

REPORT ON TOUR OF CANADA, U.S.A. AND U.K.

October 15 to December 15, 1946.

By P. C. MAHALANOBIS

I left Delhi by air on the 5th October with Mr. Pitambar Pant (who had been deputed from the Indian Statistical Institute to act as my scientific secretary) and reached London on the 7th October. After a halt of only three hours during which I had short talks with Mr. B. B. Das Gupta (Deputy Secretary, Finance Department, Bengal) and C. R. Rao and R. K. Mukherjea (workers of the Indian Statistical Institute who were working as research assistants in the Cambridge University), I went on board S. S. Acquitania and reached Halifax on October 13.

October 15 to 17 : Ottawa : At Ottawa, I began 'with a general view of the work done in the Dominion Statistical Office'. The policy adopted in Canada is complete centralization in the Dominion Statistical Office of all statistical work relating to every branch or department of Government in the Statistical Office. This is in marked contrast to the system in operation in the U.K. or in the U.S.A. where the bulk of the statistical work is done in the statistical sections or divisions of different Departments or Ministries and where the Central Statistical Office or Division is responsible primarily for co-ordination and standardization in methods of collection as in the U.S.A., or for the final utilization for Cabinet purposes as in the U.K. I had a most useful discussion with Mr. Herbert Marshall, the Dominion Statistician, about the respective merits of the two systems of centralized and decentralized work.

The Census Section of the Statistical Bureau in Canada is particularly well developed. Its work has been closely integrated with that of the Public Health Department and I found that a separate punched card (of the Hollerith type) was prepared giving particulars of death in each individual case. The use of mechanical tabulation has also been developed to such an extent that besides Hollerith equipment of the usual kind, the Statistical Office has designed and built up special tabulating machines worked by compressed air which are five or six times faster than the Hollerith machines for Census work. As these machines are not available in the market I enquired about the possibility of building up such machines in India and gathered the impression that the help of the Statistical Office would be readily available. The matter, however has obviously to be settled by mutual agreement between the Indian and the Canadian Governments.

A new sampling organization was established about two years ago and its scope was increasing very rapidly. In fact in sending me an invitation it was specifically mentioned that my advice was desired in connexion with this new Sampling Division. I had a group discussion with Messrs. Herbert Marshall (Dominion Statistician), N. Kayfitz, Warren James, and John Rutherford about sampling methods and objectives. The setup is broadly the same as that of "Master Sample" scheme in the U.S.A. supplemented by special *ad hoc* enquiries in particular regions. The scope of the sample survey at present covers crop and agricultural statistics, labour and various demographic data.

The Section for Vital Statistics is also highly developed and I got a good deal of useful information from Messrs. J. T. Marshall and P. Thornton of this Division. There was close integration of work done in the provinces and in the Federal Statistical Bureau. An individual punched card (of the Hollerith type) is prepared for each case of death and one set of such cards is maintained in the centre. Hollerith tabulating machines are used extensively for very detailed analysis of the material. I understood that proposal for separate cards for each birth is also under consideration.

I had a short discussion with Mr. Stewart Bates, Technical Adviser in the Economic Research Board, and found that very useful work is being done by this Board chiefly in connexion with re-conversion (from war to peace) programme at the present time as also with long range developmental plans. The work in this Board is in certain ways similar to that done by the Central Statistical Office in London.

I visited the National Research Council (which corresponds to some extent to the Council of Scientific and Industrial Research in India) and had a discussion with the Director, Dean C. J. Mackenzie, F.R.S.,

which covered among other things the question of arranging a Canadian scientific delegation to India this year (1946-47). As a result of this discussion the Canadian Government have kindly agreed to send to the Indian Science Congress three delegates whose passage expenses are being paid by the Canadian Government.

