

THE CONTROL OF NATIVE EDUCATION IN SOUTHERN AFRICA.

Dear

The question of the control and administration of Native education in South Africa and Rhodesia is, as you know, a vital issue. This has been chosen as the subject of a Ph.D. dissertation by the writer, which he will write under the direction of Dr. C.T. Loram, formerly of South Africa, now Professor of Race Relations at Yale University.

Among the evidences urgently needed for this study, is representative opinion on this question both on the part of European and Native leaders. The following list of questions is being sent to you in the hope that you will be kind enough to help by answering all or any of them. It is the writer's sincere hope that these questions may prove interesting enough so that answering them will mean rather a stimulating of thought than just another burden. Any help you may be able to give will, I can assure you, be most heartily appreciated and will be of use in throwing some light on this difficult problem. Unless you prefer to remain anonymous, I am presuming that you will allow me to give your name and position as source.

NAME OF INFORMANT:

OCCUPATION OR POSITION:

ADDRESS:

THE PROBLEM STATED: The specific problems with which this dissertation is to deal are these - Should Government take over the complete control of Native education? If so, ought Native education to be under the Department of Education or under the Native Affairs Department? If not, what should be the place of Missions in the educational system?

Keeping these general considerations in mind, would you kindly answer as many as possible of the following questions. If there is not sufficient space on this paper, the writer would be glad if you would use as many extra sheets as you desire.

A. THE CONTROL OF NATIVE EDUCATION.

To what extent is the present educational situation satisfactory with respect to the relative share of Gov't and Missions in -

1. THE FORMATION OF EDUCATIONAL POLICIES:

Who takes the initiative in making policies?

What is done through Advisory Boards?

What through personal consultation?

What in other ways?

What more in your opinion should be done?

2. FINANCE:

Should the Gov't give grants-in-aid or should it pay the teachers' salaries direct? On what grounds?

What is the practice in your locality?

What proportion of the expenditure on Native education is borne by the Mission with which you are acquainted?

Do you consider this satisfactory?

If not, what changes in present practice would you recommend?

(over)

3. ADMINISTRATION.

Are the Missions competent to supervise a. primary schools, b. secondary schools? Is their supervision worth while even if not fully competent?

Are teachers in your area appointed by Missions and is this appointment then confirmed by Gov't? If not, how are they made?

Do you consider this procedure satisfactory? If not, what do you suggest?

What authority should dismiss teachers? On what grounds?

Do you approve of a Black List? On what grounds should a teacher be blacklisted? For how long a time? What should be the terms of restoration?

4. SCHOOL VISITING AND INSPECTION.

How often does the Gov't require missionaries to visit the schools? What is your comment on this requirement?

Would you prefer Missionaries or Gov't Inspectors to make the regular inspections? Why?

Have you had Natives as inspectors or supervisors? Have they proved satisfactory?

Were they under the direction of Missions or Gov't? If under some joint control, describe. What type of control is preferable?

5. CURRICULUM PLANNING:

By whom is the curriculum planned?

- What is the share of a. Government
- b.
- b. Missions
- c. Natives

In what ways is the present method of curriculum planning unsatisfactory?

To what extent, if any, is it dominated by the policy of differentiating between Europeans and Natives?

What changes would Natives prefer in the curriculum and why?

Do Missions feel that they are cramped by Gov't requirements in curriculum? If so, how?

What changes in the current practice of planning a curriculum do you regard as desirable?

B. GOVERNMENT:

1. Should the Gov't take the whole responsibility for Native education to the exclusion of Missions? Reasons for and against.
2. What share of the financial cost still falls on Missions?
3. What would be the effect upon the school system if Missions were to drop out of the picture and their financial contribution disappeared?
4. Should Gov't take over control a) gradually over a period of years, or b) more rapidly, possibly with additional taxation?
5. Would the additional financial burden be shifted on to the Native? Would the Natives be willing to pay more if the Gov't took over the schools?
6. What would be the gains and losses under full Gov't control?
7. What is the present attitude of the Gov't toward religious instruction in the schools?
8. Would there be any place, and if so, what, for religious instruction under full Gov't control?
9. How far would a provision for the Right of Entry of denominational teachers meet the need?

C. MISSIONS:

1. Would Missions be willing to retain the present system of education without Gov't assistance? Could they finance it?
2. Would they be competent to administer it? What evidence have you for this view?
3. Do Missions want to retain control of the schools of all grades? If so, under what minimum conditions? If not, what would be their choice? Why?
4. Do they consider the present conditions onerous? In what ways?
5. Would Missions favour increased control by Gov't provided Gov't would pay larger grants?
6. When schools have been taken over entirely by Gov't, how have the following been affected:
  - a. Government
  - b. Missions
  - c. Natives

How have such schools succeeded?
7. Which are better and why: Union Mission Schools (as in Orange Free State, towns, etc.) or Government Schools (as Natal, etc.)?
8. How does the racial attitude of Missions compare with that of Gov't?
9. What is your view on the criticisms that Missionaries have not been sufficiently cooperative with the policies and wishes of:
  - a. Government
  - b. Natives

D. NATIVE OPINION:

1. What is the opinion of the Native people in regard to the control of education?
2. On what basis do you know or assess their opinion?
3. Are they satisfied with their present share in control? What changes have you heard them speak of as desirable. (Please answer fully.)
4. In what ways are they expressing their views?
5. Are these ways adequate a. in your opinion  
b. in theirs

E. INFORMATION:

1. Have any resolutions relevant to this inquiry been passed by some body with which you are familiar? If so, would you kindly state their purport, send a copy of them, if available, or indicate where they may be found?
2. Have you yourself written anything on the subject? Information would be welcome. Could you supply references to any recent literature you consider of value? Details of publisher, date, etc. would be welcome.

