

# physics in FINLAND

By C. E. Porter

ONE of the more difficult tasks a former Fulbright grantee can undertake is to convey to his professional colleagues in a meaningful way the most important aspects of his year abroad. Having been the first physicist in Finland under the Fulbright Program only underlines this responsibility, but having been in Finland for only a year (August 1956 to August 1957) tends to put one in the position of being a pseudo-expert. The proximity of Finland to Russia would make it very easy to fall in line with current journalistic trends in the United States and to pick a title such as "Physics in the Shadow of the Iron Curtain". If the spirit of such a title were to permeate an entire article, it would lead to a rather gross distortion of what is presently occurring in physics in Finland although there has been a certain amount of intellectual isolation resulting from Finland's geographical position.

What is really much more important is the existence of an intellectual inclination as is expressed in a quotation from a pamphlet of the Finnish National Travel Office in New York: "More books are published and read in Finland per capita than anywhere else in the world." (That Finland also has other attributes is clear from an additional statement in the same brochure: "Four Finnish girls have held the title of Miss Europe and one, Miss Universe." For further information along these lines, and especially regarding the famous "sauna" or steam bath, the December 1957 issue of the magazine *Holiday* should not be overlooked!) In addition what is needed is a not completely definable mixture of spirit and enthusiasm, plus an amount of money sufficient to provide the "leisure" time for thought and needed equipment to carry out experiments. It usually turns out that if there is sufficient spirit and enthusiasm the money problems can in most cases be somehow solved. My own impression after a year in Finland is that there is no question about the existence of the necessary spirit, and that somewhat surprisingly, despite Finland's rather critical economic position, solutions are also being found for the money problem—although I am sure that no Finnish physicist would ever say that he had access to all of the money he could intelligently and profitably use. It can thus safely be said that the interest and effort in physics in Finland is expanding rather rapidly at the present time.

A few years ago if someone had brought up the subject of physics in Finland, I would have asked immedi-

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The Institute of Physics of the University of Helsinki.



The Institute of Technology.



The Abo Academy.



The science building at the University of Turku.

The staff of the Institute of Physics of the University of Helsinki. From left to right: S. Vihinen, J. Hietala, U. Korhonen, P. Tuomikoski, R. Niini, A. Mustajoki, L. Simons, P. Tuomi, E. Skurnik, N. Fontell, V. Tuomi, O. Inkinen, A. Kuusikko, P. Tahvonen, J. Kantele, O. Siltanen, R. Winter, E. Niemimäki, G. Georgesson. Photo courtesy University of Helsinki.



ately, "Is there any physics in Finland at all?" (Someone from abroad might easily ask the same question about any of a number of states in the United States!) An American physicist working in solid-state physics might not have been so ignorant, but I would guess that most American physicists would be as surprised as I was to find so many physicists inclined toward research in Finland as there presently are. In fact, Finland even has two physical societies! (The motivation for the two societies is a linguistic one. About 8 percent of the four million population of Finland is Swedish-speaking, and both Finnish and Swedish are official languages. All Finnish-speaking children study Swedish for eight years while the reverse is true for Swedish-speaking children. Since a number of the members of the physical societies are actually secondary-school teachers teaching in schools in which one language predominates, the Swedish-speaking physicists have formed their own society.)

**T**HE major impression that one has after visiting the universities both in Helsinki and Turku is that experimentally Finnish physicists have been mainly concerned with x-ray machines and calorimeters. Most of this tradition stems from J. A. Wasastjerna who celebrated his sixtieth birthday (while visiting in New York) on November 18, 1956. He was a professor of physics at the University of Helsinki from 1925 to 1946. His interests ranged from early work on atomic size and on the corpuscular nature of light to later work on solid solutions. For his many contributions he has received international recognition. Some fourteen stu-



J. A. Wasastjerna, whose work and teaching strongly influenced the course of physics research in Finland.

dents obtained doctors' degrees under his guidance, and problems stemming from work along the lines of his interests are still the concern of a number of Finnish physicists today, many of whom worked with him or his pupils. His interests have not been totally confined to physics; he was Finland's ambassador to Sweden from 1940 to 1943, and since 1946 has not been teaching at the University of Helsinki but has been the chairman of or a member of the boards of directors of a number of large industrial corporations in Finland.

