Physical Anthropology Charts Design for Work and Living

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The art of designing is not the concern of designers alone. It is a field which deserves contributions also from artists, scientists, sociologists, public health experts and even housewives.

The designer should follow an integrated approach in his work. He must understand the sociological, psychological, anatomical and physiological aspects of the problem, and frequently discuss his problem with competent scientists. There is no other way for creating designs of ever lasting advantage, for improving people's taste, for giving consumers their money's worth and for placing the best in their hands. The designers can make man's everyday life bear a touch of science, of commonsense, of vigour and beauty.

All over the world today, the aim of planning is man. The emphasis on man and his surroundings, as the basis for planning, is essential for creating favourable conditions for the proper development of man's body and mind. This principle should find expression in all the functions of man, in architecture, in town planning, and in the design of the whole environment of man.

Our aim is to raise the standard of living of the people to make them more comfortable, more relaxed and more efficient. While we plan for human beings we must aim at certain minimum standard which is to be maintained for keeping man at human level. What is this minimun standard ? Anthropology can make a definite contribution towards finding a satisfactory answer to this question.

All around us powerful industrial plants are coming up but if man does not fashion them according to his needs and employ them for their good, they will eat away the health of industrial workers and destroy the mankind. Architect and designer too must shoulder the responsibility which is theirs. 'An architect (or designer) who ignores the health, happiness and peace of mind of those for whom he designs does not know the first thing about his art or of what makes it great and beautiful'.

Man should be the measure of all things. Whether it is the size of an article, a room, a building or an open space, it should be judged in relation to the size and functions of man. This is the anthropological approach in designing and this should be the philosophy of design in this age of science.

The designers should learn this philosophy from scientists, social scientists and people like Henry Dreyfuss. Dreyfuss never designs an article without understanding the anatomical, physiological and psychological requirements of people for whom he designs. His design is always based on accurately taken measurements of the human body and its parts. And with this scientific approach, he has designed such varied articles like telephone equipment, gas stations, railway coaches, ships, washing machines vacuum cleaners, and even clocks, crockery and cutlery.

If we want to serve man truly, we must study and understand the reactions of human beings to everything around him, even buildings, localities and the towns, The famous architect, Richard Neutra, believes that to base everything on human responses is ground safe to walk on. 'It furnishes an elementary proving method for any valid proposal in design of environment.' Neutra designs environments for no other reason, but for organic responses and that is why his building designs never get out-of-date. A biological foundation for design always makes the design lasting.

As the modern architect keeps interest in the whole province of design for man-made environment, the applied physical anthropologist should also be interested in the design of the man-made environment as a whole, including each and every article or place used by man, Indian physical anthropology, as it stands today, has failed in discharging its responsibility for looking after human welfare. It is therefore quite natural that it does not hold an honourable status in our society, educational programmes and the country.

India needs good design in almost every aspect of human life but our scientists are indifferent. Even the so-called designers do not feel like meeting the challenge. When recently an Indian manufacturer of sewing machines, was asked about his views on the poor design of Indian machines, the reply was—'They are still selling well, when the sales go down we will think of design.' The same answer can be expected from the manufacturers of other machines, ready-made garments, furniture and numerous other articles.

Thus Indian manufacturers and designers continue providing the masses with mediocrities and third-rate goods to make an easy money. They do not think of making the best use of their talents and opportunities, and just take pleasure in cheating their fellow-citizens by distributing vulgar and unhealthy designs amongst them, They are thus adding to the strai-

ned, unsatisfying and frustrated lives of the people who are striving to attain a peaceful and comfortable living.

Indian homes are generally furnished with odd pieces of odd designs, with walls decorated by countless disturbing objects, including pictures of numerous gods and goddesses. The average individual gives little thought to the usefulness, quality and weight of the articles he purchases and generally runs after attractive things. The result is often disappointing.

