'W) (see Appendix). From there the search for the location of the ‘mysterious’ bifurcation began in earnest.

For many weeks they sat cramped in a narrow Indian piragua and travelled up and down roaring river torrents under life-threatening conditions. From San Fernando de Apure their journey was up the Orinoco River, past the Meta River to San Fernando de Atabapo (4°3'N, 68°40'W), (Figure 3). It continued in a southerly direction up the Atabapo River and was followed by a four-day march, carrying their piragua across land to the Guainia River. Travelling downstream on the Guainia River, they passed its junction with the Casiquiare River and continued past San Carlos until they were convinced that they were within the Amazon River drainage system. They then back-tracked past San Carlos, entered the Casiquiare River and continued their upstream journey until they reached Esmeralda (3°10'N, 65°57'W). Since Esmeralda is on the Orinoco River, they realised that they had answered La Condamine’s question of 1744. The 400 kilometre-long Casiquiare River is the connecting waterway between the Amazon and the Orinoco drainage basins.

26

27
When Alexander von Humboldt died on 6th May, 1859, one of his great admirers, Charles Darwin (1809 - 1882) had just published his *Origin of Species*, having based much of his theory on von Humboldt’s discoveries.

Von Humboldt’s five volumes of *Cosmos - Sketch of a Physical World Description* highlight the great understanding that he had of the world. Numerous localities and geographical phenomena are named after him. However the most tangible memorial to this famous explorer is the Alexander von Humboldt Stiftung which was set up shortly after von Humboldt’s death and to this day benefits numerous young scholars all around the world.

Conclusions

Hydraulic engineers and others involved with the flow of water are fully conscious of the important effect that gravity has on the hydraulic behaviour of open channel flow. Consequently, it is common to observe that creeks join to form rivers; and that rivers join to form larger river systems. Occasionally a river divides into two or more branches but rejoins the same river further downstream, and these parallel flows are commonly known as anabranches.

However there are very few cases where a watercourse divides, i.e., bifurcates, into two streams, with each stream finally discharging into different drainage basins. For this to occur the bifurcation has to take place on the watershed of the two basins concerned. There is only one bifurcation in the world which involves a large river system, i.e., the bifurcation of the Casiquiare/Orinoco Rivers. The author of this article is surprised to observe how few hydraulic engineers are aware of this unique hydraulic phenomenon and consequently recommends focusing on the following location in an atlas: Latitude 3° North, Longitude 66° West.

The scientific world values the achievements attained under extremely arduous conditions by the two key figures of this article, viz.:

- Charles-Marie de La Condamine, the noted mathematician, geographer and explorer, who ‘re-discovered’ South America while undertaking the measurement of the distance of one degree latitude, and
- Alexander von Humboldt, the great scientist, writer and explorer, who answered La Condamine’s question of 1744 by locating in 1800 the unique bifurcation of the Casiquiare River.

References


3. J.G. Leithäuser, *Ufer hinter dem Horizont*, (Safari-Verlag, Berlin, 1968) 480 pp. (The main body of the present article is based on the information contained on pages 265-298 of the above book. The three maps in the present article have been re-drawn to the author's specifications.)

4. Film: *Alexander von Humboldt*. (This 16mm colour/sound film is one of ten in the series *The Explorers: Ten Who Dared*. The film was produced in 1975 by the consortium British Broadcasting Corporation/Time-Life Films Inc./West Deutscher Rundfunk, runs for 52 minutes, and is narrated by David Attenborough. At the time of presenting the lecture on which this article was written, the film was available from the National Film Library in Canberra, ACT, Australia.)

5. Video: *Alexander von Humboldt: Aus seinem Leben - aus seinem Werk*. (This video is of a film produced by Martin Schiefler in 1975. Although initially narrated in German, it is now available in several languages. Through the courtesy of the Alexander von Humboldt Stiftung, especially the kind assistance of Dr. Heinrich Pfeiffer, the author of this article is now in possession of the above video in English).

Appendix

The following information is taken from Reference 2, p 131.

1769
14th September, birth of Alexander von Humboldt in Berlin, Jägerstrasse 22.

1790
Journey with Georg Forster to England and France.

1791 - 1792
Study at the Freiberg Mining School.

1792 - 1796
Chief Inspector of Mines in Upper Franconia.

1796
Death of Humboldt's mother. Resignation from civil service.

1797
Visits to Jena, Dresden, Vienna and Salzburg in connection with preparations for his journey.

1798
Paris: Humboldt meets Bonpland and accompanies him to Marseilles.

1799
Barcelona, Valencia, Madrid: Humboldt obtains permission to visit the Spanish colonies.

1799
5th June, departure of Humboldt and Bonpland from La Coruna. 19th - 25th June on Tenerife. 25th June - 16th July crossing to Venezuela.

16th July arrival at Cumana.
16th - 21st November coastal journey from Cumana to Caracas.

1800
7th February - 30th March journey from Caracas to San Fernando de Apure.
30th March - 10th July Orinoco journey.
10th - 23rd July journey across the Llanos (plains) to Nueva Barcelona (Venezuela).
24th November - 19th December voyage from Nueva Barcelona to Havana.
1801 19th December, 1800 - 8th March, 1801 journeys across Cuba.
9th - 30th March voyage from Cuba to Cartagena (Colombia).
30th March - 15th June from Cartagena to Honda.
6th July stay in Bogotá as guest of the botanist José Celestino Mutis.
29th September, 1801 - 6th January, 1802 journey from Popayan to Quito (Ecuador).

1802
23rd October - 5th December stay in Lima and vicinity.

1803
5th December, 1802 - 23rd March, 1803 voyage from Callao via Guayaquil to Acapulco (Mexico).
23rd March - 11th April Humboldt continues his journey from Acapulco via Taxco to Mexico City.

1804
11th April - 20th January, 1804 stay in Mexico City. Tours across Mexico, ascent of the Jorullo volcano.
20th January - 7th March journey from Mexico City to Veracruz.
7th March - 29th April voyage to Havana and second stay in Cuba.
29th April - 19th May cruise to Philadelphia (U.S.A.).
19th May - 9th July stay in the United States, three weeks as a guest of President Jefferson in Washington and Monticello (Virginia).
3rd September Humboldt and Bonpland arrive at Bordeaux. Writing of his major travel account, mainly in Paris (1808 - 1827).

1805 - 1834
*Voyage aux régions équinoxiales du Nouveau Continent, fait en 1799, 1800, 1801, 1802, 1803 et 1804, par Alexandre de Humboldt et Aimé Bonpland. Rédigé par Alexandre de Humboldt: a total of 35 volumes.*

1805
In Rome Humboldt meets Simón Bolívar and discusses the conditions of the locals in South America.

1808
*Ansichten der Natur* published by Cotta.

1827 - 1828
Berlin: *Kosmos lectures.*
MELATONIN RESEARCH IN AUSTRALIA

Helmut M. Hügel

If man is the measure of things, then time is the measure of man. One of the most important questions an employer will ask an employee is: How did he manage his time whilst studying or doing research? I have found that students who do not use their time efficiently will be less prepared and consequently become the lower intellectual achievers. Fortunately, biological rhythms are genetically programmed and my objective is to outline some of the major areas of research involving "biological time clock" molecules.

Biological rhythms are regular variations in a biochemical process with respect to time, which occur in a predictable manner. The most studied rhythm is the one which has a period (t) of approximately 24 hours commonly referred to as circadian (from the Latin circa, meaning approximately and die, meaning day).

circadian 24h > t > 20h

The environmental factors that maintain the periodicity of a biological rhythm are called synchronisers or Zeitgeber. The most important Zeitgeber of rhythms in mammals are light-dark, sleep-activity periods, feeding and fasting periods, and the presence or absence of social contact.

Melatonin

Melatonin is a neuro-hormonal intermediate, produced naturally in the brain. Some of the ubiquitous activities involving melatonin are outlined in Scheme 1. It is synthesized at night by a small gland in the brain, called the pineal gland. Secretion is stimulated by darkness and inhibited by light. The pathway from the retina to the pineal gland is indicated in Figure 1. Photic information is transferred through the suprachiasmatic nucleus (SCN) which is the site of the body's circadian pacemaker or rhythm generator. An adrenergic mechanism is then involved in the biosynthesis of melatonin.

By day, sunlight entering our eyes feeds via the optic nerve into the SCN, which directs the pineal gland to turn down production of melatonin.

Problems arise when short winter days and long hours spent in offices, where the artificial lighting may
only be less than a fraction of the intensity of bright midday sun, cause excess melatonin production. The effect is to disrupt the body clock. The person has inappropriately high melatonin levels in the brain and feels deprived of sleep. Melatonin seems to make most individuals sleepy. Some people feel lethargic and depressed and their efficiency at work may be seriously impaired. If such symptoms sound familiar to international travellers, it is because the condition called seasonal affective disorder (SAD) has much in common with jet lag. In both cases, the internal timekeeper is put out of step with environmental (man-made) clocks. There appears to be strong evidence to support the view that melatonin plays a key role in regulating circadian rhythms. Taken orally before normal sleeping time, melatonin tablets can re-train body rhythms disturbed by lack of sunlight. Research in Australia and overseas has shown that SAD and jetlag can both be treated by carefully timed exposure to bright light. The resultant bleaching of melatonin resets the body clock. The extent to which SAD occurs in Australia is presently unknown, but there is no reason to believe that it should be different from that of the northern hemisphere (that is, with increasing incidence as one moves away from the equator towards the poles).

The use of melatonin as a chronobiologic, meaning capable of therapeutically readjusting disrupted or desynchronized circadian rhythms, has been reviewed by Professor Stuart Armstrong from the Psychology and Brain Behaviour Research Institute at La Trobe University. Armstrong has also put forward the hypothesis that melatonin may be a chronobiologic with anti-aging properties. This theory is based on the finding that melatonin, when added to the drinking water of mice during darkness, retarded the aging syndrome and prolonged life by 20% (6 months longer than average). A broad interpretation of this data has been presented whereby melatonin extends life expectancy by its chronobiologic action on the circadian pacemaker system which normally loses aspects of its homeostasis with age. In other words the circadian pacemaker system has a diminished amplitude with age as indexed by a decrease in circulating melatonin levels. Stability of the circadian system correlates

Amplitude and loss of circadian amplitude produces lability which, in turn, leads to temporal disorder. Internal temporal disorder may be a precursor of disease states. Melatonin increases the amplitude of the circadian pacemaker system by feedback systems. The SCN is thought to have high concentrations of melatonin receptors, and melatonin administration in pharmacological doses may prevent aging symptoms and lower the level of the circadian pacemaker’s amplitude.

Development of Regulin

Sheep are photosensitive breeders. They have a natural rhythm of reproductive activity. Ewes are programmed to have one breeding (stimulatory) and one non-breeding (reproductive) period each year. The precise timing of the breeding rhythm is linked to the length of day; that peak performance occurs when day length is increasing (i.e., spring). Melatonin is the natural chemical messenger from the pineal gland which plays a “time keeping role”. Melatonin secretion occurs at night so that the sheep senses changes in day length by measuring the duration of melatonin release. During the longer days of spring, the melatonin signal (short period of release) is inhibitory, whereas during the shorter days of autumn the melatonin signal (long period of release) is stimulatory. Regulin (contains melatonin) implants are designed to give continuous tiny doses of melatonin for several weeks. Such implants in spring overcome the long day inhibition and the sheep are tricked into an early commencement season. When rams are introduced at the correct time after Regulin treatment, the ewes will mate and conceive as a tight group and at a time of the early peak in reproductive performance. Regulin treatment only shifts the time at which the normal reproductive activity occurs. It does not induce responses which are greater than the animals’ natural autumn peak. The effect of Regulin on the breeding season of sheep is represented in Figure 2 and the key benefits of its use in the sheep breeds common to Australia are summarized in Scheme 2.

Fig. 2. Effect of treatment of ewes with a Regulin implant in spring on the advancement of the normal autumn peak of reproductive performance. The peak is characterized by a greater percentage of ewes cycling and a higher ovulation rate (eggs shed at each cycle). Regulin simply advances the time of the year at which the peak performance is achieved without causing an unnatural boost to normal peak performances.
mode of action of melatonin

there is sufficient evidence to suggest the brain in general and areas in close contact with the cerebral spinal fluid (csf) such as the scn in particular, as the likely sites of melatonin action6. a recent approach to the question of specific sites of action of transmitters and hormones within the brain has involved the use of in vivo autoradiography. when used with 2-[125i]-iodomelatonin, the technique has identified the scn and pars tuberalis (pt) membranes of the pituitary as the major sites of accumulation of radioactivity. this has enabled rapid screening of melatonin analogues for their receptor binding potency6. in contrast it has proven very difficult to determine sites of melatonin action using in vivo experiments, mainly because the physiological response to the photoperiod change or to melatonin administration can take from 3 to 12 weeks to become evident. thus, not only does melatonin have to be administered within a quite precise window during the day (usually 1-4 hours before darkness), but it must also be administered for many days to precipitate changes in the secretion pattern of other hormones.

studies on the chemical modification of melatonin have shown that the n-acetyl substituent has primary importance for the efficacy of binding, whereas the 5-methoxy group of the indole nucleus has greater importance for biological activity. when the methyl moiety of the acetyl group was replaced by a cyclopropyl group, a hundred-fold increase in affinity for the melatonin receptor was observed7. this finding suggested that the receptor site has a hydrophobic pocket of relatively small size, which is important for optimal ligand binding. substitution of the indole nucleus with a naphthalene structure resulted in no loss of binding potency. it is not known whether the naphthalene analogues may afford a longer biological half-life than melatonin itself. we are currently preparing compounds which are melatonin-dimer analogues and also melatonin linked by various spacer groups, to study the effect of molecular variations on binding and biological activity (scheme 3).

conclusion

nature's rules of the effect of light on biological systems have become the scientists' tools in studies of the circadian organisation and rhythms which are relevant to most biological systems. there is considerable evidence from a number of species that melatonin is involved in transmitting information about the environment. its rhythmic release at night

scheme 2

regulin has been researched and developed in australia. linton staples was the director of the development of regulin from the concept to the international market place. possible applications of regulin include control of seasonal breeding in sheep, delaying early breeding in cattle, obtaining early breeding in goats, improving yields of cashmere and mohair from goats, obtaining early breeding in deer, overcoming seasonal weakness in wool strength, inducing early changes in mink pelts, changing the birthday of horses, and improving the spawning times of fish.

regulin pre-treatment thus allows for improved lamb turnover (greater efficiency), improved selection, greater flexibility in flock structure, easier management and greater profitability.

scheme 3

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nature's rules of the effect of light on biological systems have become the scientists' tools in studies of the circadian organisation and rhythms which are relevant to most biological systems. There is considerable evidence from a number of species that melatonin is involved in transmitting information about the environment. Its rhythmic release at night
is thought to serve as a resetting signal for the endogenous biological clock. Melatonin apparently acts as an endogenous \textit{Zeitgeber}, the chemical expression of darkness. To date, the most widely demonstrated melatonin effect is its ability to drive the reproductive competence in a number of seasonally breeding animals. The localization of 2-\textsuperscript{125}I-iodomelatonin binding sites in the SCN of the human hypothalamus enhances the argument for a physiological role in humans. Development of a radio ligand assay for melatonin receptors, using \textit{paris tuberale} membranes of the pineal, has enabled rapid screening of melatonin analogues for their receptor binding potency. Often discussion and debate without scientific evidence has led to more heat than light being produced. We feel, however, that the value of this neuro-hormone cannot be overestimated because seasonal and circadian rhythms are central to most living systems.