Note: The letter rates from South Africa and Rhodesia to the U. S. America are: 3d for the first ounce and 2d for each additional oz. Book post is 1/2d for each 2 oz. The writer would be grateful for any published or other material that could be sent and would cover the cost involved.

Thanking you for your kind cooperation,

I beg to remain,

Very truly yours,

*John S. Marsh*

John S. Marsh,  
85 Sherman St.,  
Hartford, Conn.,

10th December, 1938.

U. S. America.

"THE STAR"

Native Schools- Those Talkie Machines. Pastor.

**NATIVE SCHOOLS**  
**THOSE TALKIE**  
**MACHINES**

*To the Editor of The Star*

Sir,—I have made thorough investigations about the matter of the introduction of talkie machines in native schools and the majority of teachers have admitted that they have accepted the proposal not because they approve of it but because they must do as they are told. As I do not want to prejudice any one's position, I shall avoid personalities. I wish to reassure E.M.J.P. that I am not antagonistic to the scheme as such, as I believe it is intrinsically good, but as long as its introduction involves the imposition of an unnecessary financial burden on school children and teachers I shall never accept it. Evidently your correspondent has an eye on the end and not on the means whereby that end shall be achieved, and his desire to avail himself of the opportunities that the scheme will bring about, has blinded him to its implications.

If as E.M.J.P. points out, the teachers accepted the proposal fully aware of the fact that the Government is not adequately subsidising native education, he must admit also the fact that the teachers are quite content with their meagre salaries and that there will be no justification in future to clamour for an increment. As far as the children are concerned the teachers had no business to accept the proposal without first consulting the parents, who will be responsible for the payment of this amount and some of whom are experiencing much difficulty in finding money for school fees. I wish to reiterate the statement I made in my previous letter, namely,

that save for a sum of £340,000 contributed from general revenue, native education is financed out of direct taxation whilst the contrary is the case with European education. In the circumstances there is no justification for any attempt to put an extra burden on the already over-burdened people. Just recently the Transvaal African Congress sent a deputation to interview the Director of Education with a view to the abolition of school fees, and the step taken by the teachers without being incompatible with the wishes of the deputation, is bound to give an impression to the rulers that the native is capable of paying his way as far as his education is concerned.

PASTOR.

(Continued in preceding column.)

APPRECIATIVE

**NATIVE SCHOOLS**  
**TALKING FILMS A**  
**NECESSITY**

*To the Editor of The Star*

Sir.—"Head Teacher" states in The Star of the 15th instant that "as teachers we shall always approve and support any man, Bantu, Boer or Briton who will propose a scheme that will raise such a fund as will lead to the abolition of (a) school fees and book-buying by native children; (b) proper accommodation for them in school; (c) proper staffing in their schools and; (d) other educational facilities," etc. If "Head Teacher" and his friends are prepared and will always support any man to raise funds for such things as he has quoted, then logically he cannot in the same breath state that they (teachers and children) are poor! It means they oppose the scheme of the south-western circuit to purchase a talkie for the benefit of its schools not because it will be difficult, but because "it is an educational need but not an educational necessity as far as native education is concerned to-day!" What a self-contradicting statement.

It is a pity that some of the enlightened natives will always nurse grievances, real or imaginary, until their minds and visions are befogged. You cannot hope for good things and success without some measure of effort and sacrifice. Talkies in schools are an educational need and necessity.

E. M. J. P.

**ONE OF THE PRIME EDUCATORS****Results of Organised Lessons in Observation**

By C. H. BRESLER

A schoolmistress in rural England has set wisecracks wondering why they did not think of what she is doing before her. She had turned a copy-book maxim into a school subject, and achieved in two terms a vindication of her theory that if one can make children realise that from observation all knowledge springs, everything within their daily view will give them a better grounding in the subjects in their time-tables than anything else can. But a child must be trained to observe accurately and taught to collate its observations in a relevant and coherent whole.

In the infant grades the teacher tells the story of the Arab who, having lost a camel in a desert where but a few trees grew, found his beast in two days' time in spite of a strong wind which had obliterated the camel's spoor. He looked at the leaves of the shrubs and trees, and the nibblings of the camel on them showed him the direction it had taken and whether he was nearing his straying beast. The condition of the edges of the nibbled foliage revealed to him whether the bites were recent or old. Stories of a like kind are told to the children in these grades, and when they are promoted to the next, they are given object lessons in observation—a subject in which they glory.

They are shown signs of smudging on blocks, old books and so on, and their instructor asks them to tell the story of the smudges. Some are of paint on wood, others of ink on paper and may be accidental or purposely put on; there are smudges by an untidy pupil or careless ones by a neat pupil. The children are asked, inter alia, whether the smudges were done by boys or girls.