The consumers should know their own requirements, should be able to sort out the good from the mediocre, and buy only well-designed, reliable and useful articles. It is here that we realize the great value of Consumers' Association in India which should run on the same lines in which the U. S. Consumers' Research Association and the newly-formed Consumer Research Association of U.K. are functioning. There are a few organisations in India, like the Indian Standards Institution (ISI), which exercise control over consumer goods, and while they are doing useful work, they need to be further strengthened and expanded. The ISI should play a leading role in encouraging scientific design in machines, garments, furniture, shoes and hundreds of articles of everyday use. A well-organised and independent Research Association of Indian Consumers and a regular publication of a bulletin containing its findings can do valuable service in this direction. The ultimate aim would be to see that the consumer gets the best value for the money he spends.

Reference may be made to Britain's Council of Industrial Design, 'the oldest and most efficient government organisation for the development and popularisation of good design', which was awarded the Italian 'International Golden Compasses Award' in 1959. The Council on one side, pursuades the manufacturers to improve their products and, on the other side influences the public to demand better designs and more useful things. It provides a design service to the industry and educates the public through the Design Centre in London's Haymarket and exhibitions arranged throughout Britain.

Some such organisation, backed by the government, is needed in our country also. Appropriate measures should be taken to initiate methods of physical anthropology in Indian industries. The needs of industries in matters of designing should be studied. Industrials should be pursuaded to open their own design research centres, and the scientists of various disciplines should keep in touch with them to help in the evolution of scientific design.

In an editorial to the magazine, Design (June 1960), emphasis has been laid on the close relationship between civic consciousness and design consciousness. It states that the foundation of the movement for good design is civic consciousness. Unfortunately, in our country, the sense of civic consciousness is considered to be of lesser importance than the sense of internationalism. Hardly anything is being done in our country for an effective promotion of civic consciousness.

In this connection, it must be stated that the exhibition 'Design Today in America and Europe'—held in Delhi and other places some time ago was of great value. Among the exhibits was a selection of about 350 well designed and mass-produced household objects on sale in western countries.

Modern design is primarily determined by its functional value, and the exhibits showed how functional values can be blended with visual appeal in articles of everyday use in the home or in the office. Visitors to that exhibition got an opportunity to learn a lesson from the West in progressive designing, in the use of modern materials and techiniques for the production of quality specimens.

The designers and scientists must help our masses in developing an awareness of the purpose of design. It may take some time to make people design conscious and conscious of what is good and bad in a design, but once the atmosphere is favourable for an understanding of the meaning of design, the public will rapidly improve its standard of taste and its opinion will demand a speedy change towards better and scientific designs. As the people become more educated, prosperous and more priviledged, appeals in matters of design are likely to improve more swiftly.

It may take considerable time to find a wide demand for well designed articles within the country but people in advanced countries have already developed a refined and discriminative taste. If India wants to take advantage from export to these countries, it must produce quality goods at competitive prices and deliver them in time. There are thousand and one articles which our industries can produce for the world market if the articles are scientifically designed. A scientific design is sure to get the widest market as it would always be superior in function to anything designed by guess work.

The need is for a revolt against copying, a revolt against the multiplication of bad design. This does not mean that tradition is a thing to be completely discarded in the present age. It is also not a thing to be followed blindly. It implies that 'you should profit by your grandfather's experience, not that you should borrow his clothes'.

For real progress in the field of designing the designers must learn the scientific principles formulated by researchers devoted to the study of relation between man and the equipment he uses. The application of scientific techniques to the problems of adapting the equipment to the user, can improve almost any article, whether meant for military or civilian use, for business or for recreation.

The scientific age should be marked by our belief in sound principles of function, in the fitness of form for the purpose, in expressing the essential and eliminating whatever is meretricious, merely decorative or merely ornamental. 'Utility is the parent of beauty'. Beauty must be discovered in the fitness of form for the function. When we believe in functionalism we must do it by recognizing the importance of technology in our life and exploiting it to its fullest.

When we emphasize that the articles must serve the purpose for which they are meant, we do not mean that beauty and aesthetics should be considered inconsequential or devoid of any utility in a man's life. In fact, all men need develop and maintain finer attitudes to life. A scientific design, aesthetic appeal and high quality of production are all necessary for articles to have a steady and increasing demand.