At the present time all of the research work in physics in Finland is associated with four schools, the University of Helsinki (Helsingin Yliopisto) and the Institute of Technology (Teknillinen Korkeakoulu) in Helsinki, and the Åbo Academy (Åbo Akademi) and the University of Turku (Turun Yliopisto) in Turku. Involved in some sort of physics at the University of Helsinki are approximately a dozen and a half people ranging from Hj. Tallqvist, a theoretician, professor emeritus, and the author of a large number of textbooks, to Y. Ahmavaara, a young assistant, who has been pursuing work in field theory essentially on his own with the encouragement of R. Niini. The interests of N. Fontell have been in the field of thermodynamics about which he has written a textbook. He has also been involved in calorimetric studies involving, for example, the determination of heats of formation of solid solutions. G. Järnefelt, the head of the astronomy observatory, has not only done experimental work in astronomy but has also considered theoretical questions in general relativity. U. Korhonen, currently chairman of the Finnish-speaking physical society, and recently appointed professor of physics at the Institute of Technology, has been mainly interested in x-ray work involving such things as temperature diffuse scattering, and more recently the deformation of the electron distribution of ions in ionic crystals. The senior theoretician at the University of Helsinki is R. Niini, whose interests have been in atomic problems and more recently in reactor calculations.

The major piece of experimental equipment at the University of Helsinki is a 3-Mev Van de Graaff generator. Unfortunately the history of this Van de Graaff has been a rather long and arduous one, and currently the two major problems are beam stability and the acquiring of the necessary measuring apparatus, such as

gamma scintillation spectrometers and multi-channel pulse height analyzers. An attempt was made to construct a homemade ten-channel analyzer, but this did not turn out too successfully. Such a device is difficult for anyone but a specialist to tackle. The two physicists who are most deeply involved with the Van de Graaff generator are L. Simons and P. Tahvonen. Simons, chairman of the Swedish-speaking society, is the senior nuclear physicist in Finland and has carried out experiments in beta decay and neutron-proton scattering as well as doing work on positronium. He is in the process of preparing to investigate some  $(p, \gamma)$  reactions at the Van de Graaff. Tahvonen was for a long time interested in x-ray experiments and crystal structure, and he is now building a beta spectrometer in order to carry out Coulomb excitation experiments using the Van de Graaff accelerator. During the latter half of the year that I was in Finland, there was some talk about moving the Van de Graaff out of its present building in Helsinki and into a new one to be constructed since the radiation level in the old building was a little bit too high for the people in nearby offices. Since I left Finland, the construction of the special building to house the machine has been started. The moving of the Van de Graaff will of course hold up the experimental program somewhat, but it may be better in the long run, and it will also provide space to house a Cockcroft-Walton set, some of the components (condensers, for example) of which are already at the University.

P. Tuomikoski, also at the University of Helsinki, has been interested in the determination of the properties of liquids by measuring, for example, their infrared absorption spectra. I was rather surprised to find that there are facilities for making radio-astronomy measurements in Finland. These facilities are guided by the astrophysicist, J. Tuominen. At the present time, the work going on under his supervision is in connection with the general program of the International Geophysical Year.

L. Hyvönen has measured the heat evolved during the aging of certain ionic solid solutions while A. Mustajoki has made measurements of specific heats of mixed crystals. M. Nurmia, who just completed his doctor's thesis which concerned the measurement of the heat of formation of certain mixed crystals, has also been involved in building geophysical measuring equipment. During the 1957-58 academic year, Nurmia has been at the University of Arkansas. Another recently completed PhD thesis was that by E. Skurnik on the high-frequency ion source used at the Van de Graaff machine. The engineer at the Van de Graaff at the present time is P. Tuomi, who acquired a great deal of his familiarity with Van de Graaff equipment during a stay in England.

Until recently the sole physicist on the State Committee for Natural Sciences in Finland was Hj. Brothorus, emeritus professor at the Institute of Technology. This Committee makes the decisions about the dispersal of most of the routine money above academic salaries for students, research, and related projects. The present physicist on the Committee is N. Fontell. E. Laurila, of the Institute of Technology, has been the main motivating force behind the obtaining of a research reactor for Finland. His own interests in the past have been in electronics and x-ray work, but at the present time he has been working very hard to stimulate interest in securing a research reactor and has also been arranging for the training of the personnel necessary to handle such equipment. This has involved the studying of a reactor control simulator and related equipment in Helsinki as well as sending engineers to the United States for reactor courses at Argonne National Laboratory, for example.