Guesswork is discouraged, and when a child can give no reason for its findings it is told that it has been guessing and will get no marks. The clues are given in the form of a lecture preparatory to the object lesson. They would have been told that a girl's touch is usually lighter than a boy's; that a neat child would endeavour to erase a smudge neatly;

an untidy one would erase it untidily and that many small ones scattered about also manifested an untidy disposition. The teacher gives marks according to the accuracy in reasoning shown.

There are many such ways of setting problems in observation, but the example given will suffice. As the pupils go from standard to standard their lectures become more complex and their object lessons correspondingly harder, until eventually they are asked to give a set of clues and to write an essay in the form of a logical deduction from those clues. Said this instructress to me when I was in England recently: "It would surprise you to see the ingenuity they show. They are not set any particular subject for the essays and are at liberty to choose their own. I find, when the exercise books are handed in, essays headed: 'Is it going to rain? Signs to show that it is.' Or: 'Lost boy found and restored to his parents: How it was done.'"

The subject, in that particular school, is becoming an exact science in as much as the instructors are gaining by their own experience, and are collating "observation" with every other subject on the time table. One morning a pupil stood before the class and told his teacher that he had a theory to expound. It was that his observations had led him to the conclusion that if peas were planted—as had been done in his back garden—immediately they were reaped, so that peas produced on a summer plant were planted when ripe and grew in the winter, some plants were big and others small, and that if seeds taken from these were planted in the following summer three-quarters of them were small; but that if summer peas carried over from the year before were planted in the following summer all the plants were the same as the ones that had grown in the previous summer.

His theory was that summer peas, if planted in winter, produced rubbish unless the seasons were spaced. He was perfectly right, and he had never heard of Mendel. Some day he will doubtless discover something really new.

"THE RAND DAILY MAIL" Readers' Points Of View.  
Education Policy Assists it.

The Townward Drift.

# READE

## THE TOWNWARD DRIFT

### Education Policy Assists it

## THE DANGERS OF CENTRALISATION

*To the Editor, "Rand Daily Mail."*

Sir,—After reading the leading article in last Thursday's "Rand Daily Mail," entitled "The Drift to the Towns," I fail to understand the policy of the Transvaal Education Department in helping the drift to the towns by their method of centralising the country schools.

In my vicinity the Department has closed three country schools; and the children are now conveyed by bus, not to a centralised country school, but to town. There they do not receive tuition in nature study, which they had in the country, where they were taught how to grow crops and vegetables, fight pests in crops and cattle, and so on. Instead, they now have to learn all about electricity, mining, and other subjects which will be of hardly any use to them if they want to make their living on the farm. When these children grow up, is it likely that they will want to go back to the land?

I should also like to call attention to the hardships some of these children have to endure to reach the school. Some of them have to get up while it is yet dark, dress, have a hurried breakfast, and then hurry off to the starting-place of the bus, which starts at 6.45 a.m., to be in time for school. In the afternoon the children arrive home well after three o'clock, which, I consider, makes too long a day for youngsters from six years to fourteen.

ANTI-CENTRALISATION.



Purpose Of Adult Education.  
University Methods criticised.

## PURPOSE OF ADULT EDUCATION

### UNIVERSITY METHODS CRITICIZED

Criticism of university methods was made by Professor Lancelot Hogben, Regius Professor of Natural History, Aberdeen University, in a paper at the conference of the British Institute of Adult Education at Cambridge last night. In discussing "Education for an Age of Plenty," he said that the belief that an education which aimed at unbiased treatment of controversial topics could help to solve the problems of democracy was psychologically false.

"It is easier," he said, "for a university man to feel that he enjoys the best educational facilities of his time than to recognize how little of what he has been taught is of imminent importance." He referred to the "arrogant complacency which is too common among university men," and said that if we could not meet the challenge of dictatorship with a positive educational programme we must make way for a more virile creed.

The medieval rubbish taught as economics in universities was a survival of the Aristotelian belief that a science could be built up from a foundation of self-evident principles. The most urgent need of the adult education movement was to throw overboard the existing classification of social sciences such as economics and frame a curriculum of factual studies relevant to the pressing social needs of the time.

The movement had no need for biology courses of the kind which existed in the universities. It needed courses on malnutrition, public health policy, and the revolution of agricultural technique made possible by recent biological discoveries. It had no need for elegant expositions of useless literature, but should further the study of language as a means of peaceful communication between nations.

### CAUSES OF WAR

Addressing the conference on Saturday SIR NORMAN ANGELL said war was the outcome not of bad intention but of bad political judgment, defective understanding of the conditions indispensable to peace. Most nations to-day were claiming that they wanted only to be secure from attack and for such security must be stronger than anyone likely to attack them. That sort of argument was used usually without the realization that if one nation used it another was entitled to do so; and that if both demanded the right to be stronger than the other the outcome must be war.

MR. W. O. LESTER SMITH, Director of Education, Manchester, said the adult tutorial system provided an excellent opportunity for a political education in an atmosphere of unfettered discussion. Adult education did not want the kind of cheap advertisement which, to its jeopardy, had invaded the physical training movement. He said that he travelled every day on a crowded omnibus in Manchester but used to travel in first class railway carriages from Essex to London with gentlemen of the Stock Exchange type. "I found the intellectual conversation on the bus was vastly higher," he commented.

