To study the design and construction of pre-1919 aircraft used by Australian Flying Corps

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Signed

Dated
Bristol Scout D
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INTRODUCTION

During a visit to the United Kingdom in 2009 I became very conscious of the early aviation history which was available to the average person. As a volunteer at the Museum of Australian Army Flying I identified an opportunity to rectify at least some of these deficiencies by establishing in the MAAF library a large body of information relating to the design and construction of aircraft up until the end of WWI. There already exists within the library a section dealing with the Australian Flying Corps through books and photographs. There was a paucity of technical information however, relating to the aircraft they flew. This project is the start of rectifying the situation.

It follows on, that over time, the MAAF or others will be able to construct good quality replica aircraft which were important to the Australian Flying Corps.

HIGHLIGHTS

Not surprisingly the major highlights were being able to conduct research at:

a) National Archives, Kew  
b) National Aerospace Library, and  
c) Science Museum Library

Each of these establishments provided details from slightly different perspectives. The National Archives provided technical drawings including one which identified R.A.F. drawings against aircraft types they manufactured.

The National Aerospace Library (formerly the RAeS Library) produced a wide variety of aircraft handbooks.

The Science Museum Library revealed how the modern aircraft enthusiast dealt with the construction of building flyable replicas.

From the point of seeing real aircraft the RAF Museum at Hendon was outstanding.

ACKNOWLEDGEMENTS

I will be forever grateful to the Winston Churchill Memorial Trust for providing me with the opportunity to gather the documentation on these early aircraft. The Defence Department through the staff of the Army History Unit and the staff and fellow volunteers of the Museum of Australian Army Flying supported and encouraged me to undertake this project. I also wish to thank Mr Brian Riddle of the National Aerospace Library for his help and assistance.
EXECUTIVE SUMMARY

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The Fellowship allowed travel to the United Kingdom between the 24 Sep 2012 and 1 Nov 2012 for the purpose of studying the design and construction of pre 1919 aircraft as used by the Australian Flying Corps.

This involved visits to archives, libraries and museums to gather information in the form of engineering drawings and handbooks. (This resulted in over 4,000 images). Details photographs (540) of aircraft were also taken.

Highlights

- The National Archives, Kew
- National Aerospace Library, Farnborough
- Science Museum Library
- RAF Museum, Hendon

Recommendations

In the time available I was unable to exhaust the gathering of pertinent information available at the above establishments and therefore the information gathering needs to continue.

Dissemination of Information

The information gathered needs now to be made available to the public. It is intended that the library at the MAAF will be the repository for the documentation where it will be catalogued to allow its retrieval. It is also hoped to publish some articles in aircraft related magazines.
PROGRAME

LONDON (26 SEP 2012 - 9 OCT 2012)

RAF MUSEUM, HENDON

SCIENCE MUSEUM

BRITISH LIBRARY

NATIONAL ARCHIVES, Kew

OUT OF LONDON (10 OCT - 29 OCT 2012)

FARNBOROUGH

FARNBOROUGH LIBRARY

NATIONAL AEROSPACE LIBRARY

MIDDLE WALLOP

MUSEUM OF ARMY FLYING

WROUGHTON

SCIENCE MUSEUM ARCHIVES

YORK

YORKSHIRE AIR MUSEUM

OLD WARDEN

SHUTTLEWORTH COLLECTION
RESEARCH into WWI AIRCRAFT

APPROACH

It began with an internet search of catalogues of archives, libraries and museums which I knew were likely to have had information on WWI aircraft.

Australia sources were not very productive with few books and no drawings being identified. As the aircraft used by the AFC were among the types used by the RFC I turned my attention to establishments in the U.K. The establishments chosen for my attention either had catalogues in which I had identified suitable documentation or had aircraft of the type used by the AFC.

Documents were copied by taking digital images with a camera (no Institutions allow flash photography) but in some institutions the only method was photocopying.

For aircraft all the exteriors were photographed in detail.

BRITISH LIBRARY

To be able to make use of this Library one is required to obtain a readers ticket. To get this you have to register and explain the purpose of your visit.

As most of the old books are kept off site, it takes 48 hrs for them to be retrieved. Self-service photocopying (fees apply) is the only method of copying as use of cameras is not permitted. There are restrictions as to what you can take into the reading rooms with you. Lockers are provided for your excess items.

