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Interview with Arnt Eliassen
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Interviewers: Joseph Tribbia, Phillip D. Thompson

Tribbia: My name is Joseph Tribbia. It's October 10, 1989, and approximately 2:30 in the afternoon. We're in the dining room of Phil Thompson's residence; I am conducting an interview of Arnt Eliassen. Joining me is Phil Thompson, who has been an associate of Arnt for many years. Phil, would you like to begin your questioning?

Thompson: I would like to go back about forty years, to the time of my first meeting with Arnt Eliassen. By way of background, I would like to mention that the design of electronic computers had advanced by the late forties to the point where a typical multiplication time was about one millisecond. This re-opened the question of numerical weather prediction in the minds of at least a few people, and gave them renewed hope that numerical weather prediction might be possible. By numerical weather prediction, I simply mean the application of physical principles and the methods of computational mathematics to the prediction of weather.

The first successful attempt in this direction was made by the so-called "Meteorology Project," instituted by John von Neumann at the Institute for Advanced Study. Although this project was inaugurated in 1946, it did not really take shape until 1948, when von Neumann invited Jule Charney, who was at the University of Oslo, to join the Meteorology Project at the Institute for Advanced Study for a more-or-less indefinite appointment. At the same time, von Neumann invited Arnt Eliassen to visit the Meteorology Project for an extended period of time, a year or so, to work together with Jule Charney. I had in fact been there for some while, mostly worrying alone, and very much looked forward to having someone to discuss my ideas with.

I had known Jule Charney from my days in UCLA, and was more or less familiar with his views of the problem. Furthermore, we had maintained some spasmodic correspondence during the times he was at the University of Chicago and at the University of Oslo. I was not, however, as familiar with Arnt's work. I gathered from a letter from Jule Charney that he--that is, Arnt--and Ragnar Fjørtoft had

inherited, as Jule put it, "splinters of V. Bjerknes' scepter," by which he meant that he thought they were the scientific and intellectual heirs of V. Bjerknes. Although Arnt was, I think, properly the student of Solberg, he must have been, in some sense, also a student of Vilhelm Bjerknes.

I was also vaguely aware of Arnt's recent work on _____ coordinates, and his version of the quasi-geostrophic theory as applied to numerical weather prediction. I was not, however, aware of the distinctions between his formulation of the problem and that of Jule in 1948. At that particular time, I was unaware of any other of Arnt's work at all. As far as I knew, our only common interest was in numerical weather prediction. So, Arnt, I would like to start by asking you how you became interested in the numerical prediction problem, and how you were led to formulate it in the way you did. Were there, for example, some added things in earlier work? And what connection did this have with Vilhelm Bjerknes' grand design? How did your early association with Charney influence your thinking, and your choice of new directions after that? Undoubtedly, this will lead you back into your early history as a meteorologist, and I think we would enjoy hearing that as well.

Arnt?

Eliassen: Thank you, Phil. Yes, V. Bjerknes did play a certain role in my choice of field...He gave seminars on theory, I think in physics, together with his assistant, _____, in 1938. I happened to hear about them and started to attend these seminars. That's how I became interested in meteorology. Then, of course Sverre Petterssen had a course, a technical course in 1939, and then I came to Solberg and his lectures. And I would like to say, of all these three people, Vilhelm Bjerknes, _____, and Solberg, they looked at meteorology as the field of physics. So they stress the theory of _____ they got an education which was much more theoretical than in most other countries. I have read Louis Richardson's book and and have wondered very much about the reason why it's computed _____ is so far off. And I also read Teodor Hesselback's work from Leipzig and the German Phillips' work: these two works have in common that they evaluate accelerations geostrophically. And I thought this could be used more extensively, so--this is during the war, I made some experiments trying to _____ a pressure trough, which I just defined, by the ?equations _____ the equation of motion, or say the geostrophic form not improved by the geostrophic affiliation term. And the continuity equation, together with the thermodynamic equation. The tendencies turned out to be quite reasonable, and vertical motions, which were also calculated, appeared in the right places. So I was pleased and had a certain relief that this--which I then called "_____ geostrophic method" could be further exploited.

This was during the war, and after the war--the war ended _____ in forecasting duty, night duty, too; also, I had _____ so there wasn't too much time for the search. Then, of course, we had some ? impresses from outside at that time--Rossby came through and gave a tour to Barkley's famous ?1939 paper, mainly, which I must confess I didn't quite understand. I didn't quite understand why it was possible to consider these motion sets as non-_____. Rossby didn't seem to have a very good reason either, because he said it was because the atmosphere is so thin compared to the radius of the earth, which was not really relevant, I thought.

Thompson: Actually, it should be the other way around.

Eliassen: Yes...and I had gotten--if you remember, I had the task to go through that paper in a seminar when Vilhelm Bjerknes was present. He was there for some years; he loved to go to seminars. And he did not understand _____ paper, either, because my presentation, which of course was _____ theory; I didn't understand all the English. Also, Solberg had been to Chicago in 1946, and he came back and said, "The Americans have fogotten _____. They're on the wrong track." So he was shocked over there _____ a geologist _____, he said when he came home.