October 18 and 19 : Toronto : From Ottawa I went to Toronto where I visited the University which I found was a very big one and had excellent facilities for advanced training in many subjects. For example, the Banting Institute (where insulin was discovered) is located there. I had a long discussion with Prof. Beattie (Head of the Mathematics Department and at present Dean of the Faculty of Arts and Science) and found that Indian Students of the right type would be welcome. Arrangements for the teaching of statistics are still meagre but I was told that the University was contemplating developing this subject in the near future. Dean Beattie thought that there would be no difficulty in offering a post of lecturer for one or two years to qualified Indian workers, but each case must of course be settled on its own merits.

October 20 to 24 : Washington and Philadelphia : I reached Washington on October 20 and on the same day had a long discussion with Dr. W. E. Deming (Sampling Adviser in the Bureau of the Budget, Executive Office of the President) regarding the present position of sample surveys in the U.S.A. Next day I had discussions with Stuart A. Rice (Head of the Division of the Statistical Standards in the Bureau of the Budget and Chairman of the U.N. Statistical Commission) and Donald Riley (also of the Bureau of the Budget) on various statistical matters.

I also had a discussion with Dr. Huisberger, Secretary of the International Statistical Institute, who had come from the Hague to Washington in connexion with arrangements for the forthcoming session of the International Statistical Institute which is proposed to be held in Washington in September 1947. At present there are only two members from India (K. B. Madhava and P. C. Mahalanobis). In view of the recent progress in statistical matters in India I found that a much larger Indian representation would be welcome. In fact Dr. Rice (who is the Chairman of the Preparatory Committee for the forthcoming session of the International Statistical Institute) and Dr. Huisberger thought that a delegation between 6 and 12 strong would be welcome. We also informally discussed the composition of the delegation in relation to various fields and areas of study.

On the 21st, 22nd, 23rd and 24th October I attended (as the representative of the National Institute of Sciences of India along with Sir K. S. Krishnan and Dr. H. J. Bhabha) the joint meeting of the American Philosophical Society and National Academy of Sciences in Philadelphia and Washington. This gave me the opportunity of discussing the scheme of scientific delegations with a large number of people including F. B. Jewett, D. W. Bronk (President and Foreign Secretary respectively of the National Academy of Sciences), A. Compton, I. Langmuir, L. P. Eisenhart, von Neumann, etc. and also a number of foreign scientists like Niels Bohr, Siegbahn and others.

At one of the sessions of the joint meeting von Neumann (the eminent mathematician of the Institute of Advanced Studies in Princeton) gave a general account of the new electronic calculating machine on which he was working at present. I discussed with him the possibility of building up at least one such machine in India, and was glad to find that his help would be readily available. In fact he thought he would be able to come to India next winter if invited. He explained that the cost of the first machine would be of course very high. Von Neumann told me, however, that once the first machine was built the cost for building subsequent models should be quite moderate and may possibly be of the order of only 30 or 40 thousand dollars.

October 25 to 31 : New York : I attended the special conference arranged by the Population Association of America to which about 14 or 15 scientists had been invited from abroad.

And besides attending the public sessions I had the opportunity of having a large number of group discussions. On the 25th I had a discussion with Frank Notestein (Head of the Population Research Office in Princeton), D. V. Glass (Head of the Population Investigation Office in London) and F. Lorimer (President of the American Population Association). On the 26th I had talks with Frederick Osborn (Chairman, Population Association Committee), Philip Hauser (Technical Head of the U.S.A. Bureau of Census), A. Sauvy (French representative on the U. N. Demographic Commission). On the 27th October I had a discussion with G. Cox (Director of the recently established Institute of Statistics in North Carolina), and on the 28th with Dr. Leon (Mexico), Jaramillo (Brazil) and Sulz (Poland). On the same day in the evening I had discussions with Drs. Whelpton and Fairchild who were both working on Population statistics. Besides

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participating in various discussions in the Population Conference I presented a paper on current demographic problems of India.

On the 29th October I attended the annual scientific conference of the Milbank Foundation which has been doing outstanding work in the Public Health and Nutrition sectors during the last three decades. I had further technical discussions with F. Notestein, I. Tauber and Kingsley Davis (of the Population Research Office at Princeton who is making a special study of Indian Population data) regarding the possibility of initiating investigations in India of growth of population in collaboration with the population research group in Princeton. I had a second conference next day with Tauber and Kingsley Davis on the same subject and was much impressed by possibilities of collaborative research which would facilitate comparative studies. I also attended lectures and discussions on statistics relating to influenza vaccine and on epidemiology in the Academy of Medicine, and had a discussion with Mr. S. Kwerel of the International Statistical Bureau in New York which is a purely commercial organization doing market studies for its clients.

