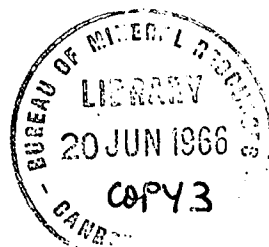


COMMONWEALTH OF AUSTRALIA



DEPARTMENT OF NATIONAL DEVELOPMENT
BUREAU OF MINERAL RESOURCES
GEOLOGY AND GEOPHYSICS

RECORDS:

UNDERGRADUATE GEOLOGICAL TRAINING IN HYDROLOGY

by

D. A. White (Bureau of Mineral Resources, Geology
& Geophysics, Canberra A.C.T.)

Presented during the discussions on hydrology at the
Symposium on Undergraduate Geological Training at the Australian
National University, 24th-25th February, 1966.

RECORDS 1966/32.

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C O N T E N T S

INTRODUCTION

WHAT IS HYDROLOGY

WHO TEACHES HYDROLOGY

WHAT SHOULD AUSTRALIAN GEOLOGY DEPARTMENTS TEACH IN HYDROLOGY

CONCLUSION

REFERENCES

UNDERGRADUATE TRAINING IN HYDROLOGY

INTRODUCTION

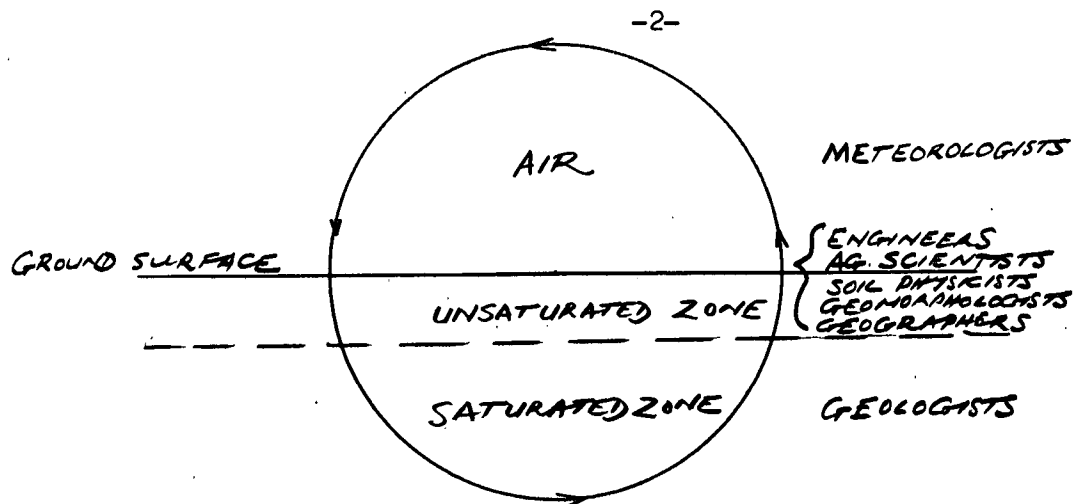
First before discussing undergraduate training in hydrology I would like to take this opportunity of congratulating Professor Brown and his staff for organising this symposium and allowing geologists the opportunity to air their views on this very complex and controversial subject. I wish his Department every success in its endeavours to seek advice in this matter.

Secondly I should warn the audience here to-day that I am not an hydrologist either in the true or complete sense of the word or in the restricted sense of the work when applied to geology - and I will later explain the meaning of this term. However I am a geologist and what I have to say about education stems almost entirely with my association with hydrogeologists through the Technical Committee on Underground Water and through my employer, the Bureau of Mineral Resources. The ideas presented here are entirely my own and in no way should be accredited or otherwise with the organisations just mentioned. I'm naturally indebted to these organisations for being able to draw on their experiences in the field of hydrology and on the Bureau for permission to speak to-day.

Thirdly before putting forth proposals for undergraduate hydrological training we need to first define hydrology, then to briefly review the existing educational facilities in Australia and outside Australia.

WHAT IS HYDROLOGY?

To be able to understand the part played by the Geologist in hydrology, if the hydrogeologists here today would bear with me for a short while, it will be necessary to define hydrology. Hydrology in my book is the study of the movement and storage of water through the air on the surface and under the ground - referred to as the hydrological cycle and illustrated thus:



There are many people studying the hydrological cycle and although their domains overlap I have indicated roughly their main field of activity on the diagram of the cycle. The true or complete hydrologist is one who has a complete knowledge of the hydrological cycle and is thus able to communicate with his fellow scientist on most aspects of hydrology (which includes the engineer, whom I hope will excuse me for including him in this category for the sake of this discussion).

WHO TEACHES HYDROLOGY?