SCIENCE MUSEUM LIBRARY

The Science Museum Library is housed within the library of the Imperial College London. The College being located behind the Science Museum. A day pass is available for the case of a single visit but registration is required if you require more visits for your research.

As the Library deals with the history of Science it has a rather large collection in a relatively small space and the overflow is held in the Archives at Wroughton. Here you have access to the items on the shelves and therefore the chance to identify publications not found by using the online catalogue. I was able to access information
from some sixty publications. There is a self-service photocopy machine however, photography is not allowed. As the library is open until 8pm this allowed me extra time I required to examine periodicals. Periodicals tend to give snippets of information e.g. layout of instrumental panels, cockpit controls etc. Time spent here was very productive with information extracted from some 50 references. This information will be put in a series of files identified by aircraft or equipment type and catalogued for access through the MAAF library,

**Instrument Panel of an Avro 504 K**

**Science Museum, London**

The Science Museum provided me with the opportunity to get up close and personal with some old aircraft engines, in particular the 9 Cylinder rotary Anzani, the Wolsey Viper and the Bentley BR II.

Their example of an RAF SE5a aircraft was one which had been modified for aerial sign writing. As a consequence photography had to be restricted to areas which were original.

I should point out that configuration control was not a high priority during WW I and many aircraft were modified in the field with no formal records kept. It is interesting therefore to compare like models to identify these modifications.
THE NATIONAL ARCHIVES, Kew

The National Archives at Kew is an easy well signposted walk from the Richmond Station on the London Underground rail system. A free carpark is also provided.

When requiring to access original documents one requires a 'readers ticket'. Staff at the welcome desk will direct you to the appropriate area for this. You require two documents, one for proof of identity and one for proof of address. I used my Australian driver's license and my passport. Firstly, you complete a short course using a computer and on completion you complete registration with a staff member. You are then given your reader's ticket which you require to order documents and gain access to the reading areas.

You are restricted in what can be taken into the document viewing areas. Apart from a laptop and camera you are only allowed a pencil and up to 20 pages of paper. Items must be in a plastic bag (supplied). There are lockers provided to secure other items.
There is a long list of rules which can be found on the National Archives Website. These rules are enforced and when you see the age/condition of items you understand why.

There are three areas used by the public for research.

The Research and Enquiries Room which allows access to the online catalogue and documents. There is an enquiries desk where you can get advice on your research. Access to this area does not require a reader's ticket.

The Document Reading Room requires a reader's ticket for access. This is the area where you examine original documents. Prior to entry to this area you need to order documents that you wish to examine. This is done either online or via computer in the Research and Enquiries Room. In the process of ordering you are allocated a particular desk in the reading room.

The Map and Large Document Room contain a variety of large desks which allow for large to very large original documents. Desks in this room are on first come first served basis. Again entry requires a reader's ticket.

Documents can be copied by using your own camera and a number of copy stands are available for use. These are usually used by patrons copying large items or where accuracy of copy is required. There are no conventional photocopiers for self-service copying. They have a system employing a camera which send the image to be printed (cost) or you have the image sent to an email address (free). You can of course, use both options for the same image.

Large documents such as maps, engineering drawings etc. may be delivered to you as large flat packs or rolled up - it depends on how they are stored. I found that as engineering drawings are stored as groups, when you order a particular drawing you get the whole group. In my case I usually wished to see the whole group of drawings so this drastically reduced ordering and waiting times.

When copying drawings which are on tracing paper I found it necessary to place white paper under the tracing paper to improve the image. The technology used at that time for reproduction of drawings was a photographic process known as Cyanotype which produced a blueprint of the drawing.
The Museum is easy enough to access by public transport and when travelling by vehicle it is well signposted. There is a large carpark which opens at 10am, however, it costs.

Within the main museum the following WW1 Aircraft were photographed.
a) Bleriot XI  
b) Bristol F2b  
c) Caudron G3  
d) RAF BE2b  
e) RAF FE2b  

The Bristol F2b is displayed with the covering removed on the starboard side exposing the aircraft structure and as the visitor can get close up to the aircraft the details of construction are very visible.

Graham-White Factory is used to display early aircraft. This building has been relocated to the Museum site from the original Hendon airfield site which is nearby and was where Graham-White built his early aircraft. It was used to produce aircraft for WW1.

Apart from the aircraft which are displayed there is also the clamping device used in the lamination process of wooden propeller manufacture.