On the 30th October we discussed with Mr. Roger Evans and Dr. Chadwell of the Rockefeller Foundation in New York the possibility of securing financial assistance from the Foundation for the scheme of Scientific Delegation. On the 31st October I saw Mr. Charles Dollard of the Carnegie Corporation in the same connexion.

During my stay in New York I met Prof. A. Wald (Head of the Department of Statistics in the Columbia University) and Prof. J. Neyman (of Berkeley, who was then on a visit to New York)—two leading mathematical statisticians of the country—with whom I had two or three talks about the organization of statistical teaching and research.

I had been also making enquiries about calculating machines and found that prices had gone up very appreciably and the supply position was extremely short. I, however, came to know that R. C. Allen & Co. in Michigan had just started manufacturing calculating machines of the ten-key type. On my way to Ames, Iowa, I made local enquiries in Michigan but found that these calculating machines were being manufactured in America under license from a business concern in Europe and were not available for export out of America.

November 2 to 8 : Ames, Iowa : The Iowa State College is one of the best organized centres of statistical training in America. My special interest here was in the "Master Sample" scheme which was brought into operation in 1945 on a national scale covering all forty-eight States in the U.S.A. About 600,000 air survey maps and all preparatory work relating to the design of the sample survey (known as the "Master Sample" scheme) of the U.S.A. are located in the State College at Ames, Iowa. Very briefly the Master Sample is a framework which enables sample surveys (on the area or grid method) being conducted throughout the whole of the U.S.A. on a wide variety of subjects with sampling fractions from one in two thousand up to 5 per cent. With the help of this "Master Sample," periodical estimates are now being prepared on a large variety of items. Technical developments in the "Master Sample" and in the work in the Indian Statistical Institute have been fundamentally on parallel lines with however significant differences in detail.

I gave five lectures at Ames on recent experiments in statistical sampling in the Indian Statistical Institute and also a general lecture on certain socio-economic problems in India before the Social and Economic group of the College.

The day after our arrival we had a general talk with Dr. Friley, President of the College, Dr. Hughes, Ex-President, and Prof. G. W. Snedecor, Head of the Statistics Department. During the next two days there were several group discussions in which G. W. Snedecor, A. J. King, Ray Jessen, A. M. Mood, George Brown and others participated. These discussions gave us a general view of recent developments in the technique of sample surveys in America. On the 6th November there was a special discussion on the standardization of the terminology of sample surveys followed by a detailed review of the possibilities of collaboration in sample survey research between America and India.

On the 7th November there was a conference on crop-cutting. A large volume of material recently collected in America was placed before the conference for review. The size of the cut (*i.e.*, the plot harvested was usually from 4 to 9 sq. feet or smaller than those used in the Statistical Institute in India, but here also there were striking similarities in the results obtained in the two countries with interesting points of difference. The general feeling was that a scheme of crop-cutting work in which the same standard speci-

fications and definitions would be used in both America and India would be of very great help in clearing up obscure points and thus achieving real progress. Fundamental problems in both countries were much the same, and yet local conditions differed sufficiently to give great scope for comparative studies. On the same day there was another conference on the application of statistical methods in the study of climatology. Dr. Thom (Chief Meteorological Adviser to the U.S.A. Air Force during the war) showed certain recent developments. The interesting point again was the similarity in lines of approach at Ames and Calcutta.

On the 8th November we saw the physical paraphernalia of the Master Sample which essentially consists of about six hundred thousand individual air photographs covering the greater part of the United States. On a suitable proportion of these photographs sample-units (at 3 or 4 different stages) were demarcated in several colours. The number of farms, individuals, etc. for such sample-units (at the time of the latest census) have also been collected; and fresh data are incorporated as soon as these become available so that the records are kept practically up to date and furnish a sound basis for the design of sample surveys of all kinds. The work was being done in well lighted rooms equipped with modern furniture and mechanical and technical adjuncts of the latest kind. The contrast with India was indeed great.