Acknowledgments

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LUDWIG LEICHHARDT

To hell and back over 5000 km!

Paul G. Lennox

Introduction

Friedrich Wilhelm Ludwig Leichhardt landed in Australia aged 29 years and with a dream of becoming a world renowned explorer. His broad education, an insatiable curiosity about everything around him and a facility in languages drove him in the quest for recognition similar to that afforded his exemplar, Alexander von Humboldt. In this article we shall examine Leichhardt’s background, his extraordinary education in spite of humble means and the personal characteristics which enabled him to tackle the unknown heart of Australia with such single-mindedness.

German Background

Ludwig was the sixth child of a farming couple, Christian and Sophie Leichhardt, and was born on 23 October, 1813 in Trebatsch, a village near Cottbus about 70km southeast of Berlin\textsuperscript{1}. He was born into a nation recovering from a crushing defeat by Napoleon’s army in 1806 and the loss of all but Brandenburg, Pomerania, Old Prussia and Silesia. It was not till Leichhardt was starting at Göttingen that Prussia again fielded a similarly sized army. Leichhardt’s father eventually rose to be Royal Post Inspector, a position of respect but minuscule remuneration, but he was able to support Ludwig through his early Gymnasium and university studies. Leichhardt did not spend much of his early life about the farm and his knowledge that he would not inherit the farm drove him to search for other means of earning a living. Leichhardt’s "Arbiter", awarded during his eighteenth year, from the Friedrich Wilhelm-Gymnasium at Cottbus, describes him as having a retentive memory, capacity for independent judgement and a zealous devotion to his studies so that

he mixed very little with his fellow students but nevertheless lived socially and peacefully with everyone\textsuperscript{1}.

Interestingly, Leichhardt was described as being good at maths and natural history, patchy at physics and backward at French!

Leichhardt firstly tackled public administration in his university studies in Berlin and Göttingen where he met John and then William Nicholson, English students studying oriental languages and medicine, respectively. These brothers were instrumental, through their father, in funding Leichhardt’s studies, travel through England, France and Italy and, later, his trip to Australia.

Four Göttingen Professors were very influential in Leichhardt’s decision to change from
philology to natural history. The 57-year-old Prof. J.F. Herbart taught forestry, forest management, climatology and soil sciences and his entreaties that "the great philologists are also great in maths and physics" caused Leichhardt to re-examine his plan for his future. After agonising during long walks in the hills overlooking Göttingen, Leichhardt wrote in his diary that

I am happy with my decision. Yes! I bow to Nature's call. My study will be of her.... If only I had met Herbart three years ago!

The other three influential professors were Carl Otfried Müller who lectured on ancient mythologies and the history of early religions, Privy Councillor Jakob Grimm who lectured on European languages and 30-year-old Georg Heinrich August Ewald who lectured on ancient languages.

William Nicholson convinced Leichhardt to study the natural sciences with him in England in September 1836 and Ludwig applied for exemption from military training. Leichhardt, aged 23 years, was obliged to perform a year's compulsory military service as a "volunteer" unless physically unfit or granted exemption. Leichhardt first attempted to pretend he was physically unfit but was passed fit, so he then applied to the King for exemption on the grounds of his future exploration to the King's own glorification. He was granted deferment and permission to travel to England subject to reporting for service within four years. He studied medicine before travelling with William Nicholson to Paris to undertake joint natural history and geological studies. He and William undertook a tour throughout southern France, Italy and Switzerland before returning to Paris. These studies enabled Leichhardt to make the most of his botanical, geological and faunal discoveries in Australia.

Leichhardt met Alexander von Humboldt briefly in Paris in June, 1841 but was not terribly impressed, writing to his brother-in-law that "... I left him no wiser than when I went in...." and noting sarcastically in his diary

Humboldt has given me thrice-marlovs advice. He told me that if I wanted to go to New Holland I'd have to learn stuffin: ich musste ausstappen lernen! And he gave me the splendid consolation that I should take the journey on while I was still skinny!

Leichhardt had hoped to enlist von Humboldt in his quest to gain exemption from military service but under the circumstances he did not pursue this issue with von Humboldt.

Leichhardt in New Holland

Preparations for Port Essington Expedition

Gradually Leichhardt's quest for recognition came to centre around exploration in New Holland. He wrote to his brother-in-law, Schmalfluss, from London in September, 1841:

This interior (of New Holland), the unknown core of the continent, is my goal, and I will never give it up until I reach it.

Once William Nicholson had decided not to travel with Leichhardt but remain and establish a medical practice in England he offered Ludwig a loan of the passage to New Holland and some money to get himself established. Leichhardt made important acquaintances during his voyage, and these had some bearing on the social circle he joined in Sydney. Ludwig was 29 years old when he arrived in Sydney and his broad scientific education, medical studies and extensive walking had admirably equipped him for exploration in New Holland. He spent the next two years travelling around the Sydney to Moreton Bay (Brisbane) area, familiarising himself with the flora, fossils and fauna. It was during a visit to the Russell brothers at Roscathl station in April, 1844 that his ideas crystallised around an expedition from Darling Downs to Port Essington. He wrote in his diary,

In the Russell brothers I believe I've found two such men as I should want for an expedition. They are excellent bushmen, excellent marksmen, active, enthusiastic, and get on well together. We have discussed a plan from every angle, and I hope to put it into operation as soon as possible. The expedition will comprise the two Russells, Fierer (his horse), two blackboys, and your humble servant. Each will take 100lb. of flour and ammunition by mule or packhorse. I hope to bring it off in two month's time.

Meanwhile Sir Thomas Mitchell, the Surveyor-General, had plans before Governor Gipps to lead an expedition to find the Australian Mississippi which he believed flowed westward through New Holland. Although Gipps privately supported Leichhardt's expedition, he could not officially support it against the plans of his Surveyor-General2. Leichhardt had to mount a privately funded expedition of small size to cover the 2000 miles to Port Essington.

Leichhardt initially had nine travelling companions but two of these returned early leaving a mixture of extremely young men both Aboriginal and English and two older men of very different social standing. From the Sydney area there was Charley Fisher an Aboriginal tracker, 16-year-old potential artist James Murphy and 44-year-old ex-attorney William Phillips who had been convicted of forgery and wanted a pardon. In the Hunter River region Leichhardt was prevailed upon to take 20-year-old John Roper who had lost his job, the Aboriginal youth Harry Brown and 13-year-old farmer James Calvert whom Leichhardt knew from previous trips to this area. In Brisbane John Gilbert, John Gould's collector, joined partly, as he wrote in his diary, to thwart a foreigner being the first to make known the treasures of Australia. Caleb, an Afro-American camp cook, and 23-year-old Pemberton Hodgson, a farmer, joined in Brisbane in September, 1844 but returned to civilisation in October.

Exploration

The early part of their 15-month-long expedition (Figure 1) was slow compared with the second half, 165 miles being covered in the first month compared with 230 miles per month in later stages. This probably reflects the initial difficulties with marshalling stayed horses, bullocks and gear, the load of food which was minimal near the end of the expedition and the nature of the countryside in the two regions. Their food consisted of minimal flour, tea,
Leichhardt named the Dawson River (after Robert Dawson, a young friend).

The party got on well enough with the local Aborigines to be led to a native-honey supply during the drying of a little steer killed to make jerky. Later Leichhardt exchanged a brass-hilted sword, four fishing-hooks, and a silk handkerchief for two kangaroo nets and their cordage from an unoccupied native camp. Leichhardt named each camp after a local feature or event and it was at Speared Horse Camp that the second problem with Charley occurred. Shortly after lunch Charley came galloping back from a search for honey, claiming that natives had attacked his horse, spearing it in the shoulder. Gilbert and others believed Charley had inflicted the wound himself with a tomahawk perhaps to cover up his unsuccessful attempts to parlay with the local natives. The horses and bullocks were immediately rounded up and the party departed without any further contact with natives. It was early November, 1844 that the party reached the Mackenzie River named by Leichhardt after Queensland pastoralist Sir Evan Mackenzie who had organised squatters to give him equipment.

Christmas Day was preceded by the killing of a fat bullock and its drying to make jerky. This provided a welcome rest for the horses and cattle. Leichhardt wrote in his diary that on Christmas Day -

We enjoyed ourselves very much, and tasted luxuriously on fried liver at breakfast, on stuffed heart for luncheon, and on a fine steak and kidneys for supper.

Proceeding further the party came across a deserted native camp with possum-skin cloaks, kangaroo nets, a dilly bag and the clan’s dinner of roast possum, goanna and turkey eggs still hot. Leichhardt ate one of the turkey eggs which he found excellent and left the rest undisturbed.

The party crossed the Tropic of Capricorn on 12 January, 1845 and soon afterwards Leichhardt discovered coal which was later to prove to be a part of the huge Blackwater coal deposits of the Bowen Basin, Central Queensland. The third bullock was killed and meat dried. During this drying Johnnie Murphy shot an unusual fish which the natives called a barramundi and which Leichhardt identified from his lectures in Paris.

In spite of unresolved difficulties with his sextant, Leichhardt wrote lyrically in his diary of the countryside.

I wish I could sufficiently describe the loveliness of the morning just before and after sunrise; the air so clear, so transparent; the sky slightly tinged with roseate hues, all nature so fresh, so calm, so cool. If water were plentiful, the downs of Peak Range would be inferior to no country in the world.

Charley fell in with a tribe of friendly Aborigines and later Brown joined him, presumably because of the companionship of the women members of that group. Both reappeared four days later begging to re-join the party. On 17 January the party killed Gilbert’s bullock and whilst it was drying, Charley again made to leave until Leichhardt remonstrated with him. Charley threatened to “stop Leichhardt’s jaw” and when Leichhardt
decided to run him out of camp, Charley hit him knocking out two of his teeth. Calvert and Roper jumped on Charley and pulled him off Leichhardt. Leichhardt consulted all the party some days later about taking Charley back into the expedition and all agreed he should, provided Charley surrendered his tomahawk.

In early March, 1845 whilst besides the Isaac River, Leichhardt appears to have passed a gallstone which he dismissed as "a severe attack of lumago". The party remained three days at Lumago Camp whilst Leichhardt recovered. Shortly thereafter the party reached the Sutor River (named after another patron) which then joined the much larger and useful Burdekin River. The northwest direction of the Burdekin was ideal for the progress of the party. The natives in the Sutor River valley were terrified of the pale face of Roper and fled upon the approach of Charley and Brown.

Whilst traversing down the Burdekin Leichhardt collected corns and bivalve shells from one bank of the river. The Rev. W.B. Clarke who had supported Leichhardt's endeavours, was later able to identify the fossils and named one after Leichhardt. By this time the party had caused maintaining the watch and was working its way down the Lynd River. The party celebrated the victory of Waterloo when last English and German troops had fought side by side. Leichhardt recorded in his diary

we had nothing left but the rage of our sugar bags; which, however, we had kept for the purpose, and which we now boiled up with our tea....  1

During the next ten days the party passed through the territories of four different native tribes.

Encounters with Natives

Leichhardt spent some time during the rounding up of bullocks by others to check the longitude of his party which indicated their position with reasonable accuracy. The error was understandable because his sextant had a mechanical defect. On 27 June, 1845, Charley and Brown supposedly spent some time hunting game and reported back that they had found armed natives sneaking up on the party's bullocks. It seems more likely Charley and Brown were seeking female companionship and this story was concocted to cover the problems experienced when they hurt one of the old men of the tribe. Many authors on Leichhardt have surmised that the reason for the fatal attack on the party the next night was the unwitting violation of a tribal ceremonial ground of the Kokooper tribe.  2

Although a reasonable account of the attack is impossible as we do not have Leichhardt's original log and white settlement came too late to hear the Aboriginal version of events, we can use Leichhardt's manuscript written one year later, to gain some insight into the events of 28 June, 1845. The party was sleeping in three tents with Gilbert some way away from the others and with his entrance facing away from the fire. Leichhardt slept in the open near the fire and was aroused soon after retiring, by Calvert and Roper's appeals for help. The natives had sneaked up on the party and showered the tents with spears some of which were barbed. Once the guns were discharged the natives bolted leaving Roper and Calvert full of spears and covered with blood from waddis. Roper had spear wounds in his scalp, through his left arm, in his cheek and loin, while Calvert had a crushed nasal bone, a

barbed spear through his left testicle and another in his knee. Gilbert had bolted from his tent after discharging his rifle but had been fatally speared between the clavicle and the neck, probably as he stopped to leave his tent. Leichhardt's medical training in Paris meant he was able to prevent Roper and Calvert wounds turning septic and because of their youth and healthy diet both recovered remarkably quickly. Even so, Leichhardt's party was in dire straits the next morning with the burial of Gilbert, the necessity to make a quick retreat south and the fact that the party's routine tasks must be shared amongst a smaller number. After three days of rapid progress south, Brown discovered the water in a creek was brackish, suggesting the party was near the Gulf of Carpentaria.

The attack on the party had made everyone vigilant and Leichhardt now selected open spaces for camp grounds with their pack-saddles protecting the tents and a full-watch in place. The navigation of Leichhardt through this Gulf country was very good in spite of the misrepresentation of others and the confusion over the naming of streams on maps.

The party came across systematically burnt grass along many watercourses. They were assisted across the Yappar River by one group of natives, gave an iron ring to one child who had not decamped with his party quickly enough, presumably because he was sleeping, and had one aboriginal walk right up to their fire in the mistaken belief it was his tribe. The poor fellow climbed the nearest tree and cried pitifully and would not be coaxed down. The party then moved some way off and retired and then his cries died down and he eventually descended the tree and fled the camp. Leichhardt also deduced how the natives were able to use the fruit of the pandanus palm, after initially finding it was bitter to the lips, blistered the tongue and caused a violent attack of diarrhoea.

By this stage the party's clothing was falling apart and to mend the body of shirts they had to cut off the sleeves and when the sleeves were depleted, the lower part of the shirt was used to mend the upper part. The party had saved their shoes, having worn mocassins along the eastern coast. The travelling now was more difficult because of the heat and the bullocks were weakening. By now they had reached the MacArthur River in the Northern Territory and had consumed the last of their tea, so their main meal was now charqui and water.

In early October, Leichhardt with much consternation, had to discard paper for drying plants, specimens of wood, a small rock collection of Mr. Gilbert and duplicates of his zoological specimens.

The whole endeavour was almost undone on the morning of 21 October, 1845, when three horses were drowned as Charley sought to retrieve the horses from near the junction of two creeks where they had stayed during the night. Leichhardt recorded with anguish in his diary

... I was obliged to leave that part of my botanical collection which had been carried by one of the horses. The fruit of many a day's work was consigned to the fire; and tears were in my eyes when I saw one of the most interesting results of my expedition vanish into smoke.  1
The loss of another horse called Macarthur, a few days later in spite of Leichhardt's efforts to save him from drowning, reduced the party's horses to nine.

In early November the party crossed into what is now the southern boundary of Arnhem Land Aboriginal Reserve. Leichhardt recorded in his diary that although the country was well grassed and well watered, the excessive heat and rocky nature of the ground made the bullocks footsore and exhausted. They now came hard up against the sandstone escarpments with their 400 metre peaks, tables, altars, pillars and pyramids. As Leichhardt recorded it in his diary,

...I had a most distressing, sickening view over a tremendously rocky country. A high land, composed of horizontal strata of sandstone, seemed to be literally hallowed, leaving the remaining blocks in fantastic figures of every shape, and a green vegetation, crowding deceitfully within their fissures and gullies, and covering half of the difficulties which awaited us on our attempt to travel over it.

