

those concerned with the primary sciences suggest that they can accomplish more in the promotion of their technical interests without the organisation of an international union, and prefer to consider the impact of their technology on society within their national societies and national academies. The fields of anthropology and archæology appear not to have been sufficiently explored from the international point of view, especially by the International Council of Scientific Unions and its Committee on Science and its Social Relations.

Three suggestions are submitted on the assumption that science and technology are fundamental techniques in international relations, and that fundamental science affords an excellent opportunity for improving the art of international collaboration. First, the foreign secretaries of the Academy of Sciences of the U.S.S.R., the Royal Society of London, and the U.S. National Academy of Sciences should explore the possibility of an inter-academy study of their international relations in those phases of science which are of benefit to all men. Secondly, the International Council of Scientific Unions, through its British and American officers, should simultaneously prepare a memorandum for all Governments which have adhered to the unions on how best the unions may collaborate in post-war research and educational problems. Lastly, the Division of Foreign Relations of the United States National Research Council should continue to advise the United States Academy of Sciences in all international scientific matters affecting the welfare of their countrymen. The memorandum contains an appendix giving a summary of Dr. Joseph Needham's memorandum on an international science co-operation service as opposed to the use of the existing international scientific unions, and although Dr. Cannon and Dr. Field appear to pass rather lightly over well-known weaknesses of the unions, their report makes a praiseworthy effort to be comprehensive and to indicate the alternative movements.

EARTHQUAKES IN SWITZERLAND

FROM a seismic point of view, Switzerland is part of the Mediterranean or Alpine-Himalayan geosyncline. Thus it experiences more earthquakes than the whole of northern Europe*. According to figures given by Montessus de Ballore, for every 100 earthquakes humanly felt per unit area in Italy, there are 86.1 in Switzerland and only 5.6 in France. Catalogues of Swiss earthquakes date from the sixteenth and seventeenth centuries, and in 1755 Elie Bertrand published his "Relation Chronologique". After the Viège earthquake of 1855, Otto Volger published a very detailed catalogue showing epicentres. In 1879 the Swiss Seismological Commission began to publish annually lists of earthquakes with intensities, description of effects, and geographical position. This was replaced in 1914 by the Swiss Seismological Service under Prof. E. Wanner, forming part of the Swiss Meteorological Institute at Zurich.

During 801-1929, 491 places in Switzerland had experienced earthquakes greater than degree 7 on the International Intensity Scale which is used by the Swiss. This scale is briefly as follows :

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| Degree 1. | Movement only registered by seismographs. |
| Degree 2. | Movement felt by a few people at rest. |
| Degree 3. | Movement felt by people at rest sufficiently for duration and direction to be appreciated. |
| Degree 4. | Movement felt by people moving. Loose objects are moved and plaster is cracked. |
| Degree 5. | Felt by everyone. Heavy objects moved. Some bells rung. |
| Degree 6. | All sleepers awakened. All bells rung. Some clocks stopped. |
| Degree 7. | Chairs and tables overturned. People alarmed. No damage to well-constructed buildings. |
| Degree 8. | Chimneys collapse. Walls are cracked. |
| Degree 9. | Buildings partially destroyed. |
| Degree 10. | Solid buildings destroyed. Faults and cracks in the ground. |
| Degree 11. | Catastrophic destruction of buildings, bridges, etc. |
| Degree 12. | Greatest catastrophe. |

The two greatest earthquakes ever to have occurred in Switzerland, so far as records go, were those of Viège and Basle.