A conference was arranged in the Seminar of Agricultural Economics in which Gerhard Tintner and Hurwicz explained briefly some of the research problems on which the Ames group was engaged at that time. This group was in close touch with the Cowles Commission in Chicago.

Ames was a most congenial centre, and we felt we had made a large number of real friends there. Besides the technique and theory of sample surveys we had repeated discussions on two broad themes, namely, the possibility of organizing collaborative investigations between India and America, and secondly the interchange of statistical (and scientific) workers at different levels. As regards the former, we found a real desire to undertake joint schemes of research in both countries at the same time. The work in each country would be self contained and financially and administratively independent, but would be done on a co-ordinated plan so as to supply material for comparative studies. The general feeling was that such co-ordinated work on crop-cutting was an urgent necessity and the Ames group has kindly agreed to prepare a scheme for further consideration. Useful comparative work can be done in connexion with the drafting of schedules for sample surveys and also in regard to the relative efficiency of certain technical methods adopted respectively in America and India.

We found there was a great diversity in the terms and definitions and sometimes even in the concepts used in the technical reports of sample surveys. The general feeling was that standardization was absolutely essential. As a result of the group discussion at Ames it was found that there was more or less complete agreement in fundamentals between the workers in Ames and Calcutta. I was in fact requested to have further talks with the group in Washington (which is the other important centre of work in sample surveys in the U.S.A.) with the understanding that I was authorized to speak on behalf of both Calcutta and Ames.

As regards interchange of statistical and scientific workers it was agreed that this could be arranged at three different levels:

(1) Top ranking and senior men could go out only for short visits of, say, from one to three months. Such visits can be mostly conveniently arranged on the lines of the Scientific Delegations sponsored by the Indian Science Congress with a carefully planned programme of lectures, conferences and advisory works settled well in advance.

(2) In the medium level it should be possible to invite statisticians (and scientific workers) of established reputation to work in one or more universities or institutions for one academic year. Efforts should also be made to make this a two-way (and not merely one-way) arrangement. I may mention here that, as a result of informal discussions in America, Mr. R. C. Bose of Calcutta has been definitely invited to give a course of lectures in the Columbia University, the Institute of Statistics in North Carolina, and other centres during the period October 1947 to May 1948 for which five to six thousand dollars would be provided to cover his expenses. I also found that some of the younger statisticians in America would be glad to come out to India for one academic year or so, provided return passages and actual living expenses in India can be met by us. This can be obviously a convenient and efficient method of strengthening statistical teaching in India.

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(3) At a still lower level would come junior statisticians (or scientific workers) who after completing their academic degrees have also gathered experience of original research or of applied work for 3 or 4 years. In such cases I was told that it would be possible to find junior positions of instructors or demonstrators carrying sufficient remuneration to cover actual living expenses in America. The cost of passage, however, will have to be borne from other sources. I also found that many young statisticians (and other scientific workers) who have obtained their Ph.D. degree in America would welcome the opportunity of coming out to India for further researches for a year or two. They will be glad to participate both in directed projects and in teaching work, and in this way earn the whole or a good part of their living expenses in India. I may in this connexion give a concrete example. Mr. D. B. Duncan who is working for his Ph.D. in mathematical statistics at Ames and expects to get this degree in February or March 1947 saw me personally and enquired whether it will be possible for him to work for sometime in the Statistical Laboratory in Calcutta.

Chicago : 9 to 10 November : We halted in Chicago on the 9th and 10th on our way to Washington and had an extremely busy session at the Cowles Commission which is the strongest centre for econometric researches in the world. Jacob Marschak is the leader of this econometric group. I had a long discussion with him in Washington during my summer tour, and he had invited me to attend a conference in Chicago at the end of September which I was unable to do owing to the delay in my departure from India. Drs. T. Koopmans, Halmos, Rubin and others participated in the general discussion which followed the talk in which I explained one line of work done in Calcutta some time ago. The econometric work in Chicago left a deep impression on our minds, and we think it most desirable that one or two competent Indian workers should go there for advanced studies and researches. It is necessary, however, to make a careful selection for this purpose. A sound knowledge of mathematical statistics is essential with a good background of theoretical research.