Since I left Finland, a number of decisions have been made about the research reactor acquisition. The Institute of Technology is in the process of completing an addition in Otaniemi, a suburb of Helsinki, and the subcritical facility, the materials for which are being purchased from England, the United States, Sweden, and the Netherlands, is located at this site. It will be owned by the YDIN Nuclear Power Association ("YDIN" means "nucleus"), but will be operated by the Institute of Technology. This research reactor is already under construction. (For more details about the reactor see *Nucleonics*, October and December issues, 1957.)

Also at the Institute of Technology is P. Jauho, a theoretician who has done work in field theory, nuclear physics, and statistical mechanics. He is now in the process of assembling the necessary equipment for nuclear resonance experiments.

**I**N the city of Turku both universities are essentially privately financed, and therefore the staffs of these schools are not formally appointed by the President of Finland as is the case for the two schools in Helsinki. One of these, the Åbo Academy (Åbo is the Swedish name for Turku just as Helsingfors is the Swedish name for Helsinki), is the major Swedish-speaking university in Finland. The other school in Turku, the University of Turku, is a Finnish-speaking university. During my



P. Jauho and E. Laurila of the Institute of Technology.



The new Wihuri Physical Laboratory at the University of Turku with the science building in the background.

stay in Finland, I was formally affiliated with both of these schools and my lectures were attended by students from both universities. At the Åbo Academy is K. G. Fogel, a theoretician, whose interests have been in the nuclear two-body problem and beta decay. He has spent the academic year 1957-58 in the United States at Cornell University. Also at the Åbo Academy is B. Ekelund who has been concerned with microwave measurements.

While I was in Finland, the University of Turku was in the midst of an extensive expansion program. This included not only the building of the new Wihuri Physical Laboratory for low-temperature and solid-state research, but also a very large building program for the University in general. (This building program was in full swing while I was at the University, and it seemed that for a few weeks the dynamite blasts were timed about every twenty minutes. It is quite amazing to witness such construction work going on in the middle of a Finnish winter!) When all the new expansion plans have been completed, the campus of the University will closely resemble that of the typical American university in that all the buildings of the University, ranging from the Business School through the Medical School to the dormitories, will be within a short distance of each other. One had the feeling of a collective "sisu" (a Finnish word meaning something like "stubborn perseverance") as far as the general support of this expansion program is concerned. It is this University that is being anchored with rock-like firmness (one could take this literally—it was the rock that required the dynamite) in south-western Finland.

Y. Väisälä, a former professor and at present a member of the Finnish Academy, has his own laboratory on the outskirts of Turku. His work has been mainly in the fields of optics and astronomy and he has been noted for his work on interference measurements and standards. Although Finland is not a member of CERN, he has been recruited to help with the magnet alignment for the big accelerator there. This is, of course, a most difficult job and requires extremely high-precision work. The new low-temperature laboratory at the University of Turku has arisen mainly through the efforts of V. Hovi. The construction of the building to house the laboratory began in the winter while I was there



O. Lounasmaa and the new Collins cryostat at the University of Turku.

and was completed in approximately four months—only four days behind schedule, two of which were the result of a strike. Milton Streeter, who works for Arthur D. Little, Inc., came in May 1957 and handled the installation of the Collins Cryostat, and before the end of May, the first liquid helium and liquid hydrogen had been made in Finland.

Assisting in this laboratory is O. Lounasmaa, who has just completed a doctor's degree at Oxford after studying two years there. He has done a number of experiments on the specific heats of solid hydrogen and solid deuterium at low temperatures and on the entropy diagram of helium between  $3^{\circ}$  and  $20^{\circ}$  K and up to 100 atmosphere pressures. He plans to extend the entropy work down to  $0.8^{\circ}$  K. Hovi has worked in the past on ionic solid solutions using x-ray and calorimetric techniques, and plans to study the properties of solids at low temperatures. It is perhaps worth pointing out that the equipment in this laboratory is not a gift from the United States as might be thought, but it was bought and paid for through a grant from a foundation established by A. Wihuri, whose source of wealth is a fleet of oil tankers. Hovi spent the fall of 1957 working on a review article on ionic solid solutions at the University of Illinois and doing research on ionic mixed crystals.

