siting a refinery in the Isle of Grain; of the engineering, technical, political and local environmental difficulties which had to be overcome in planning such a vast enterprise to meet, at the time, the unforeseeable demands for petroleum products years ahead. In this graphic account are linked some of the well-known personalities in the Company who were concerned with the initiation and construction of this plant, admittedly involving highly organized team-work under their direction, without which the scheme could never have met with success. It makes fascinating reading, because the human effort involved in overcoming natural difficulties of the site, weather, floods and other hazards, inevitably bound up with industrial developments in raw estuarine territory such as the Isle of Grain (common to so many of the world's major refinery locations), is so modestly described.

The third article, entitled "And Before the Ink was Dry", is a technical account of the growth of this Kent refinery; it brings the whole project up to date. "The establishment of a new 'grass-roots' refinery must be influenced by the market requirements, the technology available at the time and the forecasts of the foreseeable future. The history of Kent Refinery is not peculiar in these respects but the seventeen years since the project was conceived and the ten years since the first oil was processed in the refinery have been years of unprecedented change in all these directions." It is recorded that the through-put in the first full year of operation was 3·4 million tons; the 1962 figure is 9·8 million tons. Before the ink is dry in drafting new specifications for extensions to the plant, operations and products-output, technical advances move apace and overtake contemporary ideas. The oil industry is one of the most flexible of all; it is the sense of urgency and adaptability which have made it the dynamic influence it deservedly exerts in our times.

GRAVITATION IN THE U.S.S.R.

M. A. GARBELL of the Garbell Research Foundation, San Francisco, California, believes that gravitation together with its relativistic and quantum theoretical aspects constitutes the final problem of modern theoretical physics, and consequently he has taken considerable trouble to produce a detailed report of the First Soviet Gravitation Conference which was held during June 27–30, 1961, at the School of Physics, Moscow State University*.

The report consists of two parts. Part 1, composed by M. A. Garbell, contains synopses and abstracts of each of the seven subject sessions into which the conference was divided, together with analytical comments, annotations and guiding references to other pertinent papers. Part 2 consists of a full translation from the Russian of the condensed versions of the eighty-three contributions presented to the conference and which were published by the State University in 1961. The first two sessions were devoted to the classical theory of gravitation, and the subsequent sessions to non-Riemannian generalizations of geometry, the quantum theory of gravitation and non-linear equations, experiments, cosmology and gravimetry respectively.

In his general review, M. A. Garbell comments that the conference was devoid of any momentous breakthrough, and though the assembly consisted of members of the foremost Soviet schools of thought on gravitation, relativity and quantum physics—with the conspicuous absence of V. A. Fok and representatives from European satellite countries—the gathering seemed painfully perplexed with endless questions, nearly all of which remained unanswered. In general, theoretical concepts based primarily on Einstein's theory of relativity were advanced, but there were exceptions such as Petrov's classification of Einstein spaces, Ivanenko's contributions towards a non-linear unitary field theory, the atomic and molecular clock satellite programme of the Dubna group, and Smorodinskiy's ideas on the neutrino–antineutrino world.

Academician Blokhinstev commented that any assumption that the gravitational charge of an antiparticle might be negative, or even that the gravitational charge of a photon might be zero, would constitute an insurmountable paradox. Kadyskevskiy proposed the β-decay length of weak interaction as an irreducible unit for the smallest finite spatial building block of the universe. Two proposals were made by the Joint Nuclear Research Institute (Dubna) group for gravitational experiments in the laboratory. The first was an experiment in which the emission of gravitational waves could be detected without the necessity for setting up a receiver-absorber to pick up the emitted waves, and the second a vertical beam experiment for the detection of any negative gravitational mass of the *K*-meson antiparticle by means of an interference method first described by M. Good of the University of Wisconsin.

Soviet support in cosmology is for a non-homogeneous and anisotropic universe and there were strong suggestions that the neutrino exerts a substantial effect on the determination of the geometry of the universe.

S. WEINTROUB

* Garbell Research Foundation, San Francisco. Garbell Aerospace Series, No. 9: *Theses of the First Soviet Gravitation Conference held in Moscow in the Summer of 1961.* By Maurice A. Garbell. Pp. 130. (San Francisco, California: Garbell Research Foundation, 1714 Lake Street, 1963.) 7.50 dollars.

SICKLE-CELL ANÆMIA

AN investigation of the clinical manifestations of sickle-cell anæmia found in the Wankie district of Southern Rhodesia, prepared by Dr. Trefor Jenkins of the University of Natal, indicates that the disease is similar in most respects to that found in the Congo Republic, and differing only slightly from that found in West and East Africa*. The more marked differences between the condition seen in Africa and the United States have been confirmed.

Although the condition is not common in Southern Rhodesia, it is felt that many cases of sickle-cell anæmia have passed unrecognized over the years because practitioners have been unaware of the African 'variety' of the disease. Most medical text-books still describe the disease as it occurs in the American Negro, between the ages of five and ten years, when it is characterized by arthralgia, fever, anæmia, cardiomegaly, abdominal pains simulating one of a number of surgical emergencies, chronic punched-out ulcers about the ankles and a variety of neurological disturbances resulting from cerebral thromboses.