The following aircraft were photographed:  
a) Sopwith Pup  
b) Avro 504k  
c) SE5a  
d) Sopwith 1½ Strutter  
e) Sopwith Camel.

Section of clamping device to make laminated wooden propellers. (Graham-White Factory)
R.A.F. MUSEUM RESEARCH DEPARTMENT

Opening times 10am-5pm, Tuesday to Fridays.

This section of the museum is only accessed by appointment (internet). Like other archives visited security is tight. The area available for the public to conduct research is very small accommodating about 5 research desks. Photocopying both Black and White and Colour is available but carried out by staff. Use of cameras is permitted but there is a one-off cost of £5. The catalogue, which can be accessed via the Web is not easy to use effectively, nor is it over informative.

The staff is very helpful but you need to be able to give good instructions as to your requirements.

There was not a lot of technical information available (most is at the National Archives) however, the visit was worthwhile. Information on instruments and some Squadron aircraft maintenance instructions were available.

NATIONAL AEROSPACE LIBRARY, FARNBOROUGH

The library is the relocated library of the Royal Aeronautical Society of London. It is without a doubt the premier collection of books and papers on all things aeronautical. The Royal Aeronautical Society originates from 1886 and has documents and books in its collection from this time onwards.
Unfortunately, the catalogue is not yet up and running and the old catalogue (which referred to storage locations when housed in London has been removed from the Web). (It showed locations such in the 'the Walk-in Safe' or 'cabinet under stairs in basement'). Thankfully I had commenced my research well before the granting of my Fellowship and had identified a list of documents and books before the catalogue was removed. The staff are very helpful and are able to locate books relating to topics very quickly.

In relation to WW1 Aircraft it has a much larger collection of Royal Flying Corp manuals than the National Archives.

There is no self-service copying and cameras are not allowed. The staff did all the copying. The visit here was very successful which was reflected in a photocopying bill of over £95 (approx. $158 Australian).

![HP 0/400 Descriptive Handbook](image)

**FARNBOROUGH LIBRARY, FARNBOROUGH**

I had some difficulty in locating the library as it is tucked away behind a large shopping mall and not clearly signposted.
The Farnborough town library houses an Aviation Collection which contains a wide variety of books and papers from the early days of flying. The catalogue is on the Web. Many of the books are held on the shelves but older more valuable books and documents are in locked bookcases or in storage which are accessed via library staff. It was here that I was able to locate the elusive details of the aerofoil used on the Sopwith aircraft.

Data required to produce the airfoil shape of a Sopwith wing.
Museum of Army Flying, Middle Wallop

The Museum of Army Flying is located at the Middle Wallop Airfield (a Battle of Britain airfield) near the town of Andover. Whilst the Museum has a Library and Archive it held nothing in the way of documentation on WW1 Aircraft. They cover personal and Squadron histories and a large photographic collection.

They have only one WW1 aircraft, a Sopwith Pup. However, it is well supported by ancillary exhibits. As these early aircraft were often modified by Squadrons when on active service, it was good to be able to photograph another example.

Instrument Panel of a Sopwith Pup.

Science Museum Archives, Wroughton

Visiting the Archives requires an appointment (made via an email) which requires you to advise the documents which you wish to see. The Science Museum online catalogue gives the location of documents so that you know whether they are in London or Wroughton.

Security is again in evidence with a requirement to obtain a pass at the guardhouse. You are provided with a map and given instructions on how to get to the Science Museum Archives which are on the other side of the airfield.

There are no self-service copy facilities available but you are allowed to photograph documents (without the use of flash). For photographing large documents I was provided with a specially made moveable platform with appropriate safety rails (OH&S) so that I could get high enough above the posters/drawings to be able to take them with one exposure.
The staff bring to you the items you have requested from the Archival Store. Like the National Archives you do not have direct access to items so catalogue research is needed to identify the items you require.

I had identified a number of instructional posters of aircraft instruments which proved to be excellent. In one instance it showed that a casting which held a glass tube was in fact made of plaster of paris.

As this establishment is located on an airfield, it is some distance from the town of Wroughton and a vehicle is required as you need to cross the airfield to get to the Archives. There is no facility where you can obtain food or drink so pre-planning in this area is also required.

The staff were extremely co-operative and helpful, be they security staff on the gate or from the Archives.

An instructional poster for a clinometers which revealed the base is cast from plaster of paris.