M. Kantola has been interested in x rays and crystal physics and has just recently obtained new x-ray diffraction equipment. During the past year he had obtained some radio isotopes from England and was be-

Some of the Turku physicists. Left to right: K. Fogel, M. Kantola, and K. Laurikainen.



ginning to consider problems involving their use. During the spring of 1958 he was at the Pennsylvania State University for a four-month stay.

**F**INLAND has been for a long time "at the end of the line" as far as communication has been concerned, and it must be said that this is not the situation under which either theoretical physics or experimental physics thrives. On October 1, 1957, a Nordic Institute for Theoretical Atomic Physics began operation in Copenhagen (for details, see *Physics Today*, Jan. 1958, p. 40). This is a joint effort of the five Nordic countries (Denmark, Finland, Iceland, Norway, and Sweden) which will be of immense value to all the countries concerned and especially to Finland. Finland has been rather reluctant to cooperate in pan-European organizations, but she has felt rather free to join in concert with the other Nordic countries. During the academic year 1957-58, K. Laurikainen, a theoretician from the University of Turku, was Finland's senior representative at this Institute. His research interests in the past have been in the nuclear two-body problem and general relativity. Arrangements have been made for a few students from each of the Nordic countries to come to the Institute, and this included some students from Finland for the spring term of 1958. Left there be any question that this Institute is entering into current theoretical physics in a forceful way, it should be mentioned that the governing board is headed by Niels Bohr, and that the Institute has access to a near-

by Danish computer, so that both the intellectual and arithmetical needs of the Institute should be well fulfilled.

Although Wasastjerna provided a strong tradition in experimental physics in Finland, he did not function to such a wide extent as a theoretician. (He did, however, assist many Finnish physicists, theoreticians included, in obtaining positions to study abroad and was the head of the Finnish delegation which participated in establishing the Nordic Institute for Theoretical Atomic Physics.) The younger theoreticians, Fogel, Jauho, and Laurikainen, were all educated in Sweden and have not yet become well enough established to develop a tradition. (On the other hand, the mathematicians have for a long time had an established tradition in Finland as exemplified by such names as Ahlfors, Lindelöf, Myberg, and Nevanlinna so that there is really no fundamental blockade in the way of theoretical physics in Finland.) Because of this lack of tradition in theoretical physics, the Nordic Institute in Copenhagen takes on special significance for Finland.

A rather important factor in the travel of Finnish physicists to the United States so that they can come in contact with the current research work going on here is the so called ASLA program (Amerikkain-Suomen Laina Apurahat, meaning American-Finnish Loan Scholarships). This is an exchange program which grew out of the repayment of Finland of her war debt to the United States following the first World War. The United States Congress was so surprised and elated at this repayment that in 1949 it voted to invest the repaid funds in this exchange program. It is always hard to overestimate the value of a well-run exchange program, and this one is no exception. During the 1957-58 academic year there will have been five Finnish physicists in the United States for varying lengths of time. Four of these have already been mentioned, Fogel, Hovi, Kantola, and Nurmia. In addition there is a graduate student, N. Mustelin, a student from the Abo Academy, who spent the year at the Massachusetts Institute of Technology.

The ASLA program not only provides for the exchange of people, but it also functions as a channel for gifts of a certain number of books published in the



An informal picture taken at one of the Physical Society meetings. Left to right: N. Fonnell, V. Hovi, and J. Tuominen.

United States as well as laboratory equipment to universities in Finland. In physics especially, the books have provided a considerable addition to those available in the physics libraries at the various universities. (There is a good reason for this since a \$10.00 American book is equivalent to about fifteen hours of work for someone who is earning about two hundred Finnish marks per hour, a reasonable medium-level wage in Finland.) The book and equipment program is administered through a committee of Finnish citizens who supply the American Embassy with a list of requests once a year, and then this is processed through Washington. I did run into some complaints that the books and research equipment were taking as long as two years to arrive in Finland, but both were certainly very much appreciated. In addition to the ASLA program which provides for the travel of people of graduate-student level or above to the United States, there is also a secondary-school student exchange program which is sponsored by the American Field Service. One of Professor Simon's sons has recently been in high school under this program at Ojai, California.