While the designers and architects should be guided by scientific principles, it does not mean that they should lose all their freedom. Keeping the greatest regard for science, they should have the freedom to express their own talents and philosophy.

Applied Anthropometry

The best current design practice embraces scientific research, collection, analysis and presentation of anthropometric data for direct use by the designers, and all that ergonomics has to offer for the improvement of industrial design.

Newman (1953), writing on the industrial applications of anthropometry, has listed the particular advantages which the science of body measurements has to offer in determining the size and design of manufactured articles like ready-made garments, seats and shoes, and in solving space-requirement problems in industrial situations. The strengths of anthropometry lie in its (1) fresh approach to many problems of design, especially faced by industries, (2) expenence with and regaid for biological variablity (3) great appreciation of the concept of 'population' and of techniques appropriate to the gathering of adequate samples, and (4) anthropometrists' training in and a regard for precise measuring techniques.

The application of anthropometric techniques to the problems of adapting the equipment to the user, can revolutionise the whole pattern of our production standards. The rough methods used in designing equipment should be replaced by scientific methods based on a clear understanding of the relation between the physical, physiological and psychological state of man with the size and design of the various kinds of equipments (see Murrell, 1957). This will reduce fatigue and improve the efficiency of workers engaged in different professions. Reference may be made to a report issued by an American team studying the manufacture of cartons and containers. The team gave as one of the reasons for faster work by American women that 'she is picked to work a machine that *fits* her for height and reach'.

Anthropologists of our country should come forward to solve the problems of fitting the job to the worker in numerous working situations. While Indian physical anthropology has so far satisfied academic interests alone and has not yet served the country in the way it should, in advanced countries like the U.S.A., physical anthropology has made a definite contribution to the welfare and comfort of the people.

Applied Physical Anthropology received the first major recognition as a result of Civil War in the United States (Baxter 1857, Gould 1869) when the rigorous and standardized techniques of measurement developed by physical anthropologists proved to be of immediate practical utility. The first application of this science was in the scientific selection, rejection and classification of the people for military services. Anthropological measurments were used during the course of medical examination of more than a million soldires for the Armies of the United States. Physical standards, in respect of stature, weight, and the like, could thus be established for

particular ages and economic groups. This type of classification was later on used also by insurance companies and educational institution.

The military problems faced during the last World War and the success of anthropologists in solving a large number of them, helped in strengthening the belief that the dimensions of human body, and man's capacities and limitations as determined by his anatomy and physiology, are important factors which must be considerd while designing aircrafts and equipments like helmets, parachute, harness, g-and pressure suits and other garments. The Anthropology Unit of the Aero-Medical Laboratory, U.S.A., won wide appreciation for its remarkable work on human body size requirements, muscle strength and human comfort. Static as well as functional measurements of human body were extensively used for the solution of military problems. Researches in the human factor field were continued even after war. Hertzberge (1948) has given a short account of anthropological studies undertaken by the Aero-Medical laboratory in the post-war period till 1948.

Research done at the Quartermaster Corps also included anthropometric measurements taken on a large number of individuals for the establishment of clothing dimansions, size-systems, and the determination of military fit of clothing (Randall 1948).

The RAF Physiology Laboratory, later on named as the RAF Institute of Aviation Medicine, also made noteworthy contributions to the health, efficiency, safety and the general welfare of all flying personnel in the service of RAF by solving problems concerning selection of personnel, maintenance of their physical fitness, physiological effects of extreme conditions to which they might be exposed, design of special garments and equipments worn by aircrew, lay-out and dimensions of the restricted spaces in which a comfortable and efficient operation must be possible, and means of rapid escape from aircraft in emergencies (Morant 1947).

Anthropometry has thus played a valuable role in tailoring the cockpit and other parts of the aircraft according to the pysical, physiological and psychological needs of the pilot. Whillans has reported about a navigator's compartment designed for longer range aircraft in Canada which permits work in reasonable comfort and convenience. 'A suitably porportioned work space, adequate storage for his instruments and books, a high stool-like chair which gives his ready access to the sextant without undue effort, and some extra details such as a waste paper container, are some of the features'. It is to note that less space, rather than more, was found necessary for this compartment.