**SHUTTLEWORTH COLLECTION**

The Shuttleworth Collection includes vehicles and motorbikes as well as aircraft. Whilst they have a library it mainly covers personal and operational aspects and was unable to provide any new information on aircraft of the type used by the AFC.

The early aircraft of interest to my research and which were photographed in detail were:

a) Bleriot XI
b) Bristol Boxkite
c) Deperdussin (1910)

d) Sopwith Pup

e) Avro 504k

f) Bristol F2b

g) RAAF Se5a

h) RAF RE8

Of particular note is the RE8 replica which was there under temporary arrangements. It was manufactured in N.Z. for the R.A.F. Museum, Hendon. The workmanship is superb on this, a fully airworthy replica. It was constructed by the Vintage Aviator Ltd. and they also manufactured the engine from scratch.

As part of their display were a number of components one of which is shown below.

![A dual pulsometer which was used to show that the oil in the engine was flowing. (The engines used a “total loss” oil system).](image)

**Yorkshire Air Museum**

The Yorkshire Air Museum has the only Royal Aircraft Factory BE2 I was able to locate. Whilst its display position was far from ideal for photography, however the images will be well supported by images of factory drawings which were obtained at the National Archives. They also have an Avro 504K which I was able to photograph.
General Notes

For travel in London I used an Oyster Card system as it covered travel by the Underground and Bus. I used a weekly ticket option covering the longest distance I needed to travel i.e. Paddington to Richmond. This worked well and was cost effective. For travel outside London I used a Hire Car (booked using the internet before leaving Australia) with the drop off being Heathrow Airport.

Accommodation for two weeks in London and one week in Hampshire to cover Farnborough and Middle Wallop was booked and paid for before leaving Australia. Other accommodation was booked as needed using my notebook. (MacDonald's does have its uses).

Due to the large quantity of photocopying which I had accumulated I bought a scanner. This reduced both the extra volume and weight required for the return journey. Another purchase which was invaluable was a GPS. It was much cheaper than getting one from the Hire Car Company.

Conclusions and Recommendations

The amount of data amassed during my Fellowship far exceeded my expectations. There are still many gaps in the documentation relating to specific aircraft and many aircraft are not represented at all.

The documents and drawings now require editing to produce images suitable for reproduction so that they can be catalogued in the library of the MAAF. This will be a large undertaking and requires the development of skills in using Adobe Photoshop and perhaps other software. There is appropriate printing facilities within the library to reproduce the drawings.

The book images will be converted to PDF files and stored on computer with the possibility of publishing a book at a later date.

Other documents will also be stored on computer in some form of data base to allow easy location and retrieval.

A recommendation will be made to the MAAF Management that this work be continued so as to develop a repository of detailed technical information relating to aircraft flown by the AFC and then widening the scope to cover other pre-1919 aircraft. This will have to be a long term ongoing project.

Where possible extracts of the information collected during the Fellowship will be submitted to the Aviation Press for publication. The focus being on periodicals which specialize in WWI aircraft such as 'WWI Aero' (US) and 'The '14-18' Journal' (Au).
Appendices

A. Drawings
B. Instructional Posters
C. Publications
D. Photographs
E. Document Preparation
F. Drawing Preparation
Appendix A

DRAWINGS

Engineering drawings relating to the following aircraft and equipments were photographed:

- BE2c Propeller
- Bristol Fighter F2b
- Sopwith DH5
- Sopwith DH6
- Sopwith Pup
- Sopwith Snipe
- Sterling Radio Set
- R.A.F. Drawing Numbers
- R.A.F. 4a engine
- Renault 70HP engine
- Standard 700 x 75 Beaded Edge Wheel
- R.A.F. SE5a
- Standard 700 x 100 wheel
- Sopwith 1½ Strutter (one drawing only)
- R.A.F. FE2b - Fitment of Sterling W/T Set
- Speaking Tube Mk1
- R.A.F. BE2c
- R.A.F. RE 8

Note: R.A.F. stands for Royal Aircraft Factory.
INSTRUCTIONAL POSTERS

R.A.F. Air Speed Indicator Mk IVa
Beardmore Carburetor
Tampier Blocktube Carburetor
Air Pump Hispano – Suiza
Claudel Hobson Dual Carburetor RAF 3A
Oiling System Beardmore 160HP Engine
SE5a Control Diagram
Avro Type 504 Control Diagram
F.E. 2b Control Diagram
Bristol Fighter F2b Control Diagram
Sopwith Pup Control Diagram
Aneroid Altimeter Mk Vb
R.A.F. Compass Mk 11
Air Compass Type 5/17
Pressure Head, Mk 1Va
RFC Camera Type L (1)
RFC Camera Type L (2)
Clinometer
DH 6 Control Diagram
Appendix C

PUBLICATIONS

Copies of the following out of copyright books were made.