THE "STAR" Readers' Views: Bantu Schools  
Transfer Of Education Welcomed. A.D.Mdontswa

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United S. A. Pa...

**BANTU SCHOOLS**  
**TRANSFER OF EDUCA-**  
**TION WELCOMED**

*To the Editor of The Star*

Sir,—Native education in South Africa has always been the missionary's burden. In order to educate the African tribes, the various missions had to depend on the contributions from Africans to build and equip school-rooms and also on Government grants-in-aid as salaries for teachers, who, in some of the four Provinces, have no pension schemes. To make it still worse, whilst the Union Government has always been blamed for its negligence over the education of natives, to-day it seems a tragedy that when the Government is fully prepared to assume its responsibility, the Natal natives should oppose the transfer, which is the only alternative policy to lay a better foundation for the educational welfare of the aboriginal races, who a few years ago, agreed to pay the poll tax for their education.

The transfer, on the other hand, does not mean that as soon as it is effected Parliament will have nothing to do with the difficulties confronting native education. With its adoption, several long-time differences will be eliminated; in particular: (1) The erection of a better type of school building, not only in urban areas, through sub-economic schemes with the Native Affairs Department as the central figure; (2) the lifting of such a burden from missionary shoulders; (3) the introduction of a free primary education is bound to follow transfer because, with proper diplomatic relations between the Department of Finance and the Native Affairs Department, perhaps part of the indirect taxation may be utilised to assist native education.

At the present moment there is the amalgamation of higher grade native schools which may end in the establishment of high schools, but, as the Africans kick against their own advancement, there is no doubt such schemes will never be fulfilled.

Segregation has come to stay, and unless the African tribes see their salvation within its confines they will always hail Communism with fateful results; whereas if they go forward with a strong belief and will to achieve the desired end they will develop a culture pro-Bantu, which is the only purpose of the proposed transfer. Various denominations work harmoniously, and there is no need for us to fear, or suspect, that the Department of Education would utterly divorce itself from assisting its growth should need arise. The transfer should not be opposed, but instead, it should be taken as a blessing. In future we may live to prescribe our own syllabus for our schools because we know best what our essentials are—but to-day we are meeting all kinds of disappointments because we have not the chance to dictate what type of education is ideal to us. It is only when one considers the above point of view that one feels the proposed transfer as timely and a gateway to greater educational advancement among the African tribes.

A. D. MDONTSWA.

## FACTS IN SOCIAL HYGIENE—I.

MORAL AND SOCIAL HYGIENE IN  
EDUCATIONBY DORIS V. THOMPSON,  
Principal of Roedean School, Johannesburg.

The aim of education, in the broadest and only real sense of the term, must be a training for life. Yet, how often, teacher, parent and public narrow the aim to the popular limitation of a mere preparation for examinations, an imparting of a certain amount of knowledge in Latin, Greek, mathematics, English.

It is exactly in this broader aspect of their work that we teachers have found Miss Higson's visit of so great value. For moral and social hygiene, to which study she has re-directed our attention, pleads for breadth of view, a constructive and positive attitude in our educational work. We realise very clearly the immense practical difficulties which lie in the way of such broader educational ideals, but there are perhaps two ways at least in which we might more definitely move. Our curriculum could be modified, leading perhaps to more breadth of discussion in our senior classes, and we might make more and better use of the parent and teacher conference.

One of the 20th century movements overseas has been the introduction of biology into the school curriculum. This has also been done in some of the schools of the Cape Province and there is a move towards it in the proposed revision to the science syllabus in the Transvaal Education Department. One argument for it is that it is better to give a general, broad scientific training in the schools, rather than to attempt concentrated study on one branch of science only. But we must be careful that that is not the only reason for the change. A biological syllabus that rests only upon the imparting of knowledge about plant and animal life can become as devitalised as any other part of our teaching. The great reason for its adoption as a subject in the school should be that biology is the science of life, and that in the study of plant and animal life we train our children to think scientifically and unemotionally upon fundamental issues.

Such a study must lead on to physiological study, to hygiene, and to simple psychology. Then, indeed, we give our boys and girls a knowledge for which every one of them hungers at a certain period of life. We give it them scientifically and naturally; we come a little nearer success in trying to help them to see life sanely and as a whole.

## THE MOTHER AS INSTRUCRESS.

In all these matters we are, of course, still faced by the bugbear of what is popularly known as sex instruction. But there are surely few, if any, thinking people who would seriously advocate such an unnatural selection of a portion of the subject as is implied by this phrase. We must beware lest in our desire to avoid the dangers and complications of the past, arising from a mistaken silence on these matters, we allow the pendulum to swing to the other extreme. There is equal danger in any tendency to isolate these matters for particular attention and talk. Let it be taken naturally and unselfconsciously at the right time. What is the right time? For the teaching on the physical facts of motherhood and the coming of the child, the right time is surely when the child, at a comparatively early age, first asks about the baby brother. Complications have already been started when the child is put off with anything but the truth. The right person to tell these truths is the mother herself, and there is no more beautiful truth, to be told in a beautiful way, than this fact of childbirth.