The party's spirits lifted after heavy showers during the night in mid-November, 1845.

On 17 November the party proceeded along Jim Jim Creek until confronted by a precipice, with no way down visible. Charley and Leichhardt separately attempted to find a way down from the main channel of Jim Jim Creek. The party found a narrow fissure which contained boulders which lacerated the legs of the bullocks and damaged their hooves as they were led down. One bullock was slaughtered at the base of the cliff but heavy rains overnight sent the beef rotten before it dried. Soon the party was on the South Alligator River about 200km from Port Essington.

The party now heard the cooeeing of natives regularly and Charley brought a tribe of local Aborigines into camp after a sortie for game. This tribe knew of the presence of whites nearby and some of the tribe had a shawl and neckerchief of English manufacture and an iron tomahawk. This tribe guided the party around a large swamp and despite being terrified every time the horses' heads were turned in their direction, they aided the party. The tribe tried to communicate with the party using words they had picked up at Port Essington such as perikot (very good) and nogot (no good).

In early December, whilst travelling through what is now Kakadu National Park, a native stepped from among the trees with what Leichhardt recorded as "the ease and grace of an Apollo" and after Leichhardt had him welcome the man said "Commandant! Come here! Very good!! What's your name??!!". The whole party was struck by these words. Leichhardt records in his diary...

If my readers have at all identified themselves with my feelings throughout this trying journey, if they have only imagined a tithe of the difficulties we have encountered, they will readily imagine what the startling effect these, as it were, magic words produced - we were electrified - our joy knew no limits, and I was ready to embrace the fellows, who, seeing the happiness with which they inspired us, joined, with a most merry grin, in the loud expression of our feelings.

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The party still had some way to go to Port Essington but were aided by natives who directed them around most obstacles and they stayed some time in a few spots to catch the plentiful game. Even Mr. Roper who had, by this stage, lost the use of one eye from the spearing in the Gulf, joined in the hunt.

Final Goal

On 17 December, 1845, having travelled almost 5000 km, the party entered Victoria at Port Essington, and was kindly received by Captain Macarthur and the officers. Leichhardt later wrote of this:

I was deeply affected, finding myself again in civilised society, and could scarcely speak, the words growing big with tears and emotion; and even now, when considering with what small means the Almighty had enabled me to perform such a long journey, my heart thrills in grateful acknowledgment of his infinite kindness.

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INVESTIGATION OF SOLIDS BY ELECTROCHEMICAL METHODS

Alan M. Bond, Helmut Hügel and Frank Marken

Historical Remarks

Electrical phenomena have fascinated scientists ever since the eighteenth century, and early experiments with the electrical kite which drew electrical currents from storm clouds or the Leyden jar which generated very high voltages, are still regarded as spectacular. The discovery of "animal electricity" by the professor of medicine, Luigi Galvani (1791) sparked considerable interest. During this period Alexander von Humboldt also worked intensely on the electrical effects of metals on physiological materials. He investigated frog muscles as well as other animal tissues and even conducted self experiments by treating open wounds with different metals. He published his results in two volumes and speculated about the process of life. About this time (1800) Alessandro Volta developed the Voltaiic pile (first battery) without using physiological materials. Humboldt, however, had obviously also been very close to this discovery, as illustrated by the experiment in Figure 1 where he used different metal plates separated by animal tissue to see the effect on a muscle.

![Figure 1. Illustration of experiments by Alexander von Humboldt (from Ref. 2 with permission).](image)

The electrochemistry of non-physiological matter developed rapidly and in 1834 Michael Faraday published his laws of electrolysis which correlate electrochemical conversions, like the evolution of gases from the electrolytic cleavage of water, with the amount of electricity flowing. Electrical phenomena in living matter remain an exciting topic even today, because important physiological processes involve electron transfer steps, with the highest level of complexity being associated with the electrical processes that occur in the human brain.

The earliest report of the electrochemistry of solids is probably the work of Alessandro

* Paper delivered by Dr. Frank Marken
Volta but the beginning of the systematic study is dated by Hans Rickert to 1904 when B. Warburg published his work on the applicability of Faraday’s laws to solid ion conductors. However, in this report it will be shown that electrochemical methods can be used not only to explore the properties of ion-conducting solids but also of mixed or non-conducting materials and that chemical changes in solid samples can be studied.

A Systematic Overview

In principle, the electrochemical properties of solids may be classified according to their conductivity characteristics. However, the transition from non- to semi- to conducting behaviour is rather arbitrary and even the definition of the term “solid” (e.g. as given by the Oxford Dictionary: “having three dimensions”) is far from rigid because it does not consider time. A division into four groups of conducting materials is given below with some examples.

I. Electrically conducting
Metals, super- and semiconductors, conducting polymers and other new synthetic materials

II. Ion-conducting
Some inorganic salts like AgI, Ag2S, Li3N, and some doped metal oxides, ion exchange polymers and some frozen liquids

III. Electron- and ion-conducting
Some metals (Hg, Pb), redox polymers and intercalation compounds (graphite, paraffin oxide)

IV. Non-conducting
Many crystalline or glassy materials, naturally occurring and synthetic

A complication concerning the classification arises mainly in group III but also in group IV because some materials are able to change their properties continuously or suddenly when they are electrochemically treated.

Examples of Techniques and Problems

In this part of the article, examples of the behaviour in solid materials of groups I to IV when investigated in electrochemical experiments will be given, together with examples of important applications.

Group I

Electrochemical experiments can be undertaken by dipping the solid sample (electrode) under investigation into a solution and simply applying a voltage to or passing a current through it. In these so-called “voltammetric” experiments, a defined potential is applied (by means of additional electrodes and some electric circuitry) and the flow of the electrical

The resistance of the solution has to be low in order to obtain meaningful results, which means a salt. Cu2+, A+ (supporting electrolyte) is added to the solution.

In Figure 2, only the sample electrode (working electrode) is shown and the path of the current is depicted. Electrons reach the electrode surface through the conducting material and at the electrode surface a redox process converts the flow of electrons into a flow of ions. For example, in the case of a solid copper electrode, a certain positive potential will force copper cations Cu2+ to be expelled into the solution.

Fig. 2. Schematic presentation of a solid electrode immersed in a solution of a supporting electrolyte salt. The flow of electrons is converted into a flow of ions in solution.

Applying a potential or voltage can be done stepwise or by using certain excitation waveforms. In Figure 3, examples of some techniques are given together with typical current responses which could be obtained. The variation of the excitation signal allows the investigation of a variety of processes taking place at the electrode surface.

Fig. 3. Examples of current responses in electrochemical experiments using different excitation waveforms.
A simple technique, which uses a potential ramp like in Figure 3b and a second reverse ramp to return to the starting potential, is known as "cyclic voltammetry" and will be used later in some examples.

**Group II**

Ion-conducting materials such as some membranes offer the possibility of conducting certain ionic species and they can be switched into the flow of ions as shown in Figure 4. Because of this property, they are also called solid electrolytes and they find technical applications in sensors, batteries and fuel cells.

![Schematic of ion-conducting material](image)

Fig. 4. Schematic presentation of an electrode in contact with a solution which is separated from a second solution by an ion-conducting material. The flow of electrons is coupled to the flow of one type of ion.

One example described in Figure 5 is the application of an oxygen diion O$_2^-$-conducting material (doped zirconia ZrO$_2$) as a high temperature oxygen sensor used, for example, to monitor the oxygen concentration in molten copper. The ion conduction is restricted to oxygen diions and so the sensor is specific for this ion.

![Schematic of oxygen sensor](image)

Fig. 5. Schematic drawing of an oxygen sensor for molten copper (from Ref. 6 with permission).

**Group III**

Modified electrodes may be prepared by depositing a film of ion- and electron-conducting material onto an electrode surface (Figure 6). In this situation the conversion of electron flow into ion flow takes place somewhere in the solid and a chemical change accompanied by a change in properties, like colour or conductivity, can be observed. Some of these modified electrode surfaces allow specific interactions with solution species or catalytic reactions which would not be possible on the bare electrode.

![Schematic of modified electrode](image)

Fig. 6. Schematic presentation of an electrode coated with a material of mixed conductivity. Electron flow is coupled to ion uptake or expulsion.

An example of a material in this category used in current research is a film of electrodeposited Prussian Blue (Figure 7) which changes its colour from white to blue and green to yellow depending on the potential of the electrode and which allows the detection of oxygen or hydrogen peroxide dissolved in water.

![Prussian Blue structure](image)

Fig. 7. The structure and the redox conversion of Prussian Blue.
The lattice of Prussian Blue contains two different types of iron centres. One is coordinated to six nitrogen atoms (N) and the other one has six carbon (C) neighbours. These are responsible for the two steps from Prussian Yellow to Prussian Blue and from there to Eberth’s salt and, if each of these steps, the material exchanges electrons (e⁻) and cations (C⁺) with its surroundings. This type of exchange behaviour can be observed for many compounds, such as graphite⁴, intercalation compounds¹¹ and Buckminster fullerene (C⁶₀)¹².

Group IV

A non-conducting material deposited on an electrode surface would usually be expected to block any current flow and high voltages generally are required to obtain current responses in this type of experiment¹³. In a different experimental approach, the solid can be analysed in a three-phase system allowing simultaneous contact between an electrode, the sample and the solution (Figure 8).

![Schematic presentation of sample particles attached to the surface of an electrode and immersed in the electrolyte solution.](image)

A mixture of graphite and solid may be used as electrode material or small quantities of solid particles are attached to the electrode surface.

**Abrasive Stripping Voltammetry as an Analytical Tool**

![Voltammetric signals obtained for various mercury salts mechanically attached to a graphite electrode and immersed in aqueous electrolyte (from Ref. 15 with permission).](image)

A new analytical tool invented by Fritz Scholz and coworkers¹⁴ uses very small quantities of solids which are mechanically attached to a graphite electrode. When placed in aqueous media, these modified electrodes give characteristic responses for a range of materials, such as minerals and alloys. In Figure 9, the results for different mercury compounds¹⁵ are shown and the possibility of obtaining different signals for solids of identical composition but different structures (red and black HgS) indicates that information can be extracted.

**Voltammetric Behaviour of Water-insoluble, Non-conducting Compounds**

Many new substances are produced every year and the investigation of their electrochemical properties is now required more and more routinely. Electrochemical properties of solids had previously rarely been investigated, because most materials are non-conducting and difficult to investigate.

The mechanical transfer of solid samples onto graphite electrodes for their subsequent study in aqueous media is a facile method applicable to a wide range of materials. A photograph of a graphite electrode surface with solid particles attached to it, obtained by scanning electron microscopy, is shown in Figure 10. Particles with typical sizes smaller than 1 µm can be observed and they are embedded in the graphite of the electrode.

![Scanning electron micrograph of a solid sample (decamethylferrocene) mechanically attached to a graphite electrode surface. A typical particle size is 0.3 µm.](image)

Materials used in the following investigations are so-called metal complexes which consist of a central metal atom (Fe, Cr, Mo, Mn) bound to surrounding molecules (ligands:...
Fig. 11. Cyclic voltammograms using a scan rate of 200 mVs\(^{-1}\) of (a) Cr(CO)\(_2\)(dpe)\(_2\), (b) Mo(CO)\(_2\)(dpe)\(_2\), and (c) Mn(CO)\(_2\)(dpe)\(_2\)Br, mechanically attached to a graphite electrode and immersed in aqueous 0.1 M NaCl solution.

CO, dpe = \(\text{PH}_3\text{PCH}_2\text{CH}_2\text{PPh}_3\). These materials are typical insoluble, non-conducting compounds and examples of cyclic voltammograms obtained from them as described above are presented in Figure 11.

The measurement commences at low potential and, using a simple potential ramp the potential is cycled twice through the desired range. Peak currents are obtained at certain potentials and the first cycle differs from the second. Analysis of the results using a variety of experimental conditions and compounds leads to the following conclusions. (1) The electrochemical process is confined to the solid. (2) The peak positions depend on the supporting electrolyte salt in the aqueous solution, suggesting a transfer of ions occurs from the solution to the solid. (3) The observed peak currents depend on the interaction of the solid surface and the aqueous solution. (4) In many cases a change in temperature strongly enhances the magnitude of the signals obtained.

These findings can be incorporated into a first model. In Figure 12, a schematic picture of the solid-electrode-solution three-phase boundary is shown. A flow of electrons is possible at the surface of the solid and is depicted by an arrow. To allow neutralisation of the charge on the surface of the solid, an equilibrium exists that allows anions \(\text{A}^-\) from the solution phase to adsorb onto the solid. The flow of electrical current may be possible at the solid-solution boundary via a so-called "electron hopping mechanism" in which the electrons are believed to jump from molecule to molecule.

Some compounds, especially when investigated at elevated temperatures, reveal electrochemical signals which are too large to be explained solely by a surface process. An example, the oxidation of solid docosamethylferrocene\(^{16}\), is shown in Figure 13. A very useful technique for investigating the composition of solid particles on the electrode surface before and after the electrochemical process, is electron probe analysis. In this method characteristic X-ray emission after excitation with an electron beam allows the detection of the ion from the aqueous solution, which is transferred into the solid in the electrochemical process.

Fig. 12. Schematic presentation of processes occurring at the three-phase boundary between electrode, solid sample and solution. The arrow indicates moving electrons and anions \(\text{A}^-\) from solution which are adsorbed onto the charged surface.

Fig. 13. Cyclic voltammogram using a scan rate of 20 mVs\(^{-1}\) of solid docosamethylferrocene\(^{16}\) mechanically attached to a graphite electrode and immersed in aqueous 0.1 M NaClO\(_4\).
The model outlined above has to allow for ions from the electrolyte solution not only adsorbing to the surface of the material but also penetrating into the solid structure like in an intercalation process. The observed processes lead to a complicated picture and much more work will be necessary to understand the electrochemical properties of small solid particles. The coupling of electrochemical experiments with microscopic and spectroscopic methods of analysis will be essential.

Summary and Outlook

Using the method of mechanical transfer of solid samples onto electrode surfaces, it appears to be possible to investigate any electroactive and insoluble material under appropriate conditions. Information about the solid, the surface and the interaction between the solid and solution phase will be obtained, if the processes occurring can be better understood. There is a variety of synthetic materials of yet unknown electrochemical properties which can be explored and in future materials could also be tailored to have desirable electrochemical properties. The use of these solids may lead to new concepts in analytical applications or in technological developments leading to energy harvesting and storage devices.

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GERMANS IN VICTORIA

Gabrielle L. McMullen

Introduction

After British and Irish settlers, Germans represented the third largest national group in the early waves of immigration to the shores of the Fifth Continent. Although numerically they were substantially less important than the migrants from the United Kingdom and Ireland, their influence on aspects of Australian life was significant, especially in South Australia and Queensland. In particular, their contributions to the cultural life of this country were an embryonic factor in the evolution of the multicultural Australia of the late twentieth century.

German-Australian relations could be said to have commenced in 1788 with the arrival of the First Fleet. Both Captain Arthur Phillip1, its commander, and another of its prominent members, Baron Augustus Ait2, the first Surveyor-General of New South Wales, had German fathers. Phillip's had come to England as a language teacher and Ait's as an ambassador for Hesse-Kassel. Ait initiated the surveying of lands in the colony and is credited with founding Parramatta. Philipp Schiffer2 who was born in Hessen arrived in the colony of New South Wales in June 1790. He had been engaged as a superintendent of convicts, apparently because of his farming background, but his English was poor and he was little suited to this task. After less than a year, he secured a land grant, being one of the first three free men in the colony to be granted land. He planted a variety of crops and some vines, the latter being the first in the colony apart from those in Governor Phillip's garden. He called his farm, Vineyard. As well as small numbers of German free settlers who came as merchants and farmers in the first decades, several German-born convicts were transported to Australia from Great Britain4. However, it was not until the middle of the nineteenth century that larger numbers of German migrants began to arrive in Australia and it was also at this time that German immigration to Victoria began.