**M**Y duties as a Fulbright lecturer consisted of teaching a course in nuclear theory which amounted to four hours of lecturing each week. Of necessity, the lectures were given in English. The initial attendance at my lectures was rather high, numbering around twenty-five people, but gradually the number dwindled to a steady group of a little less than ten, a not unreasonable size for a class in such a subject for a university of comparable size in the United States. There was a considerable variation in the background of the students. These ranged from N. Mustelin, who worked with me on a master's degree thesis, to some for whom the combination of English and nuclear theory was just a little too much. I was also very fortunate in having Fogel and Laurikainen at most of my lectures to act as guides and critics. One must say that the traditional relationship between graduate students and professors in Finland, as in other countries in Europe, is of a very formal kind. To add to this, Finnish people in general are known as being rather quiet. (I can safely say that during my year in Finland I never saw a Finn in what would be interpreted by anyone as a frantic state!) The initial problem of obtaining some sort of "feedback" from the students was considerable, but ultimately this difficulty was overcome, and I was able to get to know a few of them fairly well. (One student, O. Varho, accompanied me to a Nuclear Reactions Conference in Yugoslavia in July 1957.)

During the spring term of 1957, Fogel, Laurikainen, and I organized a theoretical seminar which included speakers not only from Turku but also from Helsinki. All of us, both faculty and students, gave one seminar each with topics ranging from field theory to statistical mechanics. All seminar lectures were given entirely in English, and much to my surprise, many were considerably clearer than some seminars I have attended in the United States! One of the more impressive semi-

nars was that given by Y. Ahmavaara from Helsinki. It seemed unusual to find in Finland someone who could hold the attention of a group of about a dozen people for three hours (with only one break) with a talk on some new ideas he was trying to work out on field theory!

One of the most difficult problems for someone who comes to Finland to spend as much time as a year is a linguistic one. There is almost no difficulty among professional people, most of whom speak English, but if one follows his normal inclination to try to become acquainted with a few people outside of his own professional sphere, a great deal of frustration can be involved because of language difficulties. (Finnish is not an Indo-European language. It is a member of the so-called Finno-Ugric family of languages and has a postpositional structure. There are some fourteen commonly used cases for nouns. For example: *talo* = house, *talossa* = in the house, and *talossamme* = in our house.) Although the influence of the Swedish-speaking minority has been sufficient to keep the street signs in both Helsinki and Turku in both languages and also to publish Swedish language newspapers in both Helsinki and Turku, a person who is encountered at random in Finland is likely to be most at home speaking Finnish. (There are always strange language experiences to recount. I once ran into a cab driver in Turku who spoke Brooklynese English; he had lived in Brooklyn for a few years and subsequently returned to Finland.) I was personally very fortunate in being able to find two students, Miss Terttu Puroja and Miss Pirkko-Liisa Suikkanen, who were interested in exchanging English and Finnish. Although I was perhaps not the most apt pupil, my teachers were both clever and persevering enough so that during the last few months of my stay in Finland, I began to feel that a new depth had been added to my year there.

**I**T would be a rather glaring omission to mention Russia only in the first paragraph of this article, and then to say no more. One of the statements I heard repeated a number of times in Finland, especially from Finns who had traveled in the United States, was "Please make it clear to the people you talk to in the United States that Finland is not an Iron Curtain Country." This question had never really entered my mind, and until I was back in New York and attempted to buy a Helsinki newspaper, I didn't realize its relevance. Upon trying to buy a Finnish newspaper in Times Square, I was greeted with the gruff statement, "We don't sell newspapers from Iron Curtain Countries here." Fortunately a woman standing next to me corrected the view of the proprietor of the newsstand, and he then directed me downstairs to where the foreign newspapers are sold where I was able to obtain a copy of the *Helsingin Sanomat*.