The disease as it occurs in Africa affects a much younger population, the average age at diagnosis varying from just less than four years in Nigeria to just more than one year in the Congo Republic. Hendrickse raises doubts concerning the very young age at diagnosis in the Congo series. Because the diagnosis had not been confirmed by electrophoretic examinations of the hæmoglobin, he

* *The Central African Journal of Medicine*, **9**, No. 8; August, 1963.

suggests that many of the cases might be examples of primary malarial anæmia in children with the sickle-cell trait. The present small series of proved cases of sickle-cell anæmia with an average age at diagnosis of 1·04 years would indicate that in Central Africa the disease manifests itself at a significantly earlier age than it does in Nigeria.

African children under the age of two years have a high incidence of dactylitis. This is also true of American Negro children. Of 54 children with symptoms occurring before the age of two years, no fewer than 25 showed osteopathy of the metacarpals or phalanges.

No one has given a completely satisfactory explanation for the pathognomonic findings in the hands and feet of the very young children with sickle-cell anæmia. The tentative explanation put forward by Hendrickse that the mother's method of carrying the child on her back produces venous stasis in the periphery of the limbs with the resultant hypoxia and intravascular sickling would be difficult to test in Africa. However, in the United States' where the more sophisticated method of transporting babies in perambulators is used, it might be possible to disprove such a hypothesis if the dactylis were found to occur in children who had never been carried on their mother's backs.

The percentage of children less than two years showing hepatosplenomegaly was not materially different from that seen in the United States or in other parts of Africa. Lymphadenopathy and chronic leg ulcers described so commonly in the American series were not features of these cases: this is in agreement with the experience of other workers in Africa.

There is no evidence to suggest that minor variations in the clinical features of sickle-cell anæmia as seen in different parts of Africa have a genetic basis. The earlier age diagnosis in Leopoldville and Wankie when compared with Ibadan might simply reflect the ease and the readiness with which mothers bring their children to hospital.

STIMULATED EMISSION IN THE FAR INFRA-RED

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STIMULATED emission of radiation from electronic transitions in a molecular system was recently reported[1,2]. The source was a pulsed electrical discharge tube containing the molecular gas. It seemed possible that the same arrangement might give stimulated emission from vibrational or pure rotational transitions and hence to radiation at much longer wave-lengths. This article reports preliminary results of experiments designed to observe far infra-red radiation. Stimulated emission was detected at a number of wave-lengths between 23 and 79μ.

The experimental arrangement was a glass tube 4·8 m long and 2·5 cm internal diameter closed at one end by a plane aluminized mirror and at the exit end by either: (*a*) a plane polyethylene window 3 mm thick, or (*b*) a plane silicon window 1 mm thick. Both the mirror and the silicon window were aligned so that their faces were normal to the axis of the tube. Vacuum seals were made with 'Neoprene' O-rings or 'Epoxy' resin. The tube was not baked. It was filled with water-vapour to a pressure of about 1 torr. High-voltage d.c. pulses were applied to two tungsten electrodes sealed through side arms on the tube.

The pulses were produced by a delay line-type pulse generator followed by a 5 : 1 step-up ratio pulse transformer. The delay line was designed for a nominal pulse-length of 1 μsec and had an impedance of 10 ohms. The only load on the generator was the discharge. Consequently, the mismatched impedances in the early stages of breakdown produced a sharp spike on the leading edge of each pulse. The shape of the pulse was approximately triangular with a rise time of 0·5 μsec and an overall duration of 2·9 μsec. The peak voltage and peak current (omitting the spike) were approximately 46 kV and 13 amp respectively.

The radiation transmitted through the window was analysed in the first instance with a spectroscopic system comprising a Michelson interferometer, a mirror condenser system, and a Golay cell. The arrangement and essential dimensions are shown in Fig. 1. The tank containing the interferometer and the detector was evacuated. The discharge was operated at a pulse repetition frequency of 10 c/s to suit the time-constant of the Golay detector. The amplified signal from the detector was rectified in synchronism with the pulses. Interferograms were recorded and spectra were derived from them by Fourier transformation[3].

With the polyethylene window (with which there were negligible multiple reflexions inside the tube), the radiation was dominated by a strong line at a wave-length of 28μ. Interference fringes were recorded with path differences up to 30 cm, indicating that the width of the dominant line was less than 0·03 cm^{-1}. The mean power reaching the detector was of the order of 100 μW. When the silicon window was used the intensity of the 28-μ line increased and three additional lines at 47μ, 55μ and 78μ were observed. With a crystal quartz filter to remove the strong 28-μ line, fringes were recorded with path differences up to 15 cm, indicating line widths less than 0·07 cm^{-1}. The mean power from the new lines was of the order of 10 μW.

The time constant of the Golay cell is approximately 0·1 sec, which is long compared with the 3 μsec of the applied voltage pulse. If the radiation pulse is of comparable length to the applied pulse, the Golay cell is incapable of giving any information on the distribution of intensity with time and hence of measuring peak power. To obtain time resolution and to improve the detection sensitivity the Golay cell was therefore replaced by an indium-doped germanium photoconductor with a response time of 0·1 μsec. This operated at 4·2° K and was used with a grating monochromator which also allowed the isolation of individual lines for time resolution measurement. This would have been impossible with the interferometer. Again the complete spectroscopic system was evacuated, and with the new detector the discharge was operated at a pulse repetition frequency of 20 c/s.

With the silicon window, nine lines were detected in the wave-length range 23–79μ. The output pulses corresponding to the different wave-lengths were not all alike, either in their starting times in relation to the applied voltage pulse or in their durations between half-power points.