The science of body measurements has not only served the army and the airforce, but has also made possible the development of a series of commercial standards for the sizing of ready-to-wear apparel for civilians including men, women and children.

It has designed reclining seats for passenger aircrafts to meet the comfort of long-journey passengers, furniture for schools and laboratories, seats for factory workers and operators of electronic equipments, and seats for railroad carriages, cars, trucks and tractors. A specially designed 'health

chair' that eliminates factors responsible for fatigue, and keeps the body in a correct posture, is being manufactured in a Brisbane (Australia) factory.

Stein has made an extensive study of racial differences in teeth and in the size and shape of the dental arch. On the basis of these studies an American firm has developed special dentures (e.g., an upper plate with jet black teeth made for the Thailand trade) to meet the needs of various populations and these have proved highly profitable.

Among other important applications of anthropometry in the field of designing, mention may be made of footwear (for general and special use), spectacles, and artificial limbs for the physically handicapped. There are numerous other possibilities of application e.g., in designing hamlets and shoulder pads for football players, ironing-tables, storage fitments for rooms meant for different purposes, all kinds of kitchen fitments and equipments for the housewives, and even door-handles that make it easy to open whether hands are empty or full.

Anthropometry has designed positions for the operators of machine tools. It has determined the dimensions, design and convenient working heights for various equipments used in home, office, school, hospital and other situations. It has also made valuable contributions towards the solution of space-requirement problems, in general as well as special situations. In other words, it has proved its usefulness in equiping, furnishing and interior designing, and in building construction. Generally, the problems, of space pose such questions as the minimum area required for a particular establishment, work or way of living, the space that is to be left between different items of equipments, and the arrangement of equipments in the total space available so as to make work or living most convenient and efficient. In all such problems, best solution cannot be found without the aid of anthropometry. In this connection, mention may be made to Englehardt's study of 'The Working Heights of Elementary School Children', Stayton's work on 'Heights for High School Clothing Laboratory Tables', Anderson's study of dimension standards for a Foods Laboratory, Heywood's work on 'Planning and Equipping Home Economics Rooms in Kansas High School', and Caudill's study for determining the space needed for teaching and designing of Elementary Schools for Texas.

The anthropometry of working positions has been studied by Hertzberg et al (1956) by taking measurements on the body in standing, kneeling, crawling, and prone positions. A major contribution in the field of safety in transportation and in industry in general has been made by McFarland et al (1953).

Among more recently undertaken anthropological studies, as part of ergonomic research projects, mention may be made of a study of the physics of man undertaken by the Aeronautics Medical Research Laboratory, Columbus (Ohio). 'Weight, centre of gravity, tissue pressure and elasticity had been determined for all parts of the human dummies employed in aircraft and motor vehicle design, and had proved invaluable in the development of safety belts' (OEEC, 1958).

Doctor Yllo (Volve car Company, Sweden), while studying the working conditions in the data processing department, discovered the

following defects in a current model of punch-card machine : (a) keyboard too high for the arms; (b) keyboard placed in such a way that the hand could only work at its best when the forearm is forcibly rotated towards the inside; (c) keyboard not adjustable; (d) the card being punched was too far (60-65 cms) from the eye, and (e) bad lighting conditions; and (f) vibration and noise. Excepting the last two defects (which were somewhat beyond the scope of anthropology), all the difficulties were removed by carefully undertaken anthropometric studies, there by increasing the operators' output by 60 per cent. Workers were very much statisfied with the improvements made in their working conditions (OEEC, 1959).

Doctor Weiner of Oxford has cited three examples of anthropometric studies undertaken to solve the problems of work place design. They are : (a) 'Design of a telephone exchange switchboard so as to provide comfortable working conditions for 90 percent of the operators of both sexes, while enabling to them to attend also to one-half of each of the two adjoining switchboards'; (b) 'Design of assemblies consisting of seats and hand-and-foot operated controls (seats on tractors, tank or in war-ships); and (c) 'Dimensions of kitchen, school, office and laboratory or hospital furniture' (OEEC, 1959).