Later, in the course of biological study, the child gains knowledge of the scientific machinery of nutrition, respiration, reproduction, as illustrated in plant and animal and human life, and the desire for knowledge of human mating and of the part which each partner plays, will come naturally and will have more opportunity of being taught naturally when thus brought in due course into the study of the science of life.

But the physical facts must be followed in the later stages by some study of psychology and hygiene. Man is not mere animal, and to treat him

as such and to leave him as such, would be yet another example of one-sided education. The psychological make-up of man and woman can well be taught in its practical applications to our senior boys and girls. We want to encourage that fullness of life which is modern youth's inheritance and privilege and which comes from the free friendship between boy and girl to-day. But that friendship can only be free and life can only be lived at its fullest when the boy and girl know enough of each other's physical and psychological machinery to be able to help and not hinder the development of each other's personality. To those who have an opportunity of a sixth form, and who have already followed a biological course (this is essential), a book such as "Biology and Mankind," by S. A. McDowall, might well be given for study.

Such biological teaching should further tend to break down the barriers which so often exist between teacher and taught. The latter are so apt to think that the teacher stands outside life's realities, its temptations and its joys. If help is needed on some of these sex problems during later school life, the pupil will perhaps go more readily to one who has shown a sane and natural knowledge of these things in the science room.

Above all, of course, what is wanted is teachers of vision and consecration, not only capable of teaching the facts of their subject, but of seeing and bringing out the significance of these. This would, of course, apply equally to all subjects. In spite of the tyranny of examination syllabuses, should we not oftener make our subjects more vital by linking them with the facts of life? Even stocks and shares might take on a more human aspect if linked to the business life of the home!

## THE WIDER VISIONS.

It would be well, could we have as part of the training in every normal college, lectures on moral and social hygiene, which will help to give the students vision on this broader aspect of education. For when all is said and done, the only people who can really give lasting help to our young people are those who have themselves been trained to think out the meaning and responsibility of social relationships. Religious teaching, training as it should do the spiritual side of our natures, is not in itself enough. It is essential, but, unless related to social responsibilities and human problems, it will be threatened with a like ineffectualness as has threatened all our religious life during the past century. Divorce between religious and secular life is unnatural and deadening to both, for life is a unity and only the unity of spiritual mental and physical sides of human nature, into one purposeful whole, can lead to a balanced, controlled and effective personality.

The Parents' Conference too, should be a fruitful aid to this broader education. For, in every child's training, the responsibilities are divided between these two, parent and teacher. So often they work in isolation, sometimes even in antagonism, whereas by consultation they could so much better understand the pupil's need. So often the Parents' Conference degenerates into a mere discussion on school attainments and on openings for the future, whereas every part of the child's development, mentally, socially, spiritually, demands careful and broad consideration. The Parents' Conference could surely do more than is often done towards uniting home life and school life, in unifying the methods adopted by parent and teacher, each helping the other to see the whole problem from every point of view.

It will be of unquestionable advantage to this country if we are able to appoint a national lecturer in moral and social hygiene to carry on the work which Miss Higson has begun in her short visit to us. There are none who have come into contact with her and heard her lectures who will doubt the value of such an appointment.

RAND DAILY MAIL, JOHANNESBURG, MONDAY, NOVEMBER 26, 1934.

## THROUGH TIME AND SPACE

### XVII.—Bombardment of a Million Meteors

By SIR JAMES JEANS,

The famous Scientist and Author.

LET us now step out of our rocket and survey the lunar scenery.

It is natural to wonder why the scenery of the moon is so different from that of the earth. Is the moon formed of different stuff from our earth, or was it formed out of similar stuff but in a different way, or can the whole difference be traced to a difference of physical conditions?

It seems probable that the lunar mountains were formed in the first instance as wrinkles on the cooling moon. But the gases and water vapour which were expelled from the interior could not stay encircling the moon in the form of atmosphere and seas; their molecules would simply soar off into space.

Thus the factors which have smoothed the outlines of our terrestrial mountains have been lacking on the moon from the very outset, and the lunar mountains have remained perfectly clear-cut in shape.

Yet something must have happened on the moon to give the mountains those sharply-cut outlines; they are broken rocks, and something must have broken them.

Indeed, observers have occasionally seen what they have believed to be clouds of dust such as might result from falls of rock.

As there is neither rain nor ice on the moon to break up its rocks, there must be something else at work.

#### A WALK ON THE MOON

If we take a walk on the moon, we may soon find out what this is.

We have seen how hard fragments of rocky or metallic substance are continually bombarding the earth's atmosphere from outer space.

The smaller fragments live a brief, but very vivid and brilliant life, as shooting-stars, and evaporate harmlessly into dust before they reach the surface of the earth, but we have seen that the larger fragments may do a great deal of damage.

Similar bodies must of course be continually bombarding the moon, but here they find no atmosphere to check their fall and to dissipate the majority into dust before they can do any harm.

Big and little meteors alike strike the surface of the moon with exactly the motion with which they have previously been moving through space—like a rain of small bullets and big cannon-balls.

I have read a great many stories of travels on the surface of the moon, but their writers all forgot that the explorers would be under a continuous hail of fire from these objects. The experience might not be altogether amusing.

At a moderate computation, more than a million shooting-stars and meteors must strike the surface of the moon every day, their speeds averaging perhaps 30 miles a second, which is about one hundred times the speed of a rifle bullet.

