shown that silver sulphide is a substance which can act as a general sensitiser of the kind described. Sