arbitrary moving charge from its Coulomb's field[1]. Strange to say, those obtained from this transformation agree perfectly with the field usually obtained through the solution of Maxwell's equations. This not only demonstrates that our physical idea is probably correct, but also shows how remarkable Maxwell's equations are, in perfect harmony even with this idea of relativity of acceleration. The inverse coefficients, solved from the above by determinant methods, should give the field as observed by an accelerated observer but due to a charge at rest. The results agree, using the apparent velocity and acceleration, beautifully with the field due to an accelerated charge. I think this can be experimentally verified. Can we now believe in the relativity of acceleration?

The contraction coefficients or effects are remarkable when we compare them with the results deduced from Einstein's principle of equivalence and his gravitation theory. But I believe the advance of the perihelion of Mercury and the deflexion of light beams can be obtained without the use of his theory of gravitation[2].

The relative nature of acceleration is apparent when we remember that at every instant the relativistic formulæ of Lorentz were used, that is, the motion has been relative all the time. The inverse transformation coefficients illustrate such relativity most clearly.

Some new difficulties come in when we assert the relative nature of acceleration. Acceleration is not like uniform motion, which Newton claims does not need any *cause* to maintain it. If I accelerate, I shall find that all the matter in the universe is accelerating towards me. What are the causes for such *en bloc* motions? (This difficulty also appears for uniform motion, though it is usually ignored. It is also strange for the *en bloc* uniform motion of all the matters in the universe *if* I move uniformly.) I shall not take Einstein's principle of equivalence as the answer, for it might equally well be asked where the gravitational field comes from, as gravitation must be caused by matter even in Einstein's general theory.

I cannot answer these questions at present (this paper is far from complete, and would not be presented for publication if not for the fact that our University is moving to Hangchow and will not settle down for at least six months), but I wish to point out that these *en bloc* accelerations are not quite true, and that the acceleration is not quite arbitrary as we may think at first when considering a man walking arbitrarily. Acceleration, as we know, is connected with the distance of the particle from other particles and 'a man walking' is an intricate macroscopic many-body problem. However, on multiplying the general $\partial t/\partial t'$ coefficient by m_0c^2,

$$m_0c^2\frac{\partial t}{\partial t'} = \frac{m_0c^2}{\sqrt{1-\beta^2}} + \frac{r'm_0\Gamma_r}{(1-\beta^2)(1-\beta_r)} \doteq m_0c^2 + \frac{1}{2}m_0v^2 + r'F_r,$$

we see that it must be in the nature of energy. The first term corresponds to Einstein's kinetic and rest energy, the second term must correspond to potential energy. But the potential energy is ordinarily defined by an *integral* $V = -\int\vec{F}\cdot\vec{dr}$. [For the two expressions to agree, it is necessary that, for small velocities and large distances,

$$V = rF_r = -\int\vec{F}\cdot\vec{dr}.$$

The only solution of this equation is $F = \lambda/r^2$, where λ is an arbitrary constant. Thus we see that the ordinary notion of force, at least in this specified inverse square law, is intimately connected with the relativity of acceleration, and there is really not much difficulty in getting rid of the idea of force altogether.

Finally, I wish to thank M. H. Wang, K. C. Chen and S. C. Kiang for collaboration and for their valuable suggestions. I must also thank Prof. K. C. Wang, Prof. T. L. Ho, both professors of physics in this University, Dr. Y. F. Tseng, deputy chief secretary to the Central Executive Committee, and my young brother Dr. C. P. Soh, publisher of the *Shanghai Herald*, for help and constant encouragement. To my brother especially, who has aided me financially, I tender my deep gratitude.

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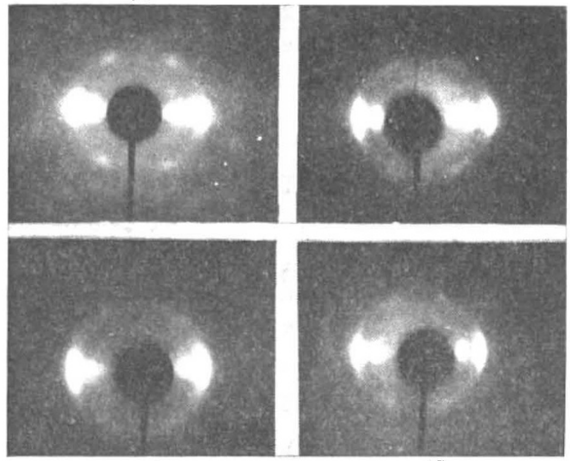
[1] *Nature*, **157**, 809 (1946).