Now a few examples about the design of driving cabs for cars and buses. Murrell, a psychologist at the University of Bristol, experienced great difficulty in driving his car as the design of the pedal was defective. The angle between his lower leg and the surface of the accelerator pedal was slightly over 50° while the desirable angle is about 75°, Due to this defect, his leg muscles hurt him very much and in giving rest to his leg he was facing the possibility of an accident. Ultimately, for this defect, he had to sell his car. The control design was defective because the designer and manufacturer had not used anthropometric data in designing the pedal (Murrell, 1960).

About eleven years back, when the Harvard School of Public started research on road vehicle design in relation to human physiological, anthropometric and psychological factors, the designs of a large number of the then existing vehicles were studied, more than thirty body-measurments were taken on each driver, and hundreds of drivers were questioned about their experiences while driving their vehicles. It was soon discovered that the design of the working space in the vehicles was defective. In several vhicles only 5 percent of the drivers could comfortably reach and attend to the hand brake. Only 60 percent of the drivers had sufficient accomodation for knee height between the pedals and the steering wheel. Many of the taller drivers were facing definite disadvantages while looking at the instruments or road ahead. Shorter individuals were unable to operate the pedals properly and too much pressure had to be given behind the knees. There was no provision for adequate seat adjustment to allow for variations in body-size of the drivers. Many defects were observed in the location and design of electrical switches, location of shift levers, location of instruments and even the distance between the windows and the driver which affects ability to see pedestrians. The conclusion was that the efficient and safe operation of motor vehicles is a function of the design of the

equipment in relation to the characteristics of the operators. Defects in the design induce fatigue, reduce efficiency, and result in errors and accidents. It is therefore necessary that driver's requirements with regard to controls, seated position and the areas of clear view, must be given full attention, even if it results in neglecting limitations imposed by present-day engineering.

In 1952, a research team was formed by London Transport to advise on the design and lay-out of the cab of the prototype Routemaster double-deck bus. Studies were made in adjustments of (a) steering wheel rake, (b) pedal travel, (c) position and angle of foot plate, (d) seat position (both horizontal and vertical), and (e) seat squab shape allowing for adjustment of lumbar support and for variation in the angle between the seat back and the vertical. Physical dimension of London Transport bus drivers and measurements of National Service recruits were considered in solving the problems. A full account of the same is given by Norman (1960). He also refers to two other projects which made full use of anthropometry. One was concerned with the design problem for motormen's cabs for new rolling stock on the Underground in London. The other was concerned with the determination of suitable sizes and designs for furniture used in administrative offices of London Transport. Items considered were desks, chairs cupboards and telephone tables. The study was made by a Furniture Committee specially set up for the purpos in March 1957.

Floyd has been the Consultant Physiologist to the Post Office in London since 1949 and has conducted research into problems of lighting, the colour and lettering on telephone switchboards and the design of seats for telephonists, for Post Office employees and for the operators of letter sorting machine (Holmes, 1960). Floyd designed an adjustable chair for various working situations in the Post Office and the Factories Department by picking up the design described by Akerblom and making modifications and alterations where necessary.

Laner (1960) has described the role of erogonomics in the steel industry, particularly British Iron and Steel Research Association, which has brought together three committees (Advisory Service, Human Factors Section and the M.R.C. Unit for Climate and Working Efficiency) to collaborate in solving ergonomic problems of interest to anthropometricians, was the necessity for providing comfort, convenience and safety in the operation of cranes. Attention was therefore given to the layout of travelling crane cabs.

Pointing out that in industrial practice, 'the anthropometry of design for the good of both producer and consumer is still grossly neglected, Weiner (1960) refers to the value of anthropometry in the solution of problems in the field of aviation engineering, e. g., in the designing of gun-turrets, cockpit and oxygen-masks. In developing a scientific design for oxygen-masks, a facial anthropometric survey was undertaken in U.S.A., including 35 measurments on each of 1500 persons, which also proved useful in sizing and designing steel helmets earphones and goggles.