Because of the nature of the beast - the hydrological cycle - we find hydrology is taught in varying degrees in many departments, but a recent survey (2&3) by the National Water Well Association in the United States on educational facilities both inside the States and Canada and outside these countries has clearly shown that groundwater geology or hydrology is taught both at the undergraduate and postgraduate level by two departments - Engineering and Geology. I do not wish to elaborate on the pros and cons in which of these two departments hydrology should be taught; the fact is that the N.W.W. A. survey has clearly shown there are three times as many geology departments than engineering departments (total number is 46 geology to 15 engineering) in the U.S.A. and Canada which offer undergraduate formal course work in what the survey refers to as

"groundwater geology or hydrology" and the same ratio for post-graduate formal course work, except the total numbers are naturally less i.e. 16 geology and 5 engineering.

Moreover an interesting fact revealed by the N.W.W.A. survey of educational facilities in countries outside U.S.A. and Canada is that although there are as far more (33) geology departments than engineering departments (14) providing some groundwater geology or hydrology instruction, there are only 3 (according to the survey) geology departments who can claim more than 40 lectures a year, and slightly more than half of the remaining 30 geology departments provide less than 10 hours of lectures a year. It is interesting to note that only 3 Australian Universities are listed in the N.W.W.A. survey which includes two geology Departments, one of which is listed in the one to ten hours of lectures per year - category. This apparent lack of educational facilities in hydrology in Australia is at present the subject of investigation by the Australian Water Resources Council, and as such I am not at liberty to disclose this information. However I have little doubt that the Water Resources Council's survey will verify the findings of the National Water Well Association.

I am assuming here that although the scene outside Australia as outlined above strongly indicates that Engineering Departments are teaching a great deal of groundwater hydrology, it is the rightful domain of the Geology Departments to teach some groundwater hydrology, if not the majority of groundwater as indicated by the N.W.W.A. survey. There is obviously some overlapping and duplication of groundwater hydrology courses between Engineering and Geology Departments, which may or may not be desirable.

WHAT SHOULD AUSTRALIAN GEOLOGY DEPARTMENTS TEACH IN HYDROLOGY?

What geology departments should teach in Australia is largely governed by the existing status of our knowledge of the water resources in Australia and the existing University facilities available for teaching geologists hydrology, and of course the needs of the employers. The first and third factors are closely related to each other. The status of our knowledge of the water resources in Australia has been reviewed up to 1963 by the Australian Water Resources Council which was published (1) last year. And as far as groundwater is concerned the overall knowledge in Australia is poor.

What of the needs of the employers, - the second factor I mentioned previously. The employers are solely the State and Commonwealth water departments, so it's a purely Government affair. The number of departments who are likely to employ geologists in Australia is about 12. The demand for geologists by these departments is the sixty - four dollar question and one which is under investigation at the moment by the Australian Water Resources Council. I think that there is a real demand for geologists trained in groundwater hydrology and I only hope a continuing demand, but this must await the result of the Council's current investigation.

Let us assume for the purpose of this discussion that there is a demand by Government Departments for geologists trained in groundwater geology or hydrology, then what should geology departments teach in hydrology, keeping in mind the existing educational facilities and knowledge of groundwater in Australia as previously discussed.

First I think it is obvious we need to start from the very beginning in training groundwater geologists and provide a fundamental course in geological mapping as applied to hydrology which involves

the use of air photographs on the regional side and plane tabling on the detail, and a thorough understanding of stratigraphy. In this top priority I would place a brief study of the hydrological cycle.

Secondly while we are stressing one of the fundamentals of geology I would include a teaching of the fundamentals of geophysics and particularly the interpretation of the results of geophysical surveys with an emphasis on bore logging, seismic and resistivity techniques.

Thirdly, the role of exploratory drilling in groundwater investigations including the various techniques.

Fourthly, the fundamentals of the chemistry of groundwater including the relationship between geology and groundwater quality.

Fifthly, the fundamentals of pump testing and the groundwater hydrodynamics.

Lastly, a liberal sprinkling of petrology and perhaps palaeontology.

And above all these requirements the groundwater geologist needs instruction in the art of writing clearly and concisely, otherwise one can forget the teaching of the fundamentals and other aspects of geology and geophysics as outlined above.

I would insist that the graduate in geology, who is proceeding with a career in hydrology, does in his first year Mathematics I, Physics I and Chemistry I, and if possible Applied Geophysics in his third year.

CONCLUSION

My crusade for teaching hydrology to undergraduates in Geology Depts. is essentially one of teaching certain fundamentals of applied geology (and geophysics), such as field mapping, together with some introduction to hydrogeology, drilling and hydrodynamics.

And above all reminding the geologists of the importance of the hydrological cycle so that they will realise that there are other scientists also studying hydrology. Whether the existing facilities in Geology Departments could provide this instruction is completely out of my field, but what is clear is that the climate is right for the Universities, whether it be in Geology Departments or Engineering Departments is not my concern, (although I would not like to see the Engineering Department teach geology in Australia which could and is happening in some Universities in other parts of the world), to face up to their obligations in providing a little more than they apparently are now providing in the way of undergraduate education in the field of hydrology. If this could be established it would greatly assist the State and Commonwealth Departments in their search for geologists who could be usefully employed in investigations of Australia's groundwater resources.

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