[2] Compare, for example, Cheng, *Nature*, **155**, 574 (1945), who considers only first-order *contraction* effects.

Effect of Dyeing, Mercerizing and Intensively Delignifying Jute Fibres on their Structure

THOUGH jute is a commercially important fibre, the study of its internal structure has not received so much attention as other cellulose fibres such as cotton and ramie. X-ray investigations of jute have recently been started in India. Banerjee and Roy[1] have found that the lattice structure of the cellulose crystallites in jute is identical with those in other cellulose fibres. The presence or absence of resins, fats and lignin does not produce any change in this structure. They have also found that the mean dimensions of the cellulose crystallites in jute are of the order of 62 A. along the fibre axis and 25 A. and 40 A. along the *a* and *c* axes respectively, so they are much smaller than those in ramie or cotton. The work is being carried out by Sircar, Rudra and Saha[2].

(*a*) (*b*)



(*c*) (*d*)

a, RAW JUTE DYED WITH CONGO RED. *b*, RAW JUTE DELIGNIFIED. *c*, RAW JUTE MERCERIZED AND DYED WITH METHYLENE BLUE. *d*, RAW JUTE DELIGNIFIED AND DYED WITH METHYLENE BLUE

X-ray photographs of jute fibres that have been subjected to intensive delignification have been taken by us. We have found that extensions of the spots take place so as to form arcs through them along the directions of the Debye–Scherrer rings. The positions of maximum intensity on the spots or their diffuseness along the radial direction are quite unaffected (Fig. 1*b*). This shows that lattice structure of the cellulose crystallites and their sizes are unaffected, while their ordering along the fibre axes has considerably deteriorated. The milder delignifications, however, as noted by the previous workers, do not produce this change. It is therefore concluded that a fraction of the lignin in jute helps to align the cellulose crystallites to parallelism and form bundles or fibrils of cellulose. This part of the lignin is much more difficult to remove than the remainder, in which apparently these fibrils are imbedded.

The effect of dyeing raw, completely delignified and partially mercerized jute fibres with Congo red and methylene blue has also been studied by X-rays. In the cases of raw (Fig. 1,*a*) and delignified jute fibres, it has been found that the X-ray pattern does not undergo any change, showing that the crystalline portion remains unmodified in structure as well as in alignment with respect to the fibre axis. It is particularly interesting that the dishevelling that is produced by the intensive delignification also remains unchanged (Fig. 1,*d*). This shows that the absorption of these organic dyestuffs is a superficial effect. Jute fibres treated with 25 per cent caustic soda solution at a temperature between 25° and 30° C. for half an hour showed diffraction spots corresponding to both native cellulose as well as mercerized cellulose. Dyeing by means of these organic dyestuffs also did not, in this case, produce any change in this partially mercerized structure (Fig. 1,*c*). So the crystallites of mercerized cellulose also are quite unaffected by the process of dyeing, both as regards internal structure as well as alignment.

We wish to thank Prof. K. Banerjee for suggesting the problem and for advice during the progress of the work.

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[1] Banerjee, K., and Roy, A. K., *Proc. Nat. Inst. Sci. India*, **7**, 376 (1941).

[2] Sircar, S. C., Saha, N. N., and Rudra, R. M., *Proc. Nat. Inst. Sci. India*, **10**, 325 (1944).

Resistivity of Thin Nickel Films at Low Temperatures

IN an earlier communication[1], we reported on measurements on the electrical resistance of thin nickel films. We found at that time that for a thickness greater than 40 mμ the films possess a positive temperature coefficient, whereas for smaller thicknesses the temperature coefficient is negative. The films were made by cathodic sputtering.

We have now measured the resistance of such films as a function of temperature down to liquid helium temperatures. We were able actually to observe that, on cooling films thicker than 40 mμ down to very low temperatures, the electric resistance passes through a reversible minimum and the temperature coefficient changes from positive into negative. The nearer the thickness approaches to 40 mμ, the more the minimum in the resistance curve is displaced towards higher temperatures. So we were able to observe that for one resistance the minimum was in the neighbourhood of about 150° K. In the accompanying figure are curves obtained for three films showing minima in the resistance curve.