Great earthquake of Viège. On July 25, 1855, about 1 o'clock in the morning, there was an earth shock at Berne and one at Basle. Just after midday on the same day, about 12.50 p.m., and without any immediate premonitory shock, an earthquake of extreme violence shook the Viège Valley from the town of the same name to St. Nicholas. The mountains began to sway, rocks fell and the inhabitants of the district fled from their homes. Immediately afterwards walls of houses collapsed, roofs slid into the streets and earthquake sounds and underground rumbling added to the commotion. One eye-witness was seated at a table in the inn "Zum Kreuze" at St. Nicholas. Without feeling the slightest preliminary tremor, or hearing the faintest sound, he was suddenly thrown to the ground and just had time to escape amidst a hail of household goods and tiles. Several tourists, journeying between Stalden and St. Nicholas, saw two chalets not far from them carried away by an avalanche of rocks; one had his horse hit and their guide was seriously injured. At St. Nicholas most of the hundred buildings were so badly damaged that they had later to be rebuilt. Several persons were injured, but none was killed. At Grachen, a similar state of affairs happened and one child was killed. At Stalden the church was seriously damaged though some of the building, including the belfry, still stood. The buildings in general were not so badly damaged as at St. Nicholas. The belfry of the church at Törbel did not collapse, but was seen to oscillate several times from north to south with amplitudes of about 2 metres at the top. Shortly afterwards, Prof. Morlot visited the place and wrote: "Viège, without being absolutely in ruins, is uninhabitable and will have to be entirely rebuilt little by little. Its population is camping in tents and one would do well for the time being not to stay there. At St. Nicholas and at Stalden many houses are completely destroyed but a good number are habitable and inhabited." Cracks and faults in the ground were visible near Stalden and Unterbach and springs occurred in different places, for example, at Vispert-erminen. At Eyholz, Mund, Gamsen and Glis, nothing collapsed but cracks appeared in the walls of buildings.

The first aftershock occurred at about 10 o'clock in the morning of the next day (July 26), the epicentre being near Unterbach, about 6 km. to the west of the Viège Valley. A second aftershock also occurred on July 26 at about 2 p.m., and three others at 3.40 p.m., 4.40 p.m. and 5 p.m. According to the Abbé Tscheinen at Törbel, between July 25 and December 31, 1855 (160 days), only eleven days were without earthquake disturbance of some sort. In

* Les Séismes de forte intensité en Suisse. By Frédéric Montandon. *Revue pour l'étude des Calamités*, 5, Nos. 18-19 (1942); 6, No. 20 (1943).

November 1856, the Abbé Tscheinen left Törbel but continued his observations at Grächen. Aftershocks of the Viège earthquake continued for sixteen years, becoming less and less intense as time passed, though occasionally there was a large one, as on April 18, 1866.

By comparison with the world's great earthquakes, the Viège earthquake was of degree 10, whereas the earthquakes of San Francisco (April 18, 1906) and Messina (December 28, 1908) probably were both of degree about $10\frac{1}{2}$. Not so much destruction was caused at Viège as at either of the other two places, but this was probably due to the facts that the Viège houses were well constructed of wood, and did not catch fire, that the fire following the earthquake caused great destruction in San Francisco, and that owing to poor construction more buildings collapsed in Messina than otherwise would have done.

Great earthquake at Basle. The greatest earthquake (degree 11) ever known to have happened in Switzerland occurred on October 18, 1356, at 10 p.m. During this earthquake the towns of Basle and Liestal were destroyed and intensive damage was done over a wide area, especially in the Jura. For a distance of four miles from the centre of Basle, scarcely a building remained standing. An intense fire occurred during the same night and lasted for several days; this added to the destruction. Not only were houses destroyed but also well-built churches, towers, fortresses, and eighty châteaux. About 300 people were killed in Basle, and the remainder of the population were obliged to camp for a long time in the fields. Cold and famine caused widespread misery. The waters of the Birsig, obstructed by the ruins of houses, flooded its banks and entered nearby caves where the people had stored much of their salvaged property. Cracks and faults occurred in the ground and from them issued warm milky-coloured water which had a strong sulphurous odour. It has been stated that sixty mountains were permanently affected. An incomplete list of forty-one châteaux destroyed during the earthquake was given by Eberhard Muller of Zurich in 1380. These were situated around Blauen, along the valley of the Birse, in the Jura Soleurois, in the Siggau south-east of Liestal and along the frontier of Alsace. Farther away, destruction occurred in Frickgau, in the basin of the Delémont, in Sundgau (Alsace), and south-west of the Black Forest, including Brombach, Otlingen and Herthen. In the direction of Mulhouse, Schodeler states that destruction occurred so far away as Landser and Steinbrunn, 7 km. south of the town.