Several reasons for the increased emigration of Germans to Australia can be identified:

1. The German states were experiencing economic hardship, as a result of the emancipation of the peasantry, high unemployment, overpopulation and, in particular, bad harvests in the late 1840s.

2. Religious intolerance was a factor especially for Old Lutherans averse to the union with the Calvinists, decreed by Prussian King Friedrich Wilhelm III, but also for small religious communities, such as the German Quakers, Moravian Brethren, Pietists and Mennonites, to name minority religious groups who came to Victoria5.

3. Unjust political systems and fear of reprisals for those who had taken part in unsuccessful uprisings, precipitated emigration. In particular, the failed Revolution of 1848-1849 led to the "cream" of German society seeking new homelands. It brought to Australia substantial numbers of these German intellectuals, known as Forty-
eighthers, "idealists who fought to establish a liberal and unified Germany". Their republican ideas probably influenced the men of the Eureka uprising.

4. Some Germans emigrated to avoid military service.

5. William Westgarth who was very impressed by the German settlers in South Australia established a bounty scheme to promote German immigration to Port Phillip.

6. The discovery of gold in the Australian colonies was a catalyst for immigration.

7. The allurement of the "new world" attracted German explorers, scientists, artists and adventurers to our shores.

8. Small numbers of affluent Germans, like Baron Ferdinand von Müller, sought a warmer climate for health reasons.

9. Chain migration, whereby the presence and reports of earlier settlers attracted their fellow countrymen, was of increasing importance.

In reaching their decision to set out for the Fifth Continent, many Germans would have been influenced by more than one of these factors, including economic considerations in most instances.

Victorian Settlement

Soon after the founding of Melbourne, German settlers began to make their homes in the Port Phillip District (see Figure 1). Many of the migrants were integrated into the local business and farming communities and early suburbs of Melbourne like Northcote, Brunswick, Collingwood, Richmond, Hawthorn and Kew had substantial numbers of German-born residents. Other migrants, however, congregated to form German settlements. In 1849 a German community was established near Geelong. It was initially known as Germanstown but was renamed Grovedale during World War I. By 1850 Lutherans from Mecklenburg, Saxony and Silesia were living around Thomastown, which was called in turn, Keelbundora, Dry Creek, New Mecklenburg, Germanstown and Westgarthtown, the latter after William Westgarth, its co-founder. The majority of the settlers were engaged in dairy farming together with some mixed farming. In the early 1850s German colonists, mostly from Silesia, bought land in the vicinity of Doncaster and established some of the first, and subsequently foremost, orchards in the area. The settlement was initially known as Bracken, later Walka and finally Doncaster. Another community grew up near Berwick at Harkaway. Lutheran settlements were established near Hamilton, in particular at Hocklith, now Tarrington, Tabor and Mt Rouse. Germans played an important role in the establishment of vineyards throughout the State. However, the greatest impact of the German pioneers was in the Wimmera and to a lesser extent in the Mallee, where substantial areas were developed by Germans re-locating from South Australia, from the Hamilton district and from the goldfields. One-third of the German settlers in Thomastown and substantial numbers in other parts of the State were Sorbs. These people of Slavic descent are from Lusatia, the south-east corner of reunified Germany.

Fig. 1. Map of Victoria showing locations of significant German settlement.

Prominent Citizens

Germans were among the prominent Victorians of the mid-nineteenth century. Wilhelm B Becker, who bought land in Collins Street in 1837 became the first banker, as agent for the Derwent Bank of Hobart Town, in 1838. He was also an early land speculator and a pioneer of the overseas shipping trade and may have named the suburb of Brunswick. Baron Ferdinand von Müller was appointed foundation government botanist in 1853 and director of the Botanical Gardens in 1857. He was a prolific collector, researcher and writer and was responsible, to a large degree, for the international recognition of Australian science. He is commemorated by a postage stamp issued in 1948 (Figure 2). Wilhelm Blandowski was a founder of the Geological Society of Victoria and, in 1854 as government zoologist, the first appointment made to the Museum of Natural History and subsequently its curator. This institution is now the Museum of Victoria. The report of the founding of the Geological Society of Victoria in the Argus of 4 October 1852 is noteworthy. It records,

some of the remarks of the gentlemen present were highly interesting and instructive, especially those used by a German named Blandowski.
The gold rushes more than doubled the number of Germans in Victoria and they represented the most numerous group of mainland Europeans on the goldfields. Dr. Georg Bruhn, a German physician turned gold prospector in 1851, undertook a mineral survey of the State in the early 1850s. It is likely that some of the State’s goldfields were located as a result of his collection of specimens and his observations. Zoologist Johann Kretschmann came to Australia in 1852 and spent five years working on the goldfields without success. He then joined Blundowki’s expedition to the lower Murray and Darling Rivers, making a rich collection of specimens. He worked for a time in the Victorian Museum collating them and eventually became curator of the Australian Museum in Sydney. The artist, explorer and naturalist, Ludwig Becker, recorded sketches of the diggings and meteorological data in Bendigo. Dr. Heinrich Backhaus of Paderborn was the first Catholic priest on the Victorian goldfields and a key figure in the development of the city of Bendigo. Archibald William and Jacob Getzschmann failed to make their fortunes at the Bendigo diggings but left their mark on the city as builders of many of the important and imposing public and private edifices. Jacob Baertel, a German civil and mining engineer, promoted the exploration of reefs at Ballarat and Bendigo, and his name is铭记 in the history of the goldfields. He later founded the Mining Institute of Victoria and undertook pioneering work on the gold fields of Gippsland. Friedrich vom Rath of Hannover was one of the key figures in the Ballarat Reform League and the Eureka Uprising in 1854. Initially, he was mistakenly supposed by the authorities to be the leader of the latter and a reward of £500 was offered for information leading to his capture, whereas the reward for Peter Lalor was only £200. Three Germans, Johann Hulse of Würtemberg, Prussian Eduard Thoenen and Wilhelm Emmernann of Hannover died defending the Eureka stockade. After a period on the goldfields, Georg Ulrich, one of Australia’s most distinguished geologists and a lecturer in mining at the University of Melbourne. Another German geologist, Gustav Thune, offered the first courses in geology and mining engineering at the Bendigo School of Mines and was instrumental in introducing steam-operated surface drills to the local mines.

Roles in the Community

Many lesser known Germans made important contributions to their new homeland, in particular to art and music, to agriculture, as in the opening up of the Wimmera, and to trades. An outstanding example of the latter is Hugo Wertheim, who came to Australia in 1875. He established himself as an importer of sewing machines but later founded a piano manufacturing works in Richmond in order to give his sons a more secure future. Wertheim became the most well-known brand name for locally produced pianos. However, of the better known Germans, it is the scientists who have won the greatest recognition for their contributions to the colony of Victoria.

As an illustration of the contributions of these scientists to the State, I will consider Neumayer in more detail. The geophysicist, astronomer and mariner, Georg von Neumayer, came to Australia in 1852 and spent a short period on the Bendigo goldfields. Here he was able to raise proudly above his tent the republican black, white and gold flag, magnetic survey of Bavaria and he recognised the potential for scientific investigations in Australia. Upon his return to Europe in 1854, he won the support of influential scholars, including Alexander von Humboldt, for his plans to undertake magnetic observations in Melbourne. With their endorsement, he was able to obtain financial backing from the Bavarian King Maximilian II. He arrived back in Melbourne in January 1857 and secured the buildings of the Signal Station on Flagstaff Hill for his observatory, which was housed in one of the old barracks. Neumayer continued his outstanding and multi-faceted scientific work in Germany, where he also published his Australian observations and measurements in four major works in English and countless smaller scientific papers.

Several learned societies were established in Victoria in the decade 1850-1860. These were both founded in 1854. With their amalgamation in 1855 the Philosophical Institute of Victoria became the Royal Society of Victoria in 1859. German scientists, Ludwig Becker, Wilhelm Blundowski, Ferdinand von Müller and Georg von Neumayer were prominent in their development and provided learned input. In material to the societies, Becker was elected a council member of the Philosophical Institute astronomy, meteorology, geology and zoology. He introduced discussions on importing new species and other useful animals to the Philosophical Institute in a meeting in 1856. He Society of Victoria, Blundowski, as one of eight founding council members of the Royal Society and, initially, the Philosophical Institute held their meetings at the Museum of Natural History, where he was curator. In 1856 he was appointed Honorary Secretary of the Society and later a life member. Müller, who had been a council member of both the Victorian Institute for the Advancement of Science and the Royal Society of Victoria, President in 1859. Neumayer was elected a councillor of the Royal Society of Victoria in 1859, its Vice-President in 1860 and a life member in 1864. That small number of the leading scientists of these learned societies included four Germans probably reflects not only the extraordinary talents of these men but also the thoroughness of nineteenth century German education and training. Their hallmarks were not just industry and thoroughness, but also the "all poppy syndrome", their Australian careers were marked by a number of poor interpersonal relations.
German-Australians established churches, clubs, schools, libraries, choirs and newspapers in their new homeland. The German club in Melbourne, the Deutscher Verein, not only organised cultural, sporting and social activities but also provided support and assistance for Germans in need. While in Melbourne, Neumayer was active in the German community, including accepting Chairmanship of the Deutscher Verein. In particular, he assisted Forty-eighters and, in turn, his landedmen helped to raise funds to erect his observatory in Ballarat, Bendigo and smaller towns, like Castlemaine, also had German clubs and Lutheran churches. By 1855 there were already two Lutheran schools, one in Germantown (Grovedale) and one in New Modelling ( Thomastown). In 1856 Karl Damm founded a Deutsches Gymnasium in Melbourne, where Neumayer gave lectures on astronomy and other sciences. Although it was short-lived, by 1900 there were ten German schools in Melbourne alone.

German newspapers were published, for example, the Melbourne Deutsche Zeitung. A key contributor to this aspect of German-Australian culture was Hermann Püttemann who was born in Elberfeld in 1811. He was well known in Germany as a writer and journalist by the time of the Revolution of 1848-1849. His progressive-minded writings necessitated his departure from his homeland. He spent a period in London as assistant librarian to Prince Albert at Buckingham Palace and eventually came to Australia in 1855. He settled in Melbourne and resumed a successful career as a writer and publisher. Other German-born journalists, like Gottlieb Schuler, wrote for the English-language press. Schuler, who was born in Wittenberg but educated in Bendigo, joined the staff of a local newspaper and became well-known as a mining reporter. In 1879 he moved to The Age where his journalistic success eventually led to his appointment as editor on 1 January 1900, a position he held until his death in 1926.

Germany was a major contributor to the World Exhibition of 1880 in Melbourne with 1,080 German firms participating; at the Melbourne Centenary Exhibition of 1888 Germany was the third largest exhibitor after Victoria and Great Britain. Johannes Lindt was the official photographer to the latter. Lindt, who was born in Frankfurt and came to Melbourne after leaving ship in Brisbane, established a studio in Collins Street. He won acclaim internationally for his society, theatre and landscape portraits and locally for recording on film the capture in 1880 of Ned Kelly.

German-Australian Relations

German-Australian relations were harmonious until the latter part of the nineteenth century. Most Germans were integrated into the predominantly British-Australian community and many were naturalised and had, thus, taken the oath of allegiance to the British crown. In 1894 Ballarat elected German-bom Johannes Heinz mayor; other fellow countrymen became members of parliament. After German unification in 1871 the Reich developed as a colonial power. The German Imperial Navy became a significant presence in the Pacific and in 1884 the Roht annexed part of New Guinea and occupied the Bismarck Archipelago. The disquiet of some Australians about these activities, about the Reich's increased promotion of Deutschlehm (i.e. the maintenance of German language and culture abroad) and about declining British-German relations, surfaced here as anti-German sentiment against even naturalised citizens of German background. The first major incident occurred in Bendigo at the time of the Boer War - a hostile demonstration took place outside the European Hotel

where the Bendigo Deutscher Verein had its headquarters and was holding a meeting. With the outbreak of World War I and Australia's participation in the war against Germany, many Germans were interned and naturalised and second-generation Australians of German descent experienced hostility, even though they avowed their loyalty to their new homeland.

A good illustration is the case of Otto Krome who was born in Hanover. He was already a distinguished educationalist, when he arrived in Victoria in 1890. Four years later he and Thomas Palmer leased property in Carlton, where they opened University High School, a private, co-educational secondary college. He was vice-principal from 1893-1897, then co-principal until 1901 and principal from 1902-1906, when he was appointed Headmaster of Methodist Ladies College. Krome was actively involved in the Schools' Association of Victoria and the Associated Independent Secondary Teachers of Victoria. Despite his achievements and high standing in the community, he was the victim of harassment during World War I, because of his German background. The intercession of colleagues failed to subdue the antagonism, which probably shortened Krome's life. He died in 1917.

"German" Place Names

Some suburbs of Melbourne were named by or after their German pioneers, as mentioned above for Thomastown, previously Germantown, and Doncaster, initially Brunswick (refer to Figure 1). Subsequently, their names were Anglicised, often about the time of World War I. However, there are still at least four suburbs with equivalents in Germany, namely Heidelberg, Coburg, Brunswick and Altona. I had envisaged that the formative years of these suburbs would have involved German pioneers. However, this is not necessarily the case. Richard Henry Browne is credited with christening the suburb of Heidelberg. He had been commissioned to sell then unamed land near the village of Warriangal. He seems to have been a larger-than-life character who was nicknamed Continental Browne for his overenthusiasm on the subject of his grand tour of Europe. He is reported to have stood in the midst of an admiring crowd on the land that was for sale near the Yarra and to have said the following or similar.

Do you not observe the silver thread of the river winding through the exquisite green valley? It reminds me so vividly of the gliding Neckar, and alas of scenes and friends, loved and lost. I can fancy that I look, at my ever-remembered, ever-regretted Heidelberg! These slopes rising from the further shore will be terraced with vineyards; and there, where you can faintly discern the snow pinnacle on your spur of the Australian Alps, I can imagine the grand outline of the Hartz Mountains. It is, it shall be, Heidelberg.

Needless to say, he was a good salesman.

Coburg was formerly called Pentridge. In 1867 local residents who objected to stating that they "lived in Pentridge" petitioned the government to rename their suburb in honour of Prince Alfred, Duke of Edinburgh, who was also Duke of Saxe-Coburg-Gotha. Consent was given and the name change became official in March 1870. Brunswick was already on electoral rolls by 1843, well before German immigrants had made any significant
contribution to the fledgling colony of Victoria. It is unclear whether it was named for Captain George Brunswick Synthe or the British royal family. It has been suggested that Wilhelm Rucker, the German land speculator, named his property Brunswick for Synthe who was in charge of military police in the Port Phillip district in 1839. Alternatively, the name Brunswick may have been chosen for the suburb in honour of either Princess Caroline of Brunswick, wife of King George IV, or Queen Victoria whose lineage included the appellation. The city of Altona52 derived its name from Robert William Wrede's property, which was earlier in the locality. Although Wrede was born in London, he had German connections and, possibly, his father, the merchant Herman Wrede, was German-born. It is understood that he called his residence after Altona at the mouth of the Elbe River in Germany, because of some topographical and geological similarity between the nameakes. This suburb of Hamburg might have been his ancestral home.

That Melbourne suburbs and streets bear names associated with both the British and German royal families serve to remind us of the close links between these royal houses. It was not uncommon in the nineteenth century for members of the British royal family visiting Australia and for vice-regal personages to address gatherings of German-Australians in German.

Two " Average" Families

In 1977, Geoffrey Blainey said.

In Australia we're still at the stage of describing the great man or the eccentric men, the great women or the eccentric women. The day will come, and it's not far distant, when histories of Australia will describe how the average Australian lived.53

In the spirit of Blainey's forecast, the final part of this paper is a detailed study of two ordinary families who are related by marriage.

The Moselle River, a tributary of the Rhine, meanders through a valley with steep, slate cliffs. The latter expose large surfaces to the relatively weak, northern sun, soaking up its warmth against the cool nights. This unique terrain makes the Moselle valley suitable for viniculture, despite its northerly latitude, and since Roman times it has been a wine-growing region.

The serpentines course of the Moselle River is dotted with little villages, which feature the local slate as a building material. The houses, from which members of the Berres and Barzen families migrated to Australia in the late 1800s, are little changed externally and often the same century later. The Berres family has had vineyards in the Ürzig since at least 152454 and the Bannerts of Reil have been connected with the wine industry for over five hundred years.

The villages, though separated by several sweeping meanders of the River Moselle, are relatively close by the land route. On 12 January 1892 Wilhelm Berres of Ürzig married Johanna Barzen of Reil. Following their wedding Wilhelm and Johanna (Figure 3) left for Genoa to board the Salter for Australia. Accompanying the young couple was Johanna's first cousin, Jacob Barzen, (Figure 4) also from Reil.

Johanna Berres, née Barzen, was not the only link between her husband, Wilhelm, and her cousin, Jacob Barzen. They also had in common their occupation - they were both vignerons - and the fact that they were younger sons of large families. Following the Napoleonic regulation of agricultural inheritance earlier in the nineteenth century, property used for primary production had had to pass intact to one child, generally a son, so that estates did not become uneconomically small. Other sons had to seek their livelihood elsewhere. Even after the Napoleonic code was supplanted with German law, the wisdom of this practice was recognized and it continued in the Barzen and Berres families. Both families were well endowed and provided capital to enable sons who were not heirs to build a new life outside their villages. Because it was a time of economic hardship in the Moselle Valley, it was necessary for them to leave the region and they decided that their prospects were better in "the new world" than elsewhere in Germany. One of Jacob Barzen's brothers had emigrated to America. Wilhelm Berres had had one of his older brothers settle in Russia and another one, Fritz, had gone to Australia several years earlier.

Correspondence from Fritz Berres apparently motivated Wilhelm and Johanna Berres to set sail for Melbourne. Jacob Barzen later said that it was not the lure of gold that drew them to Australia, but rather that they had heard that the climate was favorable to viniculture.

The Salter55, which brought the trio to the Fifth Continent, has an historic link with Australia. German colonies in the Pacific, like German New Guinea, were established with regular contact with the German government. It would not have been a paying proposition for German merchant ships to visit these colonies unless they also called at Australian ports. However, at this time German shipping lines regarded a steamer service to Australia as an uncertain business venture. In order to encourage them to sail the route, the German Government decided to provide a subsidised mail service to Australia. The service had the further, non-economic advantage of maintaining links with German expatriates in Australia and the potential to open up export and import trade between Germany and the Fifth Continent. On 14 July 1886 the Salter sailed from Bremerhaven as the first vessel on the scheduled postal run to Australia.

Upon arriving in their new homeland, the two young men bought land in north-eastern Victoria close to where Fritz Berres was residing at Numurkah (see Figure I). Wilhelm Berres established the Moselle Vineyard at Dunkeldclara near Katandra North and Jacob Barzen the Rhoen Vineyard at Cosgrove near Dookie. By mid-1895, three years and four months after his arrival, Wilhelm Berres had a large area of vines under cultivation and sought naturalisation in order to be eligible to obtain a Vigneron's Licence prior to harvest time.56 Jacob Barzen was naturalised the following year. The new colonists participated actively in the local community. Wilhelm became a director of the local Numurkah Winery Company Ltd in October 1893 He and Jacob Barzen had both been keen hunters in
Germany and by 1895 they had joined the local Cosgrove Gun Club.

Wilhelm and Johanna Berres only had one child, Gertie. When she was a young girl, she was playing in their garden and called out to her father, "Kätzchen, Kätzchen" - "Pussy, pussy" Wilhelm Berres, the consummate hunter, saw her indicating to an animal in the fork of a tree and reacted instinctively. It was not a cat; it must be a bear and he shot it. All too late he realised it was a koala.

Wilhelm Berres had just become well established in his new homeland when he died suddenly on 30 September 1905 aged thirty-nine years. He had been well known locally and "a large and representative number of citizens from all parts of the district" were present at his funeral. Although he had only been in the district for thirteen years, his obituary recorded that, "he was popular among all classes, and his loss will be deeply regretted."

His wife, Johanna Berres, sold the vineyard and took Gertie back to Germany to finish her schooling. After two years mother and daughter decided to return to Australia - Gertie was apparently keen to make her home "down under" and Johanna finally accepted a proposal of marriage, reportedly a marriage of convenience, from her cousin Jacob Barzen who had emigrated to Australia with her. The family lived on the Rhino Vineyard and was active in the local community. Johanna Berres, for instance, was involved in the St Mary's Catholic Parish at Dookie and Jacob Barzen was on the committee of the Dookie Agricultural Show and of the Mooroopna Hospital.

In 1926, he became a director of the Dookie co-operative store and a member of the Cosgrove Gun Club and the Dookie Rifle Club. In those days Cosgrove was a prosperous enough township to have a wine café, which served wine from the Rhino Vineyard.

After the phylloxera devastation in the early years of this century, the Rhino Vineyard was the only one of the over one hundred and fifty in the district still surviving. After being replanted with resistant American stock, it continued for a further half a century, producing up to 12,000 gallons of wine annually. The quality of Jacob Barzen's wines is indicated by awards received; for example, at the local Spring Show in 1905, his red wine in the section classified "suitable for export" was awarded first prize. He also won awards at the Royal Melbourne Show. Besides wine, Jacob Barzen produced currants. He had also planted fruit and nut trees and sold the harvest locally. However, despite the family's participation in the community, the Barzens experienced hostility from some neighbours during World War I. For many years the area had been plagued with rabbits and hares and this problem had actually motivated the local farmers to organise the Cosgrove Gun Club in the 1880s. When, during the war years, the Barzens found it necessary to shoot rabbits and hares, as was customary, neighbours surmised that they were training a militia and reported them to the authorities.

The director of the Dookie Agricultural College, Hugh Pye, intervened to remind locals of the significant contribution that the Barzens had made and continued to make in the district and that they were naturalised citizens. Pye had been a close friend of Baron Ferdinand von Müller. The friendship arose from Pye's interest in native grasses and other plants.

Several members of the next generation of the Barzen family emigrated from Reil to join their uncle Jacob and were employed, at least initially, on the Rhino Vineyard. Jacob Barzen, himself, was able to make a couple of trips home to Germany. His wife, Johanna, died in 1932 aged sixty-one years but right through to the 1960s the home, which they established in the midst of a typically Australian landscape, maintained elements of the "old world" and the "old century", including the hospitality. Jacob Barzen continued to work in the vineyard until he was ninety-seven years of age and, on Saturday, 8 September 1963, became Cosgrove's and the Goulburn Valley's first centenarian and the oldest German immigrant in Australia. Three hundred people packed the Dookie Hall to celebrate his one-hundredth birthday. He attributed his great age to coming from good stock, living in a wonderful country, hard work, receiving great care from his niece, also a Johann Berze, and much walking - "six miles a day if one wished to be really fit". He died a few months later on 3 February 1964.

His life and the short life of Wilhelm Berres exemplify the character traits of industry and accomplishment, frequently associated with Germans. The life of Fritz Berres, Wilhelm's brother, contrasts starkly with those of these vignerons. Fritz was the most artistic member of the Berres family and lived the bohemian lifestyle typical of artists of some means in the Victorian era. He came to Australia on the Caledonian, arriving in Melbourne on 1883, nine years before his brother. He married an Irish emigre, Lizzie Webb, and they moved about Victoria, and possibly New South Wales, as Fritz pursued a variety of occupations. During the period of his life in Australia he was a music teacher, a singing teacher, a musician, an artist, a language teacher, a tobacconist and a storekeeper. Of the five children born to Fritz and Lizzie Berres, only Hilda lived beyond infancy.

The Berres family resided for some years at Numurkah in the Goulburn Valley, where Fritz and his wife conducted two businesses. The establishment of Mrs F.A. Berres sold children's and ladies' clothes, hosery and millinery, drapery, fancy goods, glassware, jewellery and toys. The main business, F.A. Berres, stocked the corresponding men's lines, boots and shoes, books and stationery, tobacconist and sporting wares, guns, plush and leather goods, furniture, household items, a wide range of musical instruments and the "Best Assortment of Violin Material in the Goulburn Valley". This store also included a men's and ladies' hairdressing salon. In these days of late-night shopping, it is interesting to note that, because Mrs Berres' shop closed at 6 pm, a selection of her wares was also available at the main business for "late customers".

Like his brother, Fritz Berres involved himself in the life of the local community. He was a trustee of the Numurkah Athletic Park, a director of the Numurkah Winery Company Ltd and a member of the Numurkah Amateur Orchestral Society. In July 1891 he instigated 'Mr F.A. Berres' string band'. Fritz Berres was a talented artist and musician but he was not a businessman. In May 1894 his businesses were put into receivership to pay his creditors and he left the district to resume his profession as a singing and music teacher. His departure was regretted and The Numurkah Standard noted that...
he is extremely popular not only as a business man but also as an accomplished musician, who was always ready to give his services in the cause of any worthy object.

His popularity as a businessman in Numurkah is perhaps evidence of his generous nature but lack of business acumen. On other occasions Fritz’s brother Wilhelm financed him in ventures such as setting up as a tobacconist. Fritz Berres did not seek naturalisation until 1901, when he applied in order to be able to vote in the federal elections of that year.

A few years later Fritz Berres returned to Europe with his wife and daughter and participated in the family winery in Urzig. However, it seems that he made no more success at business there than in Australia and in the 1920s he was still living in Urzig but giving music lessons and painting the charming streetscapes and characteristic landscapes of the Moselle Valley. Examples of his work are still to be found in Urzig and in Melbourne. The family also lived in Surrey, England for some time and elsewhere on the Continent. Eventually they returned to Australia and father, mother and daughter, Hilda, who inherited her father’s artistic temperament and talent, spent their final years in Elsternwick, where they all died in the 1930s.

Concluding Remarks

This paper is a small expression of appreciation for the contribution that Germans have made to this State*. One of Australia’s most well-known soldiers also had a German background and this is an appropriate German connection, with which to conclude this paper initially presented at Monash University. General Sir John Monash was the son of merchant Louis Monash and his wife, Bertha, Jewish immigrants from Prussia. Louis Anglicized his name to Monash after he came to Melbourne. John Monash was raised bilingually by his parents and, like others recalled in this paper, he and his family were active in the city’s German-Australian social life.

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*Wilhelm and Johanna Berres were the great-grandparents of the author.

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CARL STREHLOW, ETHNOLOGIST

The Arunta and Aranda Tribes in Australian Ethnology

Walter F. Veit

Introduction

As an introduction to my topic proper, the hermeneutics of and relationship between missionary work and ethnography in Australia at the turn of the century, I wish to give a short outline of Carl Strehlow’s biography, which should indicate some of the questions to be asked and answers proposed later.

Before I begin, one other question of nomenclature should be settled, namely, the distinction between anthropology and ethnology. For this purpose I turn to A.C. Haddon’s History of Anthropology of 19101, which Carl Strehlow could have read. In the Introduction, Haddon mentions the differences in usage of the terms in England and on the Continent. He adopts a classification proposed by the Board of Studies in Anthropology, University of London, which distinguishes between Physical Anthropology referring to the zoological, palaeontological, physiological and physical characteristics of human beings, and Cultural Anthropology referring to the archaeological, technological, social, religious, linguistic and cultural phenomena of humanity. The latter is synonymous with Ethnology. It is with this meaning in mind that I call Carl Strehlow an ethnologist, the classification used in Germany today.

Biography

Carl Friedrich Theodor Strehlow, missionary, philologist and ethnologist, was born on 23 December, 1871 at Friedersdorf in the Uckermark at the northern border of Brandenburg province, Germany, the seventh child of Carl Strehlow, and his wife Friederike, née Schneider. His father was a teacher at a school belonging to the Free Lutheran Church, many of whose members chose to emigrate to America or Australia. It was formed when an association of Lutheran congregations had refused to join the United Church, a union of Lutheran and Calvinist Churches decreed to be the State Church in the Kingdom of Prussia in 1834.

Carl’s education began in the school of his father who at first opposed the boy’s wish to study for the priesthood. Eventually he relented and Carl first applied, although

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1 This paper is a revised version of a paper first presented to the interdisciplinary conference on Ludwig Leichhardt and the German contribution to the development of Australia’s science, exploration and the arts, at the University of New South Wales, March 24-27, 1988. In its original form it is printed in From Berlin to the Bourke’s. The German contribution to the development of Australian science, exploration and the arts. J. Tempe & D. Walker (eds.) (New South Wales University Press, Sydney, 1991) pp 108-134.
unsuccessfully, to the Leipzig missionary college. But on 1 August, 1888 he entered the college of the Free Church at Neuendettelsau, near Nürnberg in southern Germany, initially without the desire to become a missionary. Guided in his studies by the maxims of the founder of Neuendettelsau, Pastor Wilhelm Loebel, and the liberal theologian and philologist Dr. Johannes Deinzeer, the head of the seminary at the time, he graduated on 31 August, 1891 and was designated to become pastor of the Free Lutheran Church Protestant Church in America. However, on the request of the Immanuel Synod in South Australia, Carl Strehlow was sent to serve the German emigrants of the Free Lutheran Church in Australia. (Refer to Figure 1.)

He was ordained at Light Pass, a small township between Tamunda and Angaston, South Australia, on 3 July, 1892 and started his work as an assistant to Missionary J.G. Reuther of the Bethesda Mission, among the Dieri group of native Australians, at Killalpanina Mission Station in the Eyre region of South Australia. Mastering quickly the language of the Aborigines, with Reuther he translated the New Testament into the Dieri language. In September, 1894 the Immanuel Synod purchased the Fink River Mission Station at Hermannsburg from the Evangelical Lutheran Synod of Australia (ELSA) and appointed Carl Strehlow to head the Mission to the (Western-) Aranda and Lorija (Rukujia) tribes of Central Australia. On 12 October, 1894, he took charge of the Mission, founded by the pioneer missionaries F.W. Schwarz, H. Kempe and L.G. Scholle of the Hermannsburg Mission College in Lower Saxony, Germany, a friendly rival of the Neuendettelsau Mission Seminary. Except for travels among the Aborigines as far as Alice Springs, Strehlow left the station only four times during his 28 years of service. At the end of July, 1895 he went to Adelaide to marry his German fiancée Frieda Keyßer, at Point Pass, 14 km north of Euandera, South Australia, on 25 September.

So far, reliable basic information about Frieda - and by extension, also about her husband Carl Strehlow and their children - comes from the Register of German Nobility. Frieda, originally Friederike Keyßer, was born into a minor German noble family - with an attractive coat-of-arms - which is registered in Geroldsgrund, situated in Upper Franconia wedged between the borders of Thuringia, Saxony and Bohemia.

The couple returned to the financially troubled Hermannsburg on 5 November to carry on with their godly work on a very meagre salary which continued to be subsidised by the Strehlow family in Germany. From 3 June, 1903 to 4 June, 1904, Strehlow took his wife and four children, Friedrich, Martha, Karl and Rudolf, on recreation leave to Adelaide. After two more children, Herman and Theodore, were born, the whole family went on sabbatical leave to Germany from June, 1910 to 6 April, 1912.

Although Carl Strehlow had become a South Australian citizen shortly after his arrival in Australia, and an Australian citizen after Federation in 1901, during World War I he was investigated, like many other German immigrants, by the Office of the Administrator of the Northern Territory as a

German sympathiser on allegations of lecturing to aborigines regarding the present crisis on the European Continent.

The charge was dismissed, and Strehlow remained at Hermannsburg where he was considered to be

tirely devoted to his work and with no dangerous sentiments. Certainly (he) could do no harm where he is.²

Photographs depict Strehlow as having a stoic and strong physique, but his health began to fail under the strain of his relentless working schedule which included not only his pastoral and teaching duties but also the education of his children and the management of the mission farm. In his remarkable account of the last days of his father's life, Ted Strehlow has painted in Journey to Horsehoe Bend a vivid picture of life and work at Hermannsburg. Carl Strehlow's hours of rest were devoted to intensive linguistic and ethnological field work among the tribes in his care and the preparation of the results for publication in Germany. Finally, his health broke down. On 10 October, 1922 Strehlow left Hermannsburg for Adelaide, for urgent medical treatment of dropy. On this journey, he died of heart and kidney failure on 20 October at Horsehoe Bend and was buried there the next day. In her recent biography of F.W. Albrecht, Barbara Henson has described how Strehlow's work was carried on at Hermannsburg.³

Carl Strehlow's widow Frieda and son Ted continued their journey to Adelaide. After Ted had completed his education, Frieda left Australia in 1931 to join her other children in Germany. She died there in 1957. She is said to have left an extensive diary which, sadly, I have not been able to peruse.

The development of Carl Strehlow⁶ from missionary to ethnologist is typical for many German missionaries since the early 19th century. Over the years, he had not only been a protector of the Aborigines against unsympathetic white squatters and policemen, but also a voice in the wilderness proclaiming the spiritual culture of the indigenous peoples. Recognising the need first to understand the culture of those to whom he wished to bring his own, he grew from Lutheran preacher into one of the great Australian philologists of Aboriginal languages and one of the most important ethnologists in the tradition of the continental European schools and an authority on the Aborigines of Central Australia, to whom he had become the Ingezat, their trusted spiritual leader and teacher. As an ethnologist he was fully recognized only outside Australia. In addition to the Dieri language, he acquired fluency in the cognate Aranda and Lorija languages and started an Aranda dictionary. In 1891 he published an instruction booklet for Christians at Mootna; 1904, an Aranda school primer with translations of church hymns by his assistant H.A. Heinrich; about 1920, another textbook for teaching purposes. Finally, in 1919, he completed a translation of extracts from the Old Testament for children into Aranda, which was published posthumously in 1928.
However, Strehlow’s greatest achievement is his work on the myths, legends, material culture and customs of the Aranda and Loritja, in seven volumes edited first by Moritz von Leouchardt and then by Bernhard Hagen and published from 1907 to 1920 by the Stadisches Völker-Museum of Frankfurt, Germany (listed in ref. 9). Published letters to von Leouchardt had already caused a stir in ethnological circles in Europe which had split over the question of spirituality in Aboriginal civilization and whether it was important for the researcher to speak native languages. Strehlow’s research on totemism was accepted and used at the time by almost all continental European scholars like Durkheim, W. Schmidt, Malinowski, Freud, Rabelin and, more recently, E.A. Worms, Lommel, Petri and Eliake, while British social anthropologists, led by James Frazer, put their trust in Baldwin W. Spencer, the first Professor of Biology at the University of Melbourne and his collaborator Francis J. Gillen. Spencer did not consider the linguistically superior missionary Strehlow a reliable scientist and caused James Frazer to expunge any reference to Strehlow in the *Golden Bough* (see Ref. 16). The biography of Spencer by J.J. Mulvaney and J.H. Calaby is the first Australian publication which deals adequately with the conflict between Baldwin and Strehlow, who, it seems, never wrote to each other and certainly never met, and acknowledges Strehlow’s significant studies of Aranda religion, the only other major anthropology of this area.

(Ref. 10, p 124)

Charles Chwings translated *Die Aranda- und Loritja-Stämme in Zentral-Australien* into English later in his life. It remained incomplete and unpublished, available only in manuscript form in the library of the University of Adelaide. Recently, H. Oberschlicht, pastor and missionary at Hermannsburg till 1990, has finished his new and complete scholarly translation. This translation is still in manuscript form with the Strehlow-Foundation in Alice Springs, awaiting publication.

This is as much as can be gleaned from published sources. The need for archival research here and overseas is obvious. The chronology of Carl Strehlow’s life is only the time frame in which a forceful and dedicated missionary from Germany developed into one of the most successful, though controversial, ethnologists of Australia. But his work is still to be discovered by modern Australian anthropologists and phenomenologists of religion. The overbearing influence of Baldwin Spencer and his group of social anthropologists, still felt in this country today, has cast a silence over it, from which his stature as a researcher has still to emerge. Today, Australian anthropology has almost forgotten one of its greatest scholars and his work which is still one of the best sources for reliable recordings of Aboriginal myths and legends and the Aranda and Loritja languages.

Apart from *Journey to Horseshoe Bend* (1969) (Ref. 7), a moving monument set by Theodor G.H. Strehlow to the memory of his father, no adequate biography of Carl Strehlow or evaluation of his work has been attempted to date. One of the major problems in this respect is, as mentioned earlier, the inaccessibility of family sources.

My study of Carl Strehlow is concerned with his missionary, linguistic and ethnological work only so far as it is the material for my investigation of the "mental luggroge" (B. Smith), i.e., the cognitive conditions under which Strehlow and other early Australian missionaries saw and reported back to Germany, their findings on Australia and the Australian indigenous peoples.

**Australian Mythology and Ethnology**

My interest in Australian Aboriginal myths had led me to search for acceptable scholarly collections of myths and legends of the Australian Aborigines* in English translation, which could be used for comparative studies. The best example for what I have in mind is Ronald M. Berndt’s philologically fully documented *Djangawul Song Cycle*, published in 1992 and at present a much sought-after title in antiquarian bookshops. Similarly, Charles P. Mountford’s *Nomads of the Australian Desert* of 1976 and T.H.G. Strehlow’s *Songs of Central Australia* of 1971 have vanished - like all their other works - for one reason or another into the rare book rooms of our libraries.

There existed a number of smaller collections in the past, e.g., Katherine Langloh-Parker’s *Australian Legendary Tales*, first published in 1896 and reprinted several times, but for a long time no suitable collection was in print. The texts edited by A.W. Reed in his numerous publications, are popular renderings of little scholarly value.

However, there are at least three good collections available in German, one, *Märchen aus Australien*, in the highly respected series of the Eugen Diederichs Verlag *Die Märchen der Weltliteratur*, the others as paperbacks with such enticing titles as *Wie das Känguru seinen Schwanz bekam* or *Der Tanz der Vögel*. But quite recently Ronald M. Berndt and Catherine H. Berndt have published a part of their own collection of Aboriginal tales from their main areas of research in northern West Australia, Arnhem Land, and south-western South Australia under the felicitous title *The Speaking Land. Myth and Story in Aboriginal Australia* - but excluding secret myths.

It was in the German publications that I first met the name of Carl Strehlow, but it was necessary to return to Germany in order to find a complete copy of his seven-part work, *Die Aranda- und Loritja-Stämme in Zentral-Australien*. It does not take a professional anthropologist or ethnologist to realize that this is one of the best scholarly collections of Australian myths and legends even if they come from a very confined area in Central Australia. But for Theodor (Ted) G.H. Strehlow’s writings, nobody would know that Carl Strehlow, his father, ever existed. It was this silence about Carl Strehlow in Australian anthropology that made me look further into his work and the circumstances of his life and activities in Australia. That he was a missionary at Hermannsburg, some hundred and thirty kilometres south-west of Alice Springs (see Figure 1) can be gleaned from the title page of his published books. But all further curiosity is quickly disappointed. There is no entry under his name in the old *Australian Dictionary of Biography* or any other edition of the *Australian Encyclopaedia*. The volume of the new *Australian Dictionary of Biography* containing my entry for Carl Strehlow has been published only recently. In *Johannes Stoker* belated obituary, tucked away in *Auricht’s Almanac* of 1922, I found the first mention of his date of place of birth. The biographical details in publications dealing with missionary work of the Lutheran Church in South Australia or the Northern Territory, such as

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*For details of collections mentioned here, see Ref. 12.*
Everard Leske's Hermannsburg or Ward McNally's short biography of T.G.H. Strehlow, Aborigines, Artefacts and Anguish are completely unsatisfactory. Even in the writings of his son, Ted Strehlow, dealing especially with his father's life and work, such as his Journey to Horseshoe Bend or the introduction to Songs of Central Australia, exact details are rare. All of these are unsatisfactory, too, because they are not interested in the intellectual formation of this man who was to become one of the most important figures in Australian and German anthropology and ethnology and who - for the better part of his work at Hermannsburg - was right in the eye of a fierce storm raised by the gods of anthropology at the time.

In my opinion Carl Strehlow and his work became the victims of a conflict in European anthropology, which arose long before 1900, over several controversial issues concerning the original inhabitants of Australia, such as their place in the evolution of humanity, their religion, their language and their social organization. It is my contention that it was precisely the information contained in Strehlow's letters and publications which brought the controversy between the representatives of the different paradigms in anthropology to a head. Unwittingly, he had tipped off the avalanche of social anthropology in the English-speaking world which engulfed and buried in all matters Australian, the older, historically oriented anthropology of religion, as practised in France and Germany. For better or for worse, Carl Strehlow continued to work in a paradigm of theory and methodology of ethnology which had been part and parcel of his training as a missionary. He continued the postulates that the researcher be familiar with his flock and walk among the natives as a human being among other human beings who had souls, religion and language. At the same time, Baldwin Walter Spencer and a World War secured the dominance of the new "scientific" paradigm of social anthropology and empirical field studies. It is most ironic that the very time when the new social anthropology reclassified the place of the Australian aborigines on the ladder of evolution according to their Darwinist theory, from "noble savage" to "primitive," Carl Strehlow recorded, translated and published the myths of the Western Aranda and Lortji around Hermannsburg and described the extreme complexity of their religious belief system.

I am very much aware of the importance of the question of colonialism in a discussion of ethnological work carried out by scientists and missionaries alike. Publications like Imperialismus und Kolonialmission with regard to the German involvement particularly in Africa, and Arne A. Kotschou's Missionary Influence as a political factor in the Pacific islands, demonstrate this very strikingly. There cannot be any doubt that European colonialist ideologies have played a considerable role in shaping anthropological and ethnological theory and therefore ethnographic and anthropological results. Although both cannot be separated, the political parameters should be the subject of a fuller investigation than possible in this paper.

*Stolz gives a reconstruction of the events leading up to Strehlow's death in 1922. It should probably be read in defense of the role played by Pastor Johan Julius Stolz and the administration of the Lutheran Church of Australia with regard to the failed rescue mission of which Ted Strehlow was very critical in Journey to Horseshoe Bend. There is a critical reply to Scherer by Pastor Johan Sebel, "Damned with faint praise" in Forums 69 (1974) which I did not see. See also the assessment of the controversy by Ward McNally, Ref. 2 pp 156/7.

As we shall see in more detail later, in Australian ethnographic literature, Carl Strehlow merits a mention only in the rarest of cases. He has no place in H.R. Hay's 1938 survey of Australian anthropology, A.P. Elkin, in his authoritative survey given during the all important research conference in Canberra in 1961, which had brought together almost all important researchers in Aboriginal anthropology including Ted Strehlow, demonstrates the general ignorance of Strehlow's work when he writes:

To this phase (of fortuitous, individual field projects), too, belongs Pater (sic) C. Strehlow, a missionary at Hermannsburg among the Western Aranda and neighbouring Lortji groups from 1892 to 1902 (sic), who published a series of articles (sic) in German, recording the mythology, folklore and social organization of the tribes between 1910 (sic) and 1922. His material complements Spencer and Gillen's work on the Central and Eastern Aranda (Arunta).

(See Stöld ed., p 13)

In the same volume, Carl Strehlow is mentioned once more by Catherine H. Berndt in her contribution on Art and Aesthetic Expression. But his work is not mentioned. In the same publication by F.D. McCarthy (Ecology, Equipment, Economy and Trade), S.A. Wurm (Aboriginal Languages), A. Barnes and M.J. Meggitt (Social Organization), or, of course (sic) A.E. Worms (Religion), and in the index he is confused with Ted Strehlow.

Yet, there are improvements. In the 1988 survey of Australian anthropology by D.J. Mulvaney, we are told that Strehlow commenced his studies of Aranda religion in 1901, although the first volume was published in 1907.

(Ref. 14, p 201)

This puts a new perspective on the silent relationship between Strehlow and Spencer. Further historical research, into what Strehlow read and studied in matters ethnographic in preparation for his research, should clear up the present uncertainty and recover important ethnological work for the history of science in Australia.

The Great Silence

The silence was preceded by a worldwide "ethnological controversy" - already so called by A.H. Haddon in his brief reaction to von Leopold's extracts from Strehlow's letters in Globus which was published in Nature and Carl Strehlow was in the center of it although he may not have been aware of all its facets at the time. As we shall see later, it is not completely clear who started it all. But the two opposing groups were established very quickly. In fact, they existed before "the outbreak of hostilities" in Europe. It is a confrontation between the mythologists and proto-neuroscientists of religion on the one side and the empirical social anthropologists on the other. Carl Strehlow, the missionary-ethnologist, became the representative of the first group, Baldwin Spencer, the young Oxford scholar of biology, whom Melbourne University Council appointed to the first professorship in biology in 1887 and who continued to become Australia's first academic social anthropologist and, in 1899, the director of the National Museum of Victoria, the representative of the other.
John Mulvaney and J.H. Calaby, in their judicious biography of Baldwin Spencer So much that is new have carefully reconstructed the main lines of the battle that erupted in 1903 over the letters Strethlow had sent to von Leonhardi who in turn had sent extracts plus commentaries to Andrew Lang at St. Andrews and, as mentioned before, published them in 1907 in Global. The question was whether the "Amanda", as Spencer and his collaborator Gillen used to call the group of tribes they studied in Central Australia, had the notion (as Strethlow wrote) of an "Amanda High God or supreme being, Altjiya," (Ref. 10, p 392) as described by Strethlow in his letters and later in his published works albeit in a modified form. Strethlow's observations ran counter to descriptions given by Spencer and Gillen in their previously published works. Mulvaney points out (p 393) that Spencer then embarked on a campaign to discredit Strethlow;

he countered all Strethlow's data with an unfair assertion that his unreliable informants conflated Christian doctrine and tribal tradition. Because he believed that Strethlow simply wanted to discredit Gillen and himself, in turn disparaged Strethlow's work so effectively, with Frazer at least, that Frazer omitted all reference to him in his major revision of totemism. They had never met. Possibly if they had done so, Strethlow's sincerity would have convinced Spencer. His heavy-handed treatment of Strethlow was a character flaw which cannot be excused, but it may be understood in context.