Finland lost two wars in succession with Russia and paid a considerable price for this loss in terms of manpower, territory, and reparations. Just after the wars, Finland was rather strongly dominated by the commu-

nists, but after a few years this domination became less and less and today does not exist any more for Finland than for many other Western European countries. The strength of the communist vote in recent elections has run around 25 percent and has been declining. That this 25 percent vote exists in a country which consists of about 95 percent registered Lutherans indicates its economic rather than philosophical base. Many of the Finnish physicists fought in one or both of the wars, and this, of course, did not directly advance the cause of physics; there was no technical pressure equivalent to the atomic bomb program in the United States. It took a long time for Finland to recover enough to be able to devote money and energies to physics in addition to more pressing needs. One might think that because of the geographical position of Finland, the Russian language would be learned by many students, but this is not the case although there is, of course, a need for Russian-speaking Finns to help handle the appreciable trade between Finland and Russia. As a matter of fact, a rather high-ranking member of the Finnish government once quoted a former Finnish President in my presence as having said, "It is very important that some Finns should learn to speak Russian, but not too many." Another example of this same trend could be seen in the Physics Library of the University of Turku. None of the Russian language journals and only one Russian language textbook were in the Physics Library of the University of Turku. In order to obtain these journals or other Russian language books, it was necessary to go to the main university library. (Most American physicists would not be willing to put up with such an inconvenience for very long.)

While I was in Finland, there was a rumor that Russia was offering Finland a free reactor and fifty scholarships a year to Moscow. One reaction I heard to this rumor was in a rather light vein—"If we were to send fifty students a year to Moscow, what would we professors have left to do in Finland?" Although there were a few delegations of professional people from Russia that occasionally came to visit universities in Finland, despite the geographical proximity there was not any occasion when an individual physicist came from Russia to give lectures or seminars at the schools in Helsinki or Turku during the time I was there. There was, however, a twelve-day Russian atomic power exhibit in Helsinki in February, 1957, and a field theoretician from Minsk, F. I. Feodorov, was a member of the accompanying delegation. He had been in the United States and had visited Brookhaven so we had a little in common. An effort was made to arrange for him to give a lecture or a seminar in Helsinki or Turku, but this unfortunately never worked out. As far as travel of the Finnish physicists to Russia is concerned, some have been there as members of official delegations, but in general the feeling was expressed that it is better to wait until one has traveled to the United States first before making a trip into Russia. A recent letter in *Science* written by a Science Officer in the US State Department did not seem to change very much

the feeling that a visit to Russia was no help as far as a visa to the United States was concerned. However, it is reasonable to expect that if there is not a large increase in international tension, there will be some increase in communication between Finnish and Russian physicists. This would be especially true if the Russian government were to lessen the travel restrictions on the individual travel of Russian physicists. It is certain that such experts as P. Kapitza and L. Landau visiting Finland would draw as attentive an audience as the Bolshoi Ballet did in Finland in the spring of 1957 and might even draw from nearby countries as the ballet also did.

In contrast to the scarcity of visiting Russian physicists, there have been a number of American physicists visiting Finland for varying lengths of time in the past few years to give lectures and to participate in informal discussion. Among these visitors were S. Bloom of the Livermore Laboratory, F. Dyson of the Institute for Advanced Study, R. Eisberg of the University of Minnesota, and D. Hughes and H. Palevsky, both of Brookhaven National Laboratory. The financial support for these visits came not only from the United States Department of State but also in some cases from the universities and physical societies in Finland.

TO an outsider who has only been in Finland for a year, it would seem that the major problems that have confronted the recent revival of physics in Finland are isolation and a lack of tradition in theoretical physics. Although Finland is only an hour's flying time from Stockholm, there were fewer than half a dozen foreign physicists who visited Finland during the time I was there. It is, of course, true that there is a fair amount of contact with Sweden. Most of the theoreticians studied there at one time, but even so it will be of considerable advantage to the physicists in Finland to increase the circulation of physicists from other countries to Finland. Both the problem of theoretical tradition and the problem of external contact should be assisted immensely by the newly established Nordic Institute in Copenhagen, and the sizable number of physicists from Finland who have been recently in the United States should help to preserve contacts here. It will be very interesting to see the progress that takes place in the next five years or so. One can certainly expect to see both some new measurements and some new ideas originating from Finland during this time.

It would be entirely inappropriate to close this article without some expression of appreciation for the effort that was made by many people in Turku and Helsinki to make our stay as memorable as possible. In contrast to comments I have heard made by Americans who have visited other European countries for varying lengths of time, we felt that in Finland we were able to meet and get to know quite well a rather large number of people. It is these friendships that will be the most important to us in years to come, and both my wife and I would like to take this opportunity to express our appreciation for one of the most pleasant years we have spent.