We had two useful discussions in Chicago with Prof. Karl Holzinger, a leading authority in mental testing and were much impressed by the vast possibilities of using such methods for the selection of the abler students at different stages of the educational system in India.

November 11 to 20 : Washington : In Washington I gave four lectures on statistical sampling and had numerous conferences. I was given a table in the Division of Statistical Standards of the Federal Bureau of the Budget and the help of a secretary.

On the 11th November we had a general discussion with W. E. Deming, the Sampling Adviser, and on the 12th a group discussion which was attended by a large number of statistical workers in different Government Departments. On the same day we met the sociological group which consists of advanced workers in Government Departments and local universities interested in social and economic research of various kinds.

On the 13th November we spent the whole day in the National Bureau of Standards. I gave a lecture which was attended by about a hundred persons interested in the application of statistical methods and was followed by a vigorous discussion. We also had group discussions and the opportunity of talking over many matters of statistical interest with Dr. E. U. Condon (Director of the Bureau), Dr. H. L. Dryden (Assistant Director) and other members of the staff. We were particularly interested in the measurements of fundamental standards of length in connexion with which the possibilities of exploring the effective margin of error was discussed. We also had a talk about industrial standards, which fall within the scope of work of this Bureau.

We found a large number of subjects in which detailed information is likely to be of great help to India. Dr. Condon very kindly offered to give Pant all facilities for working in the Bureau. On the 14th November there was a conference in the Department of Labour Statistics where a vast mass of statistics is collected covering a wide field of labour problems. One striking feature was the use of sample surveys for short period estimates of the strength of the labour force under broad heads, volume of employment and other items of industrial interest. More detailed examination of the methods used in this department will be obviously desirable. Dr. L. H. Smith who is in charge of this division was very helpful and has kindly agreed to give all facilities for this purpose.

On the 15th November we had a group discussion on the standardization of terminology of sample survey which was attended by W. E. Deming (Bureau of the Budget), Archie Black (Army Department),

L. H. Smith (Labour Statistics), H. W. Norton (Weather Bureau) and Eisenhart (Bureau of Standards). I explained in a general way the agreement reached as a result of the group discussion at Ames, Iowa. After further discussion it was decided that I should prepare a note on the subject which would be then circulated among workers interested in this field, and would be then published after collecting all suggestions received on the subject. I also had an interesting talk with Miss Sandomire (Division of Ships, Navy Department) who showed me a good deal of data bearing on the question of standardization for purposes of comparison between results obtained in different laboratories.

On the 16th and 17th November we had discussions with Drs. Rice (Bureau of the Budget), Hauser Assistant to Secretary, Commerce Department), Condon (Bureau of Standards) and met a large number of workers interested in statistics.

On the 18th we went to the Bureau of Census and spent the whole day there. I gave a talk in which I explained briefly the work of the Population Data Committee (which had been recently set up by the Government of India) and some of the Indian sampling schemes. This was followed by a group discussion. We met Mr. J. Capt, the Director, and had a long discussion with Dr. Morris Hansen (Head of the Sample Survey Division) and found that many significant developments in sampling technique were taking place. In the regular census section we found that Hollerith equipment was being used on a colossal scale. We also saw special tabulators which have been built up in the Census Bureau itself, and which, it may be mentioned incidentally, worked on entirely different principles from the Canadian machines. It was clear that a good deal of further information from the Census Bureau would be of the greatest value to India both in the sample survey and the complete enumeration sectors.

The next day a conference was arranged in the Federal Agricultural Department presided over by Mr. Callander (Head of the Division of Agricultural Statistics) in the course of which we obtained a general idea of the work in agricultural statistics, and found that many interesting points arose which require further discussion. In the Bureau of the Census as well as in the Agricultural Department we were assured of receiving all possible facilities for further study.