Mulvaney and Calaby maintain that (p 393)

Strethlow was virtually a pawn in an international debate over religious origins.

Strangely enough, the two protagonists not only never met but they also seem never to have corresponded. Whether and in how much detail Strethlow and Spencer were aware of each other's writings can be decided only after an inspection of the relevant footnotes in Strethlow's manuscript of the Ananda- und Loita-Stämme, and of the original Strethlow letters to von Leonhardi and read in excerpts translated by A. Lang in 1901 as well as by Spencer, according to Mulvaney on, 1 December, 1903.

Spencer's criticisms concerning Carl Strethlow's methods and ethnographic findings are re-assessed in Ted Strethlow's Songs and mostly refuted without endorsing all of Carl's data. Leaving aside all aspersions on the genuineness and reliability of the informants on both sides, it comes down to a very simple, albeit surprising, fact:

Spencer and Gillen, who have given us so many excellent pages of description of various festival rites, were forced by their ignorance of the aboriginal languages to omit the texts of the songs sung on these occasions. This was obviously very unsatisfactory. ... Strethlow, on the other hand, was handicapped by the fact that he had never been an eye-witness of any of the sacred ceremonies. His view was that his missionary status prevented his appearance at all pagan rites. Hence his descriptions of the totemic ceremonies, for instance, had to be based purely on hearsay, and are therefore not very satisfactory.

(Ref. 12, 1976, 1, pp xv-xvi)

The battle line is, therefore, to be drawn not so much between the missionary and the atheist, the empirical field worker and some mischievous opinionated social theorists (who) all claim adherence to scientific methodology, but without exception ... seem to have formulated sweeping and all-inclusive explanations and then plundered ethnography to support their views.

(Ref. 10, p 329)

like Andrew Lang whom Mulvaney and Calaby view as the villain in the whole affair. Rather, it should be drawn between the empirical scientist and the philologist, or phenomenologist of religion and mythologist for whom a Darwinist had neither understanding nor regard.

It is not surprising that at the beginning of the twentieth century the empirical scientist should have won out. It nevertheless remains a mystery how James Frazer was capable of eliminating Strethlow not only from his book on totemism but even from the bibliography of the Golden Bough, although much of the information on myths and legends seems to have come from Strethlow's investigations.16

Australian Anthropology at the Turn of the Century

Before we look at another example of the progressive silencing of Carl Strethlow, we should assess the scholarly context of the whole controversy. A selective survey of the context shows how much Australia and the Australian Aborigines were at the centre of attention in Europe between 1880 and 1930.

The golden chain of important publications on the Australian Aborigines constantly to be quoted in the next half century began in 1878 with R.B. Smyth's two volumes of The Aborigines of Victoria, J. Dawson's The Australian Aborigines in 1881, and Edwin M. Curr's The Australian Race in 1886/7. While these were published in Melbourne, the following works were mostly published in Europe. In 1887, Andrew Lang forged the next link with his two volumes of Myths, Ritual and Religion before James Frazer's first instalment of the Golden Bough. A Study in Magic and Religion, (the two volumes of 1890 were to grow to thirteen by 1936), and K. Langhoh Parker's first collection of Australian Legendary Tales in 1896. Baldwin Spencer was the next with his compilation of the Report on the work of the Horn scientific expedition to Central Australia in four volumes in 1896, followed in 1898 by Andrew Lang's The Making of Religion and in 1899 by J. Mathew's study - quoted by Carl Strethlow - Eaglehawk and Crow: a study of the Australian Aborigines including an inquiry into their origin and a survey of Australian languages. In 1899 appeared also the first edition of the works of R.H. Mathew's findings, provoking an immediate reaction by all involved. It becomes clear that this small band of Australian ethnographers, i.e., Howitt, Fison, Roth, Gillen and with James Frazer on their side (WF), were drawn together
in self-defence against overseas criticism.

Rightly or wrongly, R.H. Mathews was the first victim of the controversy - Strelof was to be the next. But before that, Spencer and Gillen published The Northern Tribes of Central Australia in 1904. In the same year appeared A.W. Howitt's The native tribes of south east Australia followed in 1905 by K. Langlois-Parker's The Ewahlay tribe: a study of Aboriginal life in Australia.

But the hidden agenda is the battle between Spencer and Lang, and the battle ground is the fascinating problem of totemism or the origin of religion. The fight heated up with another controversial book of Andrew Lang's in 1905: The Secret of the Totem. Lang received support from A. van Gennep who published in 1906 his Mythes et Icônes d'Australie. It is this somewhat exited atmosphere which can still be felt in the reviews and letters published at that time in the English ethnological journals Folk-Lore and Man. In 1906 N.W. Thomas published his two books, The Native Races of the British Empire. Natives of Australia and Kinship Organisations and Group Marriage in Australia; in 1907 von Leonhardt began to edit the first two volumes of Carl Strelof's Die Aranda- and Luritja-Stämme which now became the focus of (and in the following volumes accompanied) the controversy beyond 1929, the year of Spencer's death.

On the one side, Andrew Lang's criticism of Darwinist positivism and of the school of the Anglo-German orientalist Max Müller, was taken up and developed further in continuation of German Romantic philosophy of religion by the Mechtlichist father and founder of the Viennese school, anthropology, (Pater) Wilhelm Schmidt (SVD) in his books L'Origine de l'Idée de Dieu (first published in French 1910 and then in 12 vols. in German 1912-30. Grundriss einer Vergleichung der Religions- und Mythologien der Austronesischen Völker (1910) and Die Mythologie der austronesischen Völker (1910). On the other side, as already mentioned, James Frazier expounded on Spencer's advice any reference to Strelof in his 1910 Totemism and exogamy. The title already indicated the perspective of the study. Spencer and Gillen on their part responded in 1912 with Across Australia and in 1914 with Spencer's The native tribes of the Northern Territory of Australia.

In the flurry of publications the first full-scale book in German by a medically trained anthropologist, Erhard Eblmann's Die Eingeborenen der Kolonie Südaustralien, which is satirically critical of the mission establishment at Hermannsburg, appeared in 1906 in Berlin and was hardly noticed. But it is easily overlooked that there appeared during these years the first important works of three eminent European scholars on the same topic, all heavily based on information gathered by Carl Strehlow: 1912, Emil Durkheim's Les formes élémentaires de la vie religieuse: le système totemique en Australie, translated into English in 1915, Sigmund Freud's Totem and Tabu in 1912/13, translated 1919; and B. Malinowski's The Family among the Australian Aborigines in 1913. These together with other works of Durkheim, set the new tone and indicated the new directions. The old empirical positivism and Darwinism to which anthropology owes so much, was to be replaced by a new interpretative sociology and a renewed phenomenology of religion. L. Ehrlich followed Schmidt in his 1922 Origine of Australian Beliefs. Freud was taken up by Geza Roheim in Australian totemism: a psycho-analytic study in anthropology (1923) and in Malinowski's Myth in primitive psychology (1926).

In the meantime in Australia, Herbert Basedow asserted his position between the front lines in his book The Australian Aboriginal. (1925) - introducing a conciliatory spelling of the name of the tribes in concession: Aranda - before the purging shots were fired by Spencer and Gillen in their massive summa The Arunta. A study of some age people (1927) in which two Appendices (C and D) are devoted to settle old scores on the illicit issues of 'The Churinga Belief' and 'The Alchian Belief and Traditions;' and by Spencer's two volumes of Wandering in Wild Australia of 1928.

The Paradigmatic Change in Australian Anthropology

In a sense, anthropology and ethnology had moved on even before the death of Baldwin Spencer not only with regard to methodology but also in their preferred areas of field studies. It seems that for the next twenty to thirty years field work was left again to the missionaries before the advent on the Australian scene of scholars like Radcliffe-Brown, Elkin, Stanner, Lommel, Perri, Hiatt and, of course, T.G.H. Strehlow. Going through the bibliographies of books written by Australian anthropologists, it becomes quite clear that Carl Strehlow is today little more than a name. As clearly documented also in W.E. Miller's Geschichte der Anthropologie (1984) the controversy and the protagonists have withdrawn from living memory into histories of the discipline. So much so that in the index to Australian Aboriginal Mythology, too, Carl Strehlow is given an entry under T.G.H. Strehlow. Given that in the meantime Charles Chiewings, station owner, amateur geologist and gentleman scholar in the MacDonald-Ranges, has translated most of Die Aranda- and Luritja-Stämme in Central-Australien into English, it is obvious that this suppression is not just due to the monolingual education in Australia which made this an arcane work.

But beyond all elements of personal rancour and deviousness, the silence indicates a major rift in theory and methodology between the British and Continental schools of ethnography, as mentioned before. The power of the paradigmatic change was such that in 1961, when A.P. Elkin gave his survey of the "Development of Scientific Knowledge of the Aborigines" Australian anthropologists were not even conscious of the shift having occurred. Elkin distinguishes four distinct, though overlapping, phases: 1. a phase of incidental ethnography [1770-1870]; 2. a compiling and collating phase [1870-1900]; 3. a phase of forthcoming, individual field projects [1897-1926]; and 4. a phase of organized, systematic research [1926 ff.] The recommendations from the 1961 conference on urgent further research in Aboriginal studies do not mention the necessity of historical studies at all. There is no hint that "organized, systematic research" could have taken place in other systems, e.g., the missionary system, but in the universities or other state-funded research institutes. It was left to Catherine H. Berndt to suggest at least "indirect" implications of anthropological studies (by missionaries [WAV]) for an Australian identity in the present. (See H. Shells ed.), Ref. 14 p 257.)

However, there is also the influence of at least one other much neglected element in scientific work: the cognitive power of social factors in academia, the formation of groups

*In regards to Charles Chiewings see the entry in the Australian Dictionary of Biography vol 7, pp 634-35.
and schools. How much the group formation had worked to the detriment of Carl Streilow can be seen in the relevant entries in the authoritative *Encyclopedia of Religion and Ethics* (ER8, covering almost exactly the time of our concern.

The article "Alcheringa" by N.W. Thomas in vol. 1, p 298 (1908) is based only on Spencer & Gillen, van Genep and Durkheim without any reference to Carl Streilow or Andrew Lang, for that matter. This is particularly serious because Thomas introduces the term "Dream-Times" as translation of Alcheringa into the ERE in spite of the philological objections to the concept raised by Carl Streilow already in his 1905 letter to Thomas (Ref. 17, vol. xxi) and the first volume of *Die Annalen- and Lortie-Stilme*. In vol. 1, pp 989-981 (1909) of the ERE, Andrew Lang took great delight in remediating the situation by introducing Carl Streilow's findings and the contentious issue of the "All-Father" in the article "Bull-Roarer," pushing his own barrel at the same time.

The next articles of any interest here are E. Sidney Hartland's "Totemism" and N.W. Thomas's "Transmigration" in vol. 12 of 1921. Thomas makes extensive use of Streilow's findings, quoting directly from vol. 1 in criticism of Spencer's position, while Hartland, writing on the much more important issue, did not even want to know the name Streilow and in the bibliography, produces the interesting statement: "Works in German are numerous, but of less importance." He gave expression to a new perspective was to remain dominant for the next decades. That perspective of British empirical social anthropologists took no cognizance of the growing interest in myth and the "Sacred." Therefore they found no use for Carl Streilow's work while it lives on in writers like W. Schindel, C.G. Jung, Rudolf Otto, Friedrich Ebeling, van der Luit, Mircea Eliade, Walter F. Otto, Karl Kerenyi and a host of others writing from the beginning of the century.18

The Missionary-Ethnologist

It is obvious that there remains much to be done with regard to the more biographical data of Carl Streilow's life and also to the research context of his work. Even the suspicion surrounding the authenticity of his work has to be laid to rest - the "Spencer's star" as Ted Streilow has called it. (See Ref. 12, Songs, xxii). But in spite of the son's assurance that a comparison of the manuscript, which I assume to have survived but have not been able to pursue, confirms von Leonhardi's assurance given in his Introduction to volumes I and II, (Ref. 9, 1907 and 1909) that - in Ted Streilow's words

... in the printed volume C. Streilow's own text has been presented, with only very occasional minor errors.

In fact, von Leonhardi, knowing full well the territory of research to be a mine-field of scholarly contentions, hence his many letters to Streilow requesting verification and clarification, could have averted the whole controversy by refusing to print the word "God" in a work on Australian ethnology. But Spencer's claim in *The Arunta* (vol. 2, p 589) that it was actually written by von Leonhardi and based on Streilow's notes is - albeit in a more cautious form - reinterpreted by Spencer's biographers:

*It (Streilow's vol. I) was much expanded and edited by von Leonhardi. Because Streilow's original draft was roughly expressed, Spencer expected the editing to prove 'rather free'*. (Ref. 10, p 394)

Nothing of the sort can be read out of the editor's words in the Vorwort to Volume I.*

There is however, in my opinion, much more important research to be conducted into an area which is almost completely neglected, not only with regard to Carl Streilow. It is something I wish to pursue more vigorously in the future when I shall have access to essential archival material. I am talking of the hermeneutic conditions of Streilow's research and the horizon of expectation which surrounds it. In the absence of an autobiography or a biography interested in these aspects, these cognitive parameters of his work can only be established through documented evidence about his education, both in secular and ecclesiastical matters. It boils down to the questions: how were the future missionaries prepared for anthropological and ethnological work? What are the instructions they received? Every history of anthropology, every history of journeys of discovery and exploration at least mentions the work of missionaries. Obviously, some missionaries held that the work in anthropology was already done before the advent of the professional ethnologist. One could refer here to the instruction issued to L.B. Threlkeld by the London Missionary Society in 182519. But then where are such instructions to be found which might have been issued to Carl Streilow? So far, bibliographical research has turned up very little useful material for the period in question, at least with regard to missionaries of the Lutheran Church. However, some pertinent information, albeit of much more recent provenance, was obtained from interested and knowledgeable churchmen. I propose to look in further research at these instructions for bibliographical accounts by missionaries, in order to identify the guiding cognitive topos of their research and thus come to a better understanding and appreciation of their findings and achievements.

Such topoi - which may guide directly or indirectly, specific research methodologies but, above all, our attitudes and approaches towards our research objects in a principled fashion - appear already, as expected, in Spencer's criticism of Streilow's approach. Speaking in modern hermeneutical terms, Spencer saw the work as being fundamentally flawed because he was a missionary while he himself laid claim to truth as a scientist. My argument is that the change in paradigm is based on a change in the content of the dominant topos19.

*When publishing the manuscripts entrusted to me, I have essentially restricted myself to editorial work. I have not made any changes in substance; only in places where the meaning was not completely clear or where the matter did not seem to be sufficiently researched, have I written (to Streilow) and asked for further checking and correction. I have then inserted the answers received in the appropriate places. I intend to proceed with the subsequent parts of the manuscript according to the principles. Only such a procedure seems to me to be justified. Only that should be put before the scientific world which Mr. Streilow believes to be factual, and only in that form in which he deems them to be correctly presented. It is for that reason that I have retained all those terms chosen by the author, such as god, goddess, totem-ancestor, cult-ruler, etc. I am fully conscious of the fact that one could prefer other terms according to one's scientific point of view, and in one or the other case I would perhaps express myself differently. But I also believe that the text makes its meaning sufficiently clear, and I leave it to future scientific discussions to determine, how the observed facts and described ideas have to be interpreted and correctly named. (Trans. by WV from ref. 9, vol. 1 pp 1-2)*
Language

At the heart of the dispute between Spencer and Strehlow is the question whether an intimate knowledge of the language of the Australian natives under investigation was necessary or not for anthropological research. It is certainly a question with regard to the accurate gathering of information in the field. It must have been particularly galling to Spencer to find his observations challenged on the grounds of philological and linguistic facts inaccessible to him.