Weiner (1960) has discussed the use of 'static' and 'dynamic' measurments for the solution of many problems and points out that the anthropometry of movements (functional anthropometry) includes both 'kinoma-

tics' an 'dynamometry', i. e., 'the effective range of joint movement', and the forces and pressures which can be exerted in different joint positions'.

Demster (1955a) has made a strong plea for developing dynamic anthropometry to solve 'problems of movement and postural change' and for the measurement of angular motions of links(functional dimensions) of the body, 'velocity, acceleration, rythmic patterns, space envelopes, and force' (see also Dempster, 1959). Referring to its application in solving work-space problems of industries schools, vehicles, machinery and military situations. he points out that dynamic anthropometry should contribute to human confort, efficiency, convenience and safety. Study of dynamic measurements should also help in designing furniture, cloths and artificial body-parts, in architecture, in the coaching of athletic performance and in personnel selection. The functional ranges are variable from person to person and 'measurable differences in flexibility are to pe expected, due to age, sex, disease, and possibly race and occupation'. Therefore. Dempster emphasizes the need for well-planned dynamic measurments of men, women and children, of various racial and occupational groups. He adds that dynamic anthropometry 'must proceed on an understanding of the nature of body kinematics and the importance of forces in relation to posture and movement'.

Before proceeding to plan a battery of dynamic measurements, the anthropometrist should possess 'a sound functional knowledge based upon enprience with Cadaver joints' (Dempster, 1955a ; for a study of range of motion of cadaver joints, see Dempster, 1956). Dempster has determined 'the mean location of the centers of gravity of the limb segments and of the trunk.....from seven unembalmed cadavers' (Dempster, 1955b).

For information on certain fundamentals involved in the application of forces by the body, see Gaughran and Demyster (1955), who 'made an analytical study of push and pull mechanics for the seated subject', measuring 'all significant action and reaction forces at both the hand seat', For his another experiment (publishsd in 1958), Dempster analyzed nearly 300 pulls, made by a college gymnast, in standing, braced and seated positions.

In another brilliant paper (1961) Dempster discusses free-body diagrams as an approach to the mechanics of human posture and motion, and refers to the paucity of data for the solution of problems in biomechanics and the difficulty in obtaining it by present methods. While free-body analysis forms an important tool in the solution of many problems, 'there are still other problems unknowns where an attempted use of the technique will point clearly to what we do not know'.

Since the Physiological Studies Unit was formed at the Renault Technical Centre in November 1954, entrusted with task of improving comfort and safety in their cars, the staff of the unit has answered during the first six years, 33 questious on drivers' dimensions and operative's place, 30 on road accidents, 20 about seats and 5 about controls and muscular efforts. In the majority of these cases anthropometric considerations had some or the other use. Listing the types of questions and the numbers of problems answered by the Physiological Studies Unit, Wisner (1960) discusses two pro-

blems in detail, vig., (1) anthropometric study of the driver's place, and (2) the human body regarded as a system of suspended masses.

Many other examples can be cited in which anthropometric consider ations have played an important role in designing articles, machines and work places, and thus improving comfort, convenience efficiency and safety in work. It should be therefore easy to understand that there is a very real place for the applied physical anthropologits in all types of industry concerned in the design, development, and fabrication of equipment destined for use by the human being'. His services can be further utilised fruitfully in the field of equipping, furnishing and interior designing, in architecture or the science of building, and in town planning. It presents a definite challenge to Indian physical anthropologists 'to produce properly trained personnel who may be equipped to continue the many ramifications of the apelication of physical anthropology to the comfort and well-being of their fellowmen'.

Anthropometry as Hobby

Many good contributions to applied anthropology can be expected from persons who take up such work as a hobby. Doing anthropological work as a hobby is not only useful but indispensable to the true progress of this science. It has also the advantage of exposing the worker to new interests, new ideas, and a vast field of pleasure and profit.