In Washington we had a very useful discussion with General Fleming who came to India early in 1946 and had visited the Statistical Laboratory in Calcutta with Mr. G. McKelvie, Chief Engineer (Roads). General Fleming told us that in India on the whole attention so far had been concentrated on what he called road engineering, that is, actual construction of roads rather than on what he called road geography and geometry, i.e., the geographical layout of roads. In the U.S.A. a great deal of work had been done and was still going on regarding the proper alignment of roads, and he kindly agreed to place all relevant material at our disposal.

On the 20th November we went to the Johns Hopkins University at Baltimore at the invitation of Dr. Lowell J. Reed, Vice-President of the University and Head of the Statistics Department. The special feature of the statistical section here is the collection of individual clinical records and their detailed tabulation and analysis by the Hollerith machine. The time at our disposal was too short to go into details but we felt that this section deserves much closer study. I have been invited to give some lectures and spend a few days there, and I feel I should accept this invitation if opportunity permits.

On the 22nd November I met Prof. Rensis Likert and his group who were engaged in researches on the sample survey of public opinion financed, I believe, by the National Research Council. We found many points of contact between Indian and American work on the subject and felt that there was great scope for co-ordinated research in the two countries. In any case it would be useful to collect detailed information about methods which are being at present used in America. We were assured of full co-operation and collaboration in such matters.

23 November to 5 December : New York : During our stay in New York we had the opportunity of meeting a number of members of the staff in the Columbia University such as A. Wald, J. Neyman, H. Walker, I. Lorge, J. Wolfowitz, J. Anderson and others, and had a group discussion in the statistical department about the organization of statistical courses. We had a long session in the recently established Watson Computation Laboratory which is equipped with many special machines such as a relay unit built up in the Laboratory which is capable of calculating 6 figures \times 6 figures products at the rate of sixteen thousand per hour, and an electronic calculator which has been just placed on the market. The discussion

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with Dr. Eckert, the Director of this Laboratory, was particularly useful. For the sound progress of statistics (in fact, of scientific research generally) in India it is essential to build up at least one first rate computation and calculating laboratory. It may be mentioned here that the UNESCO on its own initiative suggested a few months ago that one such laboratory should be established in India (and another in China). This matter deserves serious attention at an early date.

We had a most useful discussion with Prof. Lorge who is in charge of all work on mental testing in the Teachers Training College in Columbia. We were much impressed by the wide range of tests now available, and felt that there was good scope for use of such tests in India. I had done some work on group tests of intelligence in the medium of the Bengali language, and had also experimented with achievement tests. I was particularly glad therefore to discuss a number of technical points with Prof. Lorge. I was also especially interested in the use of frequency methods in semantic analysis of words.

I was very glad to have had the opportunity of visiting the Bell Telephone Laboratory which is the research unit of the American Telegraph and Telephone Company, and is the biggest industrial research Laboratory in the U.S.A. with an expenditure of about sixty million dollars per year during the war and something of the order of forty million dollars at the present time. I gave a lecture on certain outstanding problems in the statistical theory of errors in precision of measurement which was followed by a discussion. Arrangements had been also made for a number of persons engaged in statistical work in the A.T.T. and the Western Electric Co. (which is a subsidiary of the A.T.T.) to meet me in the Bell Laboratory. I particularly enquired about methods used for deciding plans for telephone development. I was given a general idea and assured that all facilities would be afforded to look into the statistical work in detail.

I also spent some considerable time with Dr. W. A. Shewhart, the pioneer of "quality control," who is a member of the Bell Laboratory research staff. I found that "quality control" work (which is called 'quality assurance' in the A. T. T.) was organized on a very large scale in a separate sector. This is a matter in which India is definitely backward and technical help from America would be of great help.

We also kept in touch to some extent with the work of the Statistical Secretariat in the United Nations and had a full discussion with Mr. H. Campion (who was the Head of the central statistical office in London and a member of the nucleus statistical commission and is at present Director of Statistics in U.N.) about the employment of statistical workers from India in the U.N. Secretariat.