Aircraft Design Data

AGS Parts Catalogue - (extracts only)

Data for Structure and Stability Calculation of Aircraft - Air Board 1917

Air Board Engine Book - 1917

Notes on Rigging for Air Mechanics - 1916

Brown & Barlow Aero Engine Carburetor, Mark 1 - H.B.802 - Ministry of Munitions - 1918

B.R.2 Aero Engine (Preliminary Instruction Book) - H.B.803 - Ministry of Munitions - 1918

Schedule for Sopwith Camel Biplane


Dixie Magneto (Models 60 and 63)

Dixie Magneto, Model 80

Handbook of Instructions - T.D.I. 505 - Ministry of Munitions - 1918

Notice de Moteurs D'Aviation ANZANI types 10 Cylinders 90 & 110 HP - 1916

The Curtiss Standard Model OX Aeronautical Motor Handbook - 1918

Spare Parts for Aeroplane Engines - Type R.A.F. 1a - Royal Aircraft Factory - 1916

Schedule for Aeroplane Engines Type R.A.F. 4a

The History and Evolution of the Avro Training Machine - Institution of Aeronautical Engineers - 1925

Technical Notes, R.F.C. - 1916
Scarff Compensating Sight, Mark 1 - H.591 - Ministry of Munitions - 1918

Illustrated Schedule for the Sopwith "Snipe" Aeroplane Type 7F1

Hispano-Suiza Engines - H.608 - Ministry of Munitions - 1918

Erecting and Aligning 80HP Avro Biplanes, Type 504 - 1915

Zenith Aero Carburetor, Types 55 and 65D - H.640 - Ministry of Munitions – 1918

Remy Ignition System on Aircraft Engines - Ministry of Munitions – 1918

Bessonneau Hangars, HMSO – 1917

Instruction Book 100HP & 125HP Anzani Engines - British Anzani Engine Co. Ltd. - N.D.

Instructions for the Care, Maintenance and Execution of 80HP Le Rhone Engine - W.H. Allen, Son & Co. Ltd. – 1916

Schedule for De Havilland 6 - Bomber and School Machine

Schedule for R.A.F. Aeroplane Type SE5a

Schedule for Avro 504K Standard Training Machine

Schedule of Spare Parts for the FE2b Machine

Schedule for R.A.F. Aeroplane Type RE8

The Sopwith Kauper Gun Gear Type No.3 - Ministry of Munitions – 1918

Notes of Precautions to be taken with regards to Engines in Cold Weather - 2nd Ed. - H81 – 1918

Spare Parts for Aeroplane Engines Type R.A.F. 1a - Royal Aircraft Factory – 1916

Instructions in connection with the Collapsible Hangars for Aeroplanes on the "Bessonneau" System - Royal Naval Air Service – 1915

Electrically Heated Clothing and Generating Unit for use on Aircraft - Air Dept., Admiralty – 1917

Notes on Aero Compasses and their Adjustment – 1918

Telephone, Wireless, Aircraft, Mk N - Signals Experimental Establishment – 1918

Handley Page Bomber, type 0-400, Descriptive Handbook - Ministry of Munitions - 1918
PHOTOGRAPHS

As part of my research I visited a number of Museums with a view to photographing the early aircraft. The Museum of Army Flying at Middle Wallop has only a Sopwith Pup which is displayed in a WW1 setting which reduced the opportunity for photography. At the other end of the scale is the R.A.F. Museum at Hendon with ten aircraft on display including a Bristol F2b fighter. This aircraft is displayed with the skin removed from the starboard side exposing the inner structure.

In total 540 photographs were taken of aircraft, aircraft engines and some aircraft components. The photographs are yet to be reviewed, edited and catalogued. They will eventually become part of the extensive photographic collection at the MAAF and become accessible to the public by visiting the library.
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<td>Manufacturer</td>
<td>R. R. 1.</td>
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<tr>
<td>Horsepower</td>
<td>110 Horse-Power Le Rhone Engine.</td>
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