Then came Charney in the summer of 1947. Of course, we exchanged views, but not so much as we should have done because part of it was I was so busy. I remember Charney's coming Sunday morning to go with me up in the woods and I had just fallen asleep after night duty. So it wasn't so easy.

Thompson: Arnt, I have a question I would like to interject at this point. Some of the work that you've described, particularly on the use of geostrophic approximation in approximating the acceleration terms, certainly goes back to 1943. Which of course is five years before the major effort at Princeton began. And my question is, who else was working on numerical weather prediction at the time, say, between 1943 and 1948, who you know of, among your European colleagues?

Eliassen: As far as I know, nobody was working on the--I cannot remember now, anyway. Of course, Sutcliffe had written a paper before the war; it was approaching a little bit the problem, but that's all I know.

Thompson: It was only half of the problem.

Tribbia: Arnt, can I ask a question about your time even prior to the war? How did you get interested in meteorology in the first place, and perhaps any influences that might have existed in your childhood, growing up as a young boy. In fact, we haven't mentioned when you were born yet so perhaps we should put that in at this point.

Eliassen: Sure. I was born on the 9th of September, 1915, in Oslo. It was obvious during my time at school, in high school, that I was not very good at languages, but I was quite good at physics and mathematics! So I wanted to study science and I did. But I had not the faintest idea what kind of science I wanted to study. I was not particularly interested in meteorology at the beginning; I think I sat in the astrophysics building reading because I thought this might be an interesting field. In the astrophysics building was also Vilhelm Bjerknes and his group. That's how I became acquainted with meteorology.

Tribbia: So, then you were at the University in Oslo and began listening to the seminar series in meteorology, is that correct? Was that your first contact, or--?

Eliassen: Yes--it was not exactly meteorology because these people had--Vilhelm Bjerknes was planning to write a book on classical theory of geophysics. Only the first volume was ever printed. We went through the manuscript in seminars and that's how I was attracted to this, and how I met them.

Then they said the next January there would be a course in meteorology--"why don't you follow that?" And I had no other plans, so I did. This was Sverre Petterssen. So _____ had written a book, _____ analysis of forecasting, and he wanted to go through the manuscript with us. So we used that during that course. Fjortoft was at that course, and many of the meteorologists

_____

After that course I was sent to _____ as a trainee in forecasting for a few months. Then I went back to Oslo to complete my studies, my education.

Tribbia: What year was that, do you recall?

Eliassen: It was 1939.

Tribbia: You went back to the University for two more years?

Eliassen: Yes, I took my Master's in 1941, in the Spring.

Tribbia: By that point, it was the middle of World War II. What were your duties and what was your occupation during World War II?

Eliassen: The country was occupied by the Germans, of course, since April 9, 1940. In the beginning, I just completed my study, but at the University there were several people who left for the Underground; _____ that I mentioned, he formed a group coding telegrams. The telegrams were sent by engineers on the trains to Stockholm and I don't know how they got to England from there. They came back the same day. All telegrams had to be in code, of course. And we were at the Meteorogical Institute Weather Service. That was a

nice place because it had this huge archives of maps. We could find things and the date, a certain date, it was very easy to find them..._____ _____. some sort of military duty.

Tribbia: And were you being employed as a professional forecaster during that time?

Eliassen: Yes, I got sort of pay as a forecaster, although we did not forecast. The Germans tried to get the Norwegian Meteorological Institute to cooperate, but Hasselbad said, no, of course he couldn't do that because that was the enemy. So they were just left alone. We had no duties. Of course, we tried to look at old maps and tried to learn something about how we should do it when the war was over.

Tribbia: During this time, you began working on quasi-geostrophic systems?

Eliassen: No...

Thompson: So we have you up to 1947. That's soon after Jule came. You mentioned going to Sweden.

Eliassen: Jule was giving some seminars at the Institute, I remember, and I think I gave one of my things. I don't think we quite understood each other. I had difficulties understanding English, and I don't think I was really aware that the creation of motion turned upside-down _____ in respect to the velocity _____ and this into the continuity equation, _____ form of the vorticity equation. I wasn't aware of that, of course. I wasn't aware of that and he--Jule, of course, used what he used _____.

So I think we talked by each other; we didn't quite understand _____. It was in Dember 1947 that he proposed that I should go to Princeton. I agreed to do that _____, but he left for Stockholm ?to see his wife who he left in the United States?

Tribbia: Now the quasi-geostrophic system that you developed is really a very short section of a very long article on using pressure as an independent variable. During the war, were you also considering this, were these your ideas during the wartime, that you had fermented and then distilled afterwards?

Eliassen: No. I had formally quasi-geostrophic equations in high school, in geometry. It was only after I had been forecasting after the war for a couple of years that I occurred to me that since we are doing maps in certain _____, why shouldn't we use the same coordinates in our equations? That's _____. The reason why it is all in one paper is that I thought it was necessary in order to get the doctor's degree--that one had to have quite an extensive to deserve a Ph.D at that time. So