All the evidence shows clearly that the epicentre of the shock was near the mountain called Blauen. Destruction thus occurred up to at least 38 km. from the epicentre. The châteaux at Assuel, Klus and Frohburg were never rebuilt after their destruction by the earthquake; those at Dorneck, Eptingen, Gilgenberg and Pfeffingen were rebuilt but later fell into disuse. Only three are known to have been rebuilt after destruction by the 1356 earthquake and to be in use still—those at Angenstein, Birseck and Wildenstein.

Aftershocks, strong and weak, occurred for a long time afterwards. More than ten took place on the night of the original shock, and a chronicled shock, by no means the last, happened in November 1357.

By comparison with the world's greatest earthquakes, the one at Basle in 1356 probably had a maximum acceleration of between 3,500 and 4,500

mm./sec.², whereas the Tango (Japan) earthquake of March 7, 1927, had one of 4,700 mm./sec.². Both were greatly exceeded by the Assam (India) earthquake of June 12, 1897, where rock boulders were flung into the air and the acceleration must have exceeded 9,400 mm./sec.², corresponding to degree $12\frac{1}{2}$.

From the foregoing and a study of the existing catalogues of Swiss earthquakes, we find in the past a distribution in time such that for earthquakes of degree 7, one shock occurred every three or four years; for earthquakes of degree 8, one shock occurred every five years; degree 9, one shock every seventy or eighty years; degree 10, one shock every 300 years; and degree 11, one shock every 1,000 years—altogether, for all shocks of degree 7–11, one shock every two years. For the distribution in space, that is, positions of epicentres, for the fifteen most disastrous earthquakes (degrees 9–11) the epicentres were mostly near Basle, or in the 'Haut Valais' or near the 'lac des quatre Cantons', and two were in the Grisons and the mountains of Appenzell and St.-Gall. It must here be remarked that the area around Eglisau experiences an incredible number of small tremors, but that it has never experienced a great earthquake.

Swiss earthquakes in recent years until 1940 have been regularly reported in the columns of *Nature* as they occurred. I have just had the great pleasure of hearing from Prof. E. Wanner again. There are now five Swiss seismological observatories situated at Zurich, Chur, Neuchâtel, Basle and Brig, each equipped with seismographs recording in three mutually perpendicular directions. These instruments include Quervain-Picard, Mainka, Kreis and Wiechert. In 1942, twelve earthquakes were felt in Switzerland of degree greater than scale 3, and 166 additional earthquakes were strongly recorded on the instruments. In 1943, fourteen earthquakes were felt by people in Switzerland with degree greater than scale 3, the greatest being scale 5 on August 16, at 4h. 41m. at Klettgau, Kt. Schaffhausen. Additionally in 1943, 230 earthquakes were registered by the instruments. Isoseismal maps of the epicentres of earthquakes humanly felt, together with numerical details of all shocks, are given in "Jahresbericht des Erdbebendienstes der Schweiz in Jahre 1942" and the corresponding volume for 1943, by Dr. E. Wanner.

According to *Schweizerisches Erdbebenbulletin*, Nos. 164–175 (January to December 1944), 188 earthquakes were registered by the seismographs during the year in Switzerland. The earthquake of July 19 was felt by people in Sitten with intensity 4.

During the months January to May 1945, eighty earthquakes were registered by the Swiss seismographs. The shock of February 5 was felt with intensity 4 in Oberengadin, and the epicentre is thought to have been south of St. Moritz. The shock of February 23 occurred in Ofenpass and was felt with intensity 3–4. The shock of May 13 had its epicentre some 5 km. south of Freiburg and was felt with intensity 4 in Freiburg. During October, November and December 1945, thirty-seven earthquakes were registered by the seismographs at Zurich, Neuchâtel, Basle and Chur in Switzerland. Of these, three were humanly felt in Switzerland, the greatest with intensity 5 on November 10.

In the present year, there has been the swarm of earthquakes of moderate intensity during January 25–26 (see *Nature*, Feb. 2, p. 130).

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