I was to have left New York by air on the 5th, but my departure was delayed by one day owing to bad weather.

December 7 to 9 : London : I reached London on the 7th December, and in the evening of the same day I had a full discussion with Mr. Tunnard-Moore about arrangements for the Scientific Delegation and also a talk with Prof. Munro Fox, one of the delegates. On the 9th December there was a conference in the Royal Society attended by some of the officers of the Royal Society, the Secretary of the British Association, and Mr. Tunnard-Moore in which various matters connected with the Scientific Delegation were discussed.

On the same day I visited the Laboratory of the Scientific Computing Service and had a discussion with Dr. L. Comrie, its Director. This unit has a good equipment of modern mechanical appliances, a trained staff of 40, and it undertakes statistical and mathematical computations of all kinds. The work is done on a purely commercial basis, and Dr. Comrie told me the demand is so great that he is unable to cope with it.

In London I gave a lecture on the application of statistical methods in anthropometry at a special meeting of the Royal Anthropological Society which was presided over by Prof. Fleure, F.R.S., President of the Society. In this lecture I gave a general account of the analysis of anthropometric material collected in the United Provinces by Dr. D. N. Majumdar during the Indian Census of 1941. After the meeting was over I had technical discussions with G. M. Morant and J. C. Trevor, two noted anthropologists of Great Britain.

December 10 to 11 : Cambridge : I had several discussions with Prof. R. A. Fisher and visited his department of genetics and saw the work which was being done there. Prof. Fisher is now concentrating his attention on the theoretical aspect of genetics and developing necessary statistical tools for this purpose. At Ames, Iowa, I had the opportunity of seeing at first hand something of the revolution brought about by

the application of the science of genetics to the production of improved varieties of Indian corn. The urgent need and importance of similar work on rice cannot be over-emphasized. Prof. Fisher pointed out the great need of establishing in India a first rate institute for the scientific study of genetics. This is indispensable for real progress in agriculture either on the side of plant or of animal breeding. I was glad to find that Fisher's help would be available in every way for the development of statistical researches in India.

In London and Cambridge I saw the work which C. R. Rao and R. K. Mukherjea (two workers of the Indian Statistical Institute who have been given research assistantships in Cambridge) were doing. I suggested to C. R. Rao that he should study the statistics of Fisher.

December 11 to 15: London : I visited the Department of Applied Statistics in the University College and had a long talk with Prof. E. S. Pearson and Dr. Penrose (who is now holding the Galton Chair of Eugenics). I found that existing arrangements for the teaching of statistics are not yet of pre-war standard, and that there was a great shortage of trained statisticians. During my visit in the summer I had suggested to Pearson that K. R. Nair (one of the old workers of the Indian Statistical Institute who is studying for his Ph.D. degree in Statistics in London) might be given some teaching work in the University College, and I was glad to find that this suggestion had been accepted.

I visited the British Tabulating Machine Co. and pointed out the shortage of improved models of Hollerith equipment in India and I discussed what could be done to remove the bottleneck. The real difficulty is that the International Business Machine Corporation of New York owns the original patents of Hollerith machines while the British Tabulating Machine Co. has the agency for the British Empire. In Europe and other countries of the world the latest models can be obtained directly from the U.S.A., but in India we have to go through London which not only causes delay but also often results in our failing to secure the improved models. The present position is clearly unsatisfactory.

I had discussions with Dr. Wormsely (Head of the Mathematics department of the National Physical Laboratory) and Dr. Buckley (of the Board of Scientific and Industrial Research) regarding the possibility of manufacturing small calculating machines in India. I learnt that a British firm has secured the right of manufacturing Brunsviga (the original German) calculating machines, and I got in touch with this firm with a view to making arrangements for the assembling in the first instance and later the manufacturing of such calculating machines in India. I gathered the impression that it would not be difficult to reach some suitable arrangement in this matter.

I left London by air on the 16th and reached Karachi on the 18th December 1946.