Anthropometry in the form of hobby becomes highly interesting and equally useful when it comes to furnishing of offices, schools, laboratories and homes etc. There is need for saving precious floor space everywhere. Many items in furniture and other equipments can be specially sized and designed to fit the space well. They should also provide convenience in work and have proper working heights. Further, the arrangements of articles in the available space should be such as to allow for convenient traffic lanes, to ensure an efficient working, and to give an impression of space.

For comfort in residential, office and other buildings, we have not only to consider structural and thermal or physical conditions, humidity, air movement and temperature, and the temperature of the surfaces to which the boby is exposed, but also its general fittings and furnishing, the size and shape of chairs und their seat-height, height of other items of furniture and equipments, height of all working surfaces, and even the height of electric switches in relation to the reach of man's hand.

I wonder why the folding seat on a walking stick should not be at a suitable height to make sitting a comfortable job for the user. Why not the car-drivers spend a little time in adjusting the height of the driver's seat according to their requirements? Why the spectacle-manufacturers should not be supplied with such data as may be used in manufacturing spectacles of useful sizes? Should not a customer expect advice from leading dealers on the design of spectacle would look best on her face and add to her personaltty? Such interesting problems must draw the attention of young anthropometricians willing to take up applied work as hobby.

Anthropological Consultants

How irritating it may be to a learned man if he finds that the shelves of the bookcase purchased by him are not large enough to accomodate his encyclopaedias and other big books. This simple example points out the many aspects of human activity in which carefulness and advice of someone may be needed. There is, therefore, a great need for anthropological consultants, with wide knowledge of human requirements, whose aim should be to help customers in finding things which exactly suit them (Verma, 1959). Young couples, setting out to make their first home, can use them with advantage in purchasing well designed, reliable and useful articles. Carelessness at this time may put them to loss because when a wrong buy is made, nine times out of ten the purchasers have to live with it, for they simply cannot afford to cut their losses today and make a fresh start. Anthropometricians can help them in sorting out the good from the mediocre or useless goods, and in planning how best to arrange the possessions. When one buys furniture, they can advise that the good quality of wood, beautiful look and strength are not everything, that man needs convenience and comfort too. A graceful and charming piece of furniture is no good if it is not designed on scientific principles and does not serve the basic purpose for which it is needed. They can advise people to avoid congestion and a disproportionate pressure on the living space by rejecting bulky and cumbersome furniture. They must emphasize that good furniture does not mean expensive furniture. They can thus help in making purchasers a well informed people who know their own requirements and can decide when and where to take advice of an expert. In this way, the anthropometricians can help in giving homes a happy appearance.

People should be advised to keep as few piece of furniture as possible in order to save space for a healthier living. This can best be done, without losing comfort, by purchasing articles that serve more than one purpose. An example of such articles is the hide-a-bed sofa, very much in use in America and available in India also, that can easly be opened in seconds to a full-sized bed. If scientifically designed, such combinations of two useful articles save floor space wonderfully. Certain items can be made much more useful by providing adjustable heights (e.g., in ironing table or lamps) and various position possibilities (e.g., in bench-cum-tables).

Another example may be given of an article serving more than its basic purpose. Take the case of a cabinet which accomodates among other articles a typewriter. The typewriter is lifted out and placed on the table when used. An intelligent remodelling of the cabinet can pull out typewriter at a proper height without lifting it and transferring it on to a table. To those who are going to build a house for themselves, anthropological consultants can advise over such considerations as, for example, the major and minor purposes the room will serve, not only immediately but also in future, how many will use the room, what are their necessities and requirments, their personal likes and dislikes, and their habits. They can suggest that, for a growing family it is better to

own a larger house, and that separate independent living units under the same roof with certain common amenities may be a solution to the break-up to the joint family system (Verma, 1959).