At the very centre of native mythology, the fabled "Dream-Time" is a case in point. I have already mentioned that N.W. Thomas in his ERE article Alcheringa (in Ref. 18, Vol. 1 p 298) called on his authority:

According to Spencer-Gillen the word alcheri means 'dream' and alcheringa is equivalent to 'dream-times'.

The Northern Tribes of Central Australia was published in 1904. There is, however, in Folk-Lore xvi (pp 428-433) a communication "Religious Ideas of the Arunta" which N.W. Thomas had read in a meeting of the Folklore Society on May 17, 1905 in the presence of Andrew Lang and A.C. Haddon. This paper is particularly important as Thomas publishes in it extracts from two letters (February 11 and August 3, 1905) received from Carl Strehlow. The second letter refers critically to Spencer and Gillen.

(They) assert that alcheri means dream, and alcheringa, the dream times; this is a mistake. Dream is ajirringa, a dreamer, ajirrarna; a dream 'time' is unknown to the blacks.

One wonders why N.W. Thomas suppressed this correction in his ERE article. In addition, there is among the papers of Spencer, dated 20.12.01, an extract from a letter of Herr C. Strehlow (sic), a missionary of the New Delittemper (sic) body of Missionaries, at Hermannsburg, Finke River South Australia, which contains all the elements of description and etymology of Alfisha in the opening paragraphs of Strehlow's volume I, without making the conclusion equally explicit. Very generously, John Mulvany has made available to me transcriptions of letters and documents from the Tylor Collection which show that this extract plus commentaries must relate to the extracts made from Strehlow letters by "a German" - I assume by von Lehnardt - and sent to Lang on 20.12.01. On October 19, (1903?) Lang sent a copy to Tylor describing them as "notes on Arunta religion and commenting:

It does not suit Spencer and Gillen and put a very different face on matters.

Again on October 28, (1903?) he reports to Tylor:


I sent the original German to Prof. Spencer in Melbourne. Does he know Arunta? His book (Native Tribes of Central Australia) has no philology in it, I think.

In my opinion, both extracts - the one Mulvany found in the Tylor Collection and the other in the Spencer Collection of the Museum of Victoria - are different translations of extracts made - I assume - by von Lehnardt, from letters received from Strehlow and supplied with notes. However, a good look at the "original German" extracts - kindly supplied to me by Dr. Kingsley Rowan, Spencer's grandson - which Lang sent to Spencer, reveals that we are in fact not dealing with von Lehnardt's original communication to Lang but with transcriptions in two different hands and by people of limited knowledge of German handwriting and grammar. When trying to translate the sometimes very garbled text, Spencer's philology was put several times and very successfully to the test. In any event, the content of the extracts coincides largely with the letters Strehlow had sent to von Lehnardt in 1905 and 1906, who published them in extracts in Globus in 1907, as mentioned earlier.

Only if the original letters of Strehlow can be compared with von Lehnardt's and Spencer's excerpts and translation, can a proper sequence of events be established. But for the time being it seems clear to me that in 1903 Spencer did know more about Strehlow's work and the implicit criticisms of some of his own findings than he was willing to accept or acknowledge in his forthcoming book. If we entertain, for a moment, the thought that he owed his knowledge of the philology of Alfisha and Alcheringa to the findings of the missionaries, then Strehlow's Accounts in page 2 of volume I - which essentially repeats what he had maintained all along and passed on in his letters - must have come like a full blow to Spencer's efforts in his controversy with Andrew Lang and the continental ethnologists. For in this new, Strehlow argues on grounds of etymology that Spencer got it all wrong:

When Spencer and Gillen maintain: 'the word alcheri means dream,' their contention is incorrect ... The word 'alcheringa,' which according to Spencer and Gillen is supposed to mean 'dream-time' is obviously corrupted from ajirrerta. Furthermore, the natives do not know anything about the 'dream-time' as a period in time; (alcheringa) denotes the time during which the Alfisha mitjina walked on this Earth.

(Ref. 9, 1907, part 1, p 2)

I am not in the position to report whether Strehlow's etymology is acceptable to Arrnuda (or Arrnanta/Arrrnta) specialists today. But it if is correct, as is suggested by Charles P. Mountford**, our present-day use of "Dreamtime" would be wrong - and a legacy of not only Spencer's linguistic misinterpretation and his contempt for missionaries, but also of the whole controversy described in this paper.

The quotation given here is the translation of the original German text.

**See also Charles P. Mountford Nomads of the Australian Desert (Rigby, Sydney. 1976) p 53, Fnt.12:

We have not used the word 'Dream-time' in this book. It is a term adopted by Spencer and Gillen (1927 p 98) to refer to the creation period. This peculiarity of word is now being used by ethnologists under the impression that it is of Aboriginal origin. In fact, many of them are using it as a cliché to express a wide range of meanings, some being totally ridiculous.
But our observations have to go one step further. I have quoted the example in order to demonstrate the difference between the cognitive parameters of the anthropologist and those of the linguist-missionary for whom the word is everything: the belief that it is language which unlocks the doors of understanding of the foreign, traditionally basic to the studies of theologians, the preacher knows its power. For the European ethnologist trained first in linguistics, language becomes the first and foremost tool of his work.

Moritz von Lebhardt states this with perfect clarity in his introductory notes to volume I, as he had done already in Globus: (See Ref. 6)

*During his activities among the two tribes over many years, Mr. Strehlow has acquired a perfect command of their languages; he also has had printed some texts for use in divine services ... The knowledge of the languages enabled him during his research to communicate with the natives in their mother tongues - an advantage which cannot be valued too highly; because the tasks are to comprehend, contemplate and preserve in writing these difficult and, in part, rather sophisticated ways of thinking of the Aboriginal peoples.*

The last sentence is the most important because it states explicitly the three tasks of anthropology as these European scholars saw them. The example of Strehlow is supported by the evidence from many reports and writings of other missionaries. Here I can only refer to the earlier Western Australian missionary Dom Rosendo Salvado O.S.B. who published his memoirs in 1851.

**Religion**

It seems superfluous to mention religion among the cognitive topoi of missionary ethnological research. We take it to be a matter of course and anticipate the consequences, i.e., biased and, therefore, scientifically dubious results. This is exactly Spencer's critique of Carl Strehlow's findings. The opening sentence of volume I, in which Strehlow states:

*According to the tradition of the elders there exists a highest good (mara) being, Aljira,*

would have been inoffensive to the fraternity of ethnologists, had he not continued three paragraphs on:

*Aljira is the good god of the Aranda who is known not only to men but also to women.*

In the same passages and later, Strehlow uses the term "totem gods" (Totengötter). This description is in conflict with Spencer’s observation in a letter to Frazer of 19 August, 1902 which, in W.E.H. Stanner's opinion, 20 "put his view beyond doubt".

I think conclusively, that the Central Australian natives have nothing nearer in the way of a simple, pure religion ...

But the occasion, if not the cause, of his irritation, was the missionary Strehlow’s attempt to find a High God. The scholars who wrote as if religion did not exist, and the men of religion who worked as if it could not exist, among so barbarous a people, were not in even distant collusion with authorities who had no motive of credibly to think or act beyond a vague and ill-policed policy of protection. ... there must have been a score of causes to Aboriginal misery. But from the early nineteenth century, none had a more devastating effect than the pervasive doctrine of Aboriginal worthlessness. That depended on a decisive extent on the specific blindness to which I have referred (i.e., the pervasive ignorance about Aboriginal religion). Yet, as R.M. Berndt has rightly said: traditional Aboriginal religion was "a living faith, something quite inseparable from the pattern of everyday life and thought". The connection was so intimate that 'there is no sharp demarcation between secular and sacred life'. In the words of the Rev. E.A. Worns, Aboriginal religion "penetrates all facets of life and has little to fear from distinctions which are both abstract and divisive and which we, with our philosophical education, often make".

Later ethnological research has found that the notion of a High God is indeed alien to the native tribes of Australia. But that does not mean that they had no religion and, in consequence, no culture. It is clear that the notion of a High God belonged to the cognitive horizon of the missionaries, brought up in the European mythology binding together the High God of their Christian faith with the High God of their Greek and Latin studies and elevating them to the top of a religious hierarchy which put earlier "animistic" forms of religion at the very bottom. The destruction of these earlier cultures was then equated with necessary progress in the development of civilization.

But their very "bias" allowed the missionaries to give at least an early, if perhaps not quite accurate, description of the native religion and culture because they knew what religion was and were quite capable of recognizing a religious culture when they met one. To the missionary Strehlow, the Aranda religious culture was a heathen culture. But to the ethnologist Strehlow, it was anything but "primitive." It is well-known that the term "primitive" has undergone a considerable change, ranging from "first or earliest of its kind" in Antiquity to "an aboriginal; a man of primitive (especially prehistoric) times" as early as

*Translation of original.*
1779 (see Oxford English Dictionary). In the end, there is the juxtaposition of the primitive or savage and the civilized or progressive. As far as I can see, Strehlow did not use the term "primitive" at all. He prefixed the relevant concepts with the equivalent "Ur-", such as "Urvolk" or "Urvater." In 1907 then, "primitive" meant to Strehlow a member of the human race living in remote areas, practising a culture of considerable antiquity and complexity and in need of salvation.

To Spencer the "primitive" was a specimen of humanity surviving from early stages of the development of homo sapiens living in remote areas and to be preserved for further investigation, like any other natural phenomenon not yet fully explored. For Strehlow it was a living present, for Spencer the surviving Stone Age. Because the "primitives" were perceived by the scientists at the time of having remained on an early, i.e., lower rung on the ladder of evolution, they could not possibly have notions such as that of an "All-Father" belonging, in their judgement, to a much later stage of civilisation.

This "bias", as any pre-judgement (Vor-Urteil), is part of the normal heuristic process. It is the denial of "bias" - on the basis of scientific methodology - which has caused and still causes havoc in anthropological research. To deny it is part and parcel of the semantics of "scientific" and the root-cause for the fact that the exports of Aborigines studies coming together in 1961 were not prepared to face the notion of the "sacred," or reconsider their use of "myth" from an intercultural perspective. Strehlow himself finds it necessary to inform the reader about his own particular restrictions obviously taking for granted that everybody concerned knows that the goal of the missionaries was the replacement of the native religious world with a different, imported faith and culture.

One case is particularly telling. In volume II, (Ref. 9) Strehlow describes the various forms of the "jurungas" of the Aranda and informs us that they are kept in secret and sacred place, in stone caves - arkanuana - which are prohibited areas to uninitiated members of the community.

These caves are regarded as sacred places, as places of cults. That the natives connect the latter concept with that word, I conclude from the fact that when during my translation work I looked for an expression for 'church,' two baptised blacks suggested to me, in all seriousness the word arkanuana, after I had explained to them the concept of church in detail. But because the blacks associate too many heathen perceptions with the word arkanuana, I declined to use the expression. (Vol. II p 78)

These examples must suffice to demonstrate again the clash of two paradigms in anthropology: while some anthropologists were wondering whether the Aranda had a proper language or religion at all, Strehlow translated the Aranda myths into German and the Bible into Aranda. This difference in perception is a fundamental one. (See footnote on page 95.)

Conclusion

Since the critical attitude of the missionary towards his home base becomes obvious even in his religious work, we are entitled, in my opinion, to search for the cognitive basis of this attitude in the missionary impulse and motivation of the missionary, but also for the effects of it within the cognitive frame which must dominate all ethnological research (not to speak of the effect it had on the lives of the natives). We can assume that Carl Strehlow, like his brother-in-law Christian Keesers, a student of Löhe and Neumannrangen, was imbued with the spirit of critique of euro-centric christendom. This attitude fuelled at the same time his intense interest in and guided his cognition of the native tribes of Central Australia.

Spencer was right in his assumption that Strehlow's religious motivation was bound to influence deeply his findings, and he was right again in his suspicion that Strehlow's approaches were not in keeping with the latest methods in empirical research. But he was wrong in his belief that his own attitude and cognitive frame, as well as his method, were free of value judgments. It is precisely in the juxtaposition of the different cognitive frames and topoi of both protagonists that their relative merit, their perspectives, the basic tenets of their anthropology become apparent. On the basis of a Darwinist evolutionary theory, Spencer had to assume that the primitives had, of necessity, no higher religious notions. Therefore the findings of Strehlow were offensive to him and his group. Phenomenology of religion, on the other hand, as practised by Strehlow and others is not bound by such a restrictive ideology and method and is therefore able to understand much better the phenomena of the sacred and their meaning among the natives. No doubt, it is humperated, at this early stage, by a too narrow Lutheran understanding of religion. In the case of both, Strehlow and Spencer, we find a euro-centric perspective in the approach to the non-European world. In terms of modern hermeneutics and the methodology of intercultural studies, the dilemma is unavoidable - quite on the contrary. Without such a perspective - whatever its ideology - no understanding would have been achieved.

At the same time, tragedy lurks in the dilemma. I do not think that it is correct to speak of a cult of forgetfulness or disremembering in which the white man in Australia is caught when considering the principles and history of his relationship to the original Australians. I believe that I have shown that the catastrophic relationship between black and white people in this country is the result of a culture clash which is born out of the scientific mode of thinking which became dominant in the nineteenth century. It is not accidental but systematic and, therefore, tragic.

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Footnote: Patrick Francis Cardinal Moran in History of the Catholic Church in Australasia. From Authentic Sources (The Oceanic Publishing Company, Sydney, 1899) pp 166/7, comments:

Carnalism is sometimes practised by them. Of this there can be no doubt; I have had the declaration from their own mouths. They have neither temples nor idols, but many superstitions. They stand in great fear of one or more evil spirits. At full moon, they hold solemn religious dances in the woods beneath her breasts, called corroborees in which they mimic their own wars and the natural habits of the kangaroo and emu. They have faith in the power of witchcraft and the transmigration of souls, believing the spirits of the fathers to return in the form of animals around them, and in the white bodies of the Europeans. What may be their real ideas of a Supreme Being, of Divine Providence, and of the ultimate future state, no one has been able to elic. It is exceedingly difficult to induce them to speak of their religious notions.
It is for both these reasons that a renewed study of Carl Strehlow and his contribution to Australian ethnography is of greatest importance. Such a study would not only allow us to reflect the conditions under which this country was and still is studied, but allow us to recover an alternative but long forgotten approach which, in spite of its deeply rooted problems, takes humanity more seriously. Furthermore, it would permit us to subject the ideological base of the topos, identified earlier, to a hermeneutic critique which might uncover further pre-judgments not discussed here. In addition, it most certainly would not close but open up emancipatory insights into the basis and history of the cultural conflict between Aboriginal and immigrant Australia. It would also provide an opportunity of recovering historically important intercultural relations between Australia and the German-speaking countries. Some progress in the development of a historical consciousness could be initiated by the publication and study of the new and philologically faithful translation into English of Carl Strehlow’s work.

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   1907. I. Teil. Mythen, Sagen und Märchen des Aranda-Stamms, bearbeitet von Moritz Freiherrn von Leonhordi; 104 pp., 8 Tafeln, (6 Mythen, 64 Sagen, 4 Märchen)
   1908. II. Teil. Mythen, Sagen und Märchen des Luritja-Stamms. Die totemistischen Vorstellungen und die Dürrungen der Aranda und Luritja, bearbeitet von Moritz Freiherrn von Leonhordi; 83 pp., (6 Mythen, 42 Sagen, 2 Märchen)

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