#### A TERRIFIC BOMBARDMENT

At a speed of 30 miles a second, a tiny pellet of matter has as much energy—and also as much capacity for doing damage—as a motor-car moving at 30 miles an hour, while a half-pound meteor has the same energy as the Royal Scot rushing along at 70 miles an hour; there would not be much left of a house if such a meteor fell on it.

Clearly we terrestrials owe a good deal to our atmosphere for saving us from this sort of adventure.

All the evidence goes to show that the surface of the moon consists in the main of a mass of volcanoes and their outpourings of lava and volcanic ash.

It is possible to test this conjecture scientifically. Let us imagine an eclipse of the sun occurring during our visit to the moon. What shall we find?

We must expect our foremost sensation to be one of extreme cold.

Those of us who have been present at an eclipse of the sun on earth know that it can get fairly cold when the sun's light is suddenly shut off, but the earth has warmth stored in its atmosphere and soil which saves us from being completely frozen.

Here on the moon there is no atmosphere to store up warmth, and we cannot expect much from the soil, since volcanic ash is an exceedingly poor conductor of heat, being just about as poor as the asbestos which the plumber packs round hot-water pipes to prevent the heat escaping.

#### SENSATIONAL CHANGES OF TEMPERATURE

Thus, when the sun's light and heat are shut off we must expect the more than tropical heat of the full sun to give place to a cold more intense than anything known on earth.

And this is what happens. In a factory we may occasionally see a workman pointing an instrument known as a pyrometer, towards some point of an oven or fire to discover its temperature.

In precisely the same way, in an observatory an astronomer may occasionally point a telescope furnished with a thermocouple towards a star or a point on the moon's surface to discover its temperature. In this way the changes of temperature on the moon's surface can be followed through the various stages of an eclipse.

The changes are found to be quite sensational, both in amount and rapidity.

As the earth's shadow passes across the face of the moon, and covers any particular spot in darkness, the temperature at that spot may be observed to fall from about 200 degrees Fahrenheit to about 150 degrees below zero within a few minutes.

Such a rapid fall of temperature suggests at once that but little of the heat stored in the moon's interior comes up to its surface, which, of course, means that the moon's surface layers must be bad conductors of heat.

Actual calculations show that they must have just about the same feeble conducting capacity as volcanic ash.

#### BLANKET OF VOLCANIC ASH

Equally violent changes of temperature occur at the ordinary rising and setting of the sun, although, of course, not with the same startling rapidity.

The temperature may be as low as 250 degrees below zero Fahrenheit before sunrise and may have risen to more than 200 degree Fahrenheit, or about the ordinary temperature of boiling water, by the time the sun is directly overhead.

Through all these changes the blanket of volcanic ash keeps the interior of the moon at a fairly uniform temperature; if we dig only about an inch down we shall come to a steady temperature somewhere near to that of melting ice.

Taking all the evidence together, it seems very probable that the moon's surface does consist of volcanic ash; it behaves like volcanic ash in its very low capacity for conducting heat; and, what is equally significant, it lies at the feet of what are almost certainly volcanoes.

(To be continued.)

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# THROUGH TIME AND SPACE

## III.—The Birth of the World

By SIR JAMES JEANS,

The famous Scientist and Author.

THE earth was born in a cataclysm which would probably stir up the various constituent substances and mix them up, even if they were not thoroughly mixed already. Then, as peace and calm succeeded to turmoil and confusion, the lighter substances would begin to float upwards, while the heavier would sink towards the centre of the earth.

All this time the earth is cooling; at last it begins to liquefy, and after this to solidify.

As soon as a piece of the earth has once solidified its various constituent substances are no longer able either to sink or rise; they are trapped in the solid mass, and must stay for ever where they were when the process of petrification overtook them.

The distribution of light and heavy substances in the earth's crust and interior shows that the process of arrangement was well advanced, but not complete, when the earth solidified.

The outermost layers of the earth, having no blankets around them to keep the heat in, would of course cool most rapidly, and so be the first to solidify. When this had happened the earth would consist of a solid outer crust enclosing a hotter interior of gas and liquid—rather like a mince pie, in which we know that a deceptively cool exterior often conceals an interior which is too hot to eat.

Just as with a mince pie left to itself, this would be succeeded by a stage in which the inner layers would also begin to cool and probably also to shrink, since most substances, and especially gases, shrink as they cool.

### THE CRUST AND THE PIE

The crust of an ordinary mince pie can easily support its own weight, but the crust of a mince pie which weighed a million tons would not be able to do so, and it must have been the same with the far more massive crust of the earth.

As the inner layers shrank away from under it, and no longer supported its weight, it must gradually have caved in upon these inner layers to find support.

In so doing it was faced with the problem of how suddenly to grow smaller, although it had already ceased contracting—a problem which it solved in the only possible way, by crumpling up into wrinkles and folds, just as an apple does when its softer centre shrinks with the onset of old age.

In some such way as this, the earth formed its mountain ridges and valleys.

The process is not entirely ended yet; the earth's surface is still moving slightly, falling in here and being pushed up there so that new elevations and depressions are for ever being formed.