It has been reported that in America an increasing number of women are cultivating the hobby of furnishing and decorating their homes themselves. Why not anthropometricians help Indian women do the same for themselves? Such hobbyists and consultants can explain the advantage of hanging or placing frequently used tools within easy reach, particularly in kitchens where the busy and hardworking housewife needs convenience. For housewives giving some time to cooking, the kitchen really needs the best possible planning. The kitchen intelligence demands that it is best to measure. the kitchen walls and floor space before going to the dealer for its equipments. The size and shape of the room and the amount of continuous wall space make a difference in the selection of appliances. The wall and floor units must be suited to the space, should have proper working heights and should meet the requirements of the lady in the kitchen.

Even little matters. like the difficulty in opening drawers and cupboards, and the design of their handles matter much if a convenient living is the objective. In cloakrooms, the hangers used for placing coats should be at an arm's reach. In bathrooms, it is need for safety, that all electrical apparatuses are placed well out of reach so that they cannot be touched with wet hands.

It would not be out of place to mention that 'Domestic Science' or 'Home Economics' has a lot to borrow from anthropometry. A proper development of 'Home Science' to suit the requirements of our country can go a long way in educating and training women for a better living. Emphasis must be laid on the functional look of the home, on tastefulness with true comfort, on giving home a picture of balanced beauty, comfort and practical living.

If Home Science is concerned with the art of gracious living, anthropology has valuable material to contribute to the same art—the art of working and living. While our country is trying to evolve basic principles of home science to suit the requirements of people living in rural and urban areas, anthropologists should also come forward to assist in the task and add wherever necessary. Whether the Union Ministry invites them or not, anthropologists should try to attend the Home Science Conferences held in India from time to time, and put their point of view before the members.

Anthropological Consultants, at a higher level, should follow the example of Prof. Ross A. McFarland (who has earned a great reputation in the United States as an advisor to industries on problems of ergonomics, including static and functional anthropometry), W.F. Floyd (the Consultant Physiologist to the Post Office in London, who pays regard to anthropometric considerations also while solving the problems at hand), the staff of the Physiological Studies Unit at the Renault Technical Service (which solved problems of work-space, drivers' body-size, seat design, controls and muscular efforts etc.), Doctor Ylio (Medical Advisor to Volvo Car Com-

pany, Sweden, who was responsible for redesigning the working conditions in the data processing department) and other specialists, whose interest helps so much in bringing together the scientists, engineers, industrialists and other workers of a firm, to discuss and solve the problems of fitting the job to the worker. It is only through such collaborations that anthropologists can hope to apply their knowledge in designing the plant and machinery for the productive processes, in designing manufactured goods and equipments used by man, in improving the productivity and in promoting the health and well-being of industrial workers.

Prevention of Disease and Accidents

We realize fully the need for improving and maintaining the health of mankind. The best health-schemes are those which, as one of their primary objectives, aim at seeing that illness does not occur. It is with this belief that diseases should not be allowed to occur, that physical anthropologists should work for the health and well-being of the people. And it is in this context that the need for fundamental anatomical and physiological researches for the solution of health problems must be stressed (Verma, 1959).

The service of anthropologists is needed for the safety of the people, not only from the point of view of health, but also through the methods of accident prevention. Accidents in any situation of activity have human, social and economic repercussions. To save our country from economic loss and to save human beings from suffering, physical mutilation or death, accident prevention in various working situations must be taken up by anthropologists as their sacred duty. The important factors which cause accidents may be the fitness and condition of equipment used, the physical, physiological and intellectual state of the worker, the manner in which work is organized, and the conditions prevailling at the working place or outside. By making scientific studies of these factors, anthropologists can greatly reduce the rate of accidents. By educating and training the masses they can help in the development of awareness of the importance of safety at all times (Verma, 1959).

Anthropologists must perform the double duty. On one hand they should study and solve the problems of health, comfort, efficiency and safety of the people at home and in different working situations. On the other hand, they should educate and train the masses in methods of science applicable to their daily life and day-to-day problems.

Just as engineering applications are aimed at ameliorating the miseries of mankind, it would be an honourable profession for physical anthropologists to work for the health and comfort of the people. The spirit of hobby will be a great force in an endeavour of this sort.

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