Occasionally a sudden slip may result in an earthquake such as we have already discussed. At other times the steady pressure of the falling or fallen crust may squeeze the hot material up through cracks and crevices until it emerges on the surface of the earth, as we see in volcanoes, oil wells, and in the spoutings of hot water known as geysers and hot springs; such happenings must have proceeded with incomparably greater vigour in the early days of the earth's history, and have left their marks very unmistakably on its present condition.

### LEGIONS OF VOLCANOES

For although there are few active volcanoes on the earth now the number of mountains which show evidence of having once been volcanic is enormous. Immense streams of lava and molten rock which they poured out in long-past ages still lie spread over large parts of the surface of the earth, and form the layers of rock which we describe as "igneous"—rocks laid down by fire. A lava flow at Ballantree, on the Ayrshire coast, which must clearly have flowed directly down to the sea, was immediately petrified into its present "pillow" formation, and has retained its original form, through perhaps 400 million years, to the present day.

The basaltic rocks of the well-known "Giant's Causeway" in Antrim form evidence of a similar outpouring of molten rock, which must have crystallised at once into its present hexagonal form.

These rocky outpourings from primeval volcanoes provide us with true samples of the substance of the earth's interior. Water and gases must have been forced up in a similar manner and would, of course, have made their contribution to the earth's ocean and atmosphere.

When the earth's crust fell in upon the shrinking inner mass, its wrinkles would not form entirely at random. For the crust would be likely to contain lighter and heavier parts.

On the whole, the lighter parts would most readily be thrust up to form mountain ranges, while the heavier parts would tend to sink to the bottom

of the folds, and form valleys and sea-bottoms.

Thus we should naturally expect the mountains to be of lighter substance than the bottom of the sea. Recent careful measurements have shown that this is actually the case.

### A NEW THEORY

Recently, a theory known as *isostasy*, has given greater precision to these ideas.

It asserts, in brief, that mountains stand up above the level of the land for just the same reason that ships stand up above the level of the sea—because they float.

It also supposes that, as with a ship, their total weight determines the height at which they float.

A ship whose total weight—hull, cargo, crew, captain, and all—is 30,000 tons will float at a height at which she displaces exactly 30,000 tons of water; in other words, if she were suddenly lifted out of the water, she would leave a hole which it would take 30,000 tons of water to fill.

The theory of *isostasy* supposes that the height at which mountains float is determined in precisely the same way.

The mountains are not, of course, supposed to be floating in water, or in any true liquid, but in some inner layer of the earth's substance which is plastic enough to behave like a liquid.

Various calculations suggest that we have to go to a depth of perhaps twenty miles to reach this plastic layer, and the heat at this depth will probably provide the small degree of plasticity needed.

The theory tells us that a mountain which weighs a million million tons will

### CUT OUT THESE ARTICLES

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float at just such a height that it displaces a million million tons of this plastic inner layer.

The most refined and careful measurements of which science is capable indicate that this theory gives an accurate account of the observed heights of the mountains.

### CONTINENTS AFLOAT

I must here digress to tell you of a more recent theory, put forward by a German scientist, Wegener, which is perhaps even more interesting, although it has not yet gained such widespread acceptance from scientists.

According to this theory, the continents and larger islands are also floating, and not only like ships, but like independent ships, which can approach towards and recede from one another.

The old and new worlds are supposed originally to have formed a single big ship, which suffered shipwreck and broke into two, after which the parts drifted away from one another, the one forming Africa and Europe, while the other formed the American continent.

It is claimed as evidence that if the New World were towed about 3,150 miles to the E.N.E. it would fit very prettily on to the Old World, the point of Brazil on which Pernambuco stands fitting into the Bay of the Cameroons on the African coast.

We cannot dismiss this close fit as a pure coincidence, for not only are the coastlines similar on the two sides of the Atlantic, but also the mountains, the rocks, and even the fossils.

For these reasons geologists have for long suspected that the two continents had once formed a single mass; the new theory provides an explanation of how they became separated.

If North America is now towed still further to the east, it will fit quite well on to Europe, New England fitting on to our Old England.

Wegener believes that all the land which stood out above the sea some hundreds of millions of years ago can be fitted together to make one continuous continent, which would then cover about a third of the face of the globe.

(To be continued.)

# THROUGH TIME AND SPACE

## XIX.— We Shall Find No Men on Mars

By SIR JAMES JEANS,

The Famous Scientist and Author.

STILL travelling out into space and increasing our distance from the sun, we pass by our own earth, which we have already studied sufficiently, and come next to Mars.

If Venus is a twin sister of the earth, Mars is the earth's little brother.

If Venus is a warmer edition of the earth, Mars is a much colder edition.

If Venus suggests a picture of what the earth may have been in the remote past, Mars suggests what the earth may possibly be in the remote future.

Mars cannot compare with Venus or the earth in bulk and substance, having only a little more than half the diameter, and only a little more than a tenth of the substance, of the earth.

A considerable thickness of atmosphere is still left on Mars.

No direct evidence of water vapour in the atmosphere can be found, although it has often been thought that there is a certain amount of circumstantial evidence that water vapour is present.

Mars has its alternation of hot and cold seasons as we have, and it is noticed that certain features of its surface change regularly with the seasons.

### WHITE CAPS AT THE POLES

White caps, for instance, appear round the poles in the cold season and disappear in the warm season. It has often been conjectured that these may be ice or snow—perhaps clouds of icy particles in the air, or perhaps fields of snow on the ground—although it is, of course, also possible that the snow may be merely carbon dioxide or some substance quite other than frozen water vapour.

It is also noticed that dark patches appear regularly in the Martian spring, and fade away again in the autumn—mainly in the tropical regions and southern hemisphere.

It was at first thought that these were real seas of water, but this is now considered improbable. For one thing, they vary too much and too rapidly in colour; one, for instance, was observed to change from blue-green to chocolate-brown and back again within a very few months.

They also resemble the supposed seas on the moon in never reflecting the sunlight, as sheets of real water would do. At one time astronomers thought they might be forests, or masses of vegetation.

Since then the surface of Mars has been examined in the same way as the surface of the moon, and appears to be of somewhat similar composition—possibly volcanic lava or some such substance.

Thus the dark patches may be produced by showers of rain wetting a dead dry surface like that of the moon.

### AN INHOSPITABLE CLIMATE

If we are planning to take our rocket to Mars, it is clear that we must again take air and water with us. We must also be prepared for an exceedingly inhospitable climate, and we may as well know the worst before we start.

Mars has days and seasons very like our own. It takes 24 hours and 37 minutes to turn on its axis, so that its day is slightly longer than ours. And as this axis is tilted at an angle of 25 degrees 10 minutes, as against the earth's angle of 23 degrees 27 minutes, we must expect to find the Martian seasons rather more pronounced than ours on earth; there will be a greater difference between summer and winter.

If we are planning to land our rocket on Mars, we may as well take advantage of what warmth there is—even so, we shall soon find there is little enough.

Let us then arrange to arrive when Mars is nearest the sun and to land slightly south of the equator at midday.

Here we may find a temperature as high as 60 degs. Fahrenheit.

But if we cherish any hopes that we have come to a fine, warm climate, they will be dispelled as evening closes in. For there are neither clouds nor atmosphere enough to retain the planet's warmth, so that it will get cold with great rapidity as soon as the

direct radiation of the sun diminishes—just as on a terrestrial desert, only far more so. It is likely to freeze before sunset, and may well fall to 40 degrees below zero before the sun reappears on the scene.

### THE SUPPOSED "CANALS"

This is the very best climate Mars can offer. If we travel to the poles we must expect to encounter temperatures of more than 100 degrees Fahrenheit below zero.

When we step out of our rocket we must expect the general nature of the scenery to be rather like what we found on the moon.

Are we likely to encounter Martians? It is a thrilling question, although now that we know more about Mars it is less thrilling than it was a few years ago.

In 1877, the Italian astronomer Schiaparelli studied Mars very intensively through a low-powered telescope, and announced that in addition to the large markings that looked like seas there were finer markings which, writing in Italian, he described as "canal."

He used this Italian word merely to indicate channels of water, like the Grand Canal and the other canals in Venice, and did not mean to suggest that there were canals in the English sense, either straight lanes of water or the work of intelligent beings.

Yet, as his description of them was translated into English by the word "canals," people began to argue that if there were canals, there must be intelligent beings to make the canals, and have so argued ever since.

### NO "MARTIANS"

Of late, however, doubts have been expressed as to the very existence of these channels or canals. There seems to be little doubt that astronomers see two different kinds of markings on Mars, which may properly be described as "subjective" and "objective."

When the human eye is straining to its utmost to see things by inadequate light, there is an unmistakable tendency for it to see imaginary straight lines connecting up dark patches.

If we decide to take our rocket to Mars, I do not think we need trouble much about the prospect of meeting Martians.

We are more likely to find an uninhabited and inhospitable desert, which may not show quite the same extremes of climate as the moon, but may be even worse in some ways, since what warmth there is will never last for more than a few hours at a time.

If we leave Mars and continue our journey outwards into space, we shall find that we have to travel a very long way to pass from Mars to the next planet Jupiter.

Our journey may not be devoid of incident, since it will take us through the shoals of minor planets or asteroids.

The largest of these, Ceres, has a diameter of only 480 miles, which is less than a quarter of the diameter of the moon, and the only known limit to the size of the smallest asteroids is that set by the power of the observer's telescope.

### AMONG THE ASTEROIDS

Smaller than the smallest asteroid we can see, there must be thousands that we do not see from the earth because they are too small to be seen. We may be able to see a number of them from our rocket, as this traverses the long distance between Mars and Jupiter.

Many of the asteroids are turning round in space, a complete rotation frequently occupying from eight to ten hours, and a number vary in brightness as they rotate.

The reason for this variation is probably that the asteroids in question are irregular in shape, so that, as they rotate, the amount of surface they expose to our view continually varies. The huge gravitational pull of a big object such as the earth results in the object becoming very nearly spherical in shape, but a small body is not affected in the same way, and many of the asteroids are so small that gravitation can have done but little to mould them to a spherical shape.

On many of them the pull of gravitation is so feeble that a good cricketer would be in danger of bowling all his balls off into space, and the batsman of making every ball a lost ball—lost for ever and ever, as the ball would itself become a new planet circling round the sun.

Needless to say these asteroids are far too small to retain atmospheres.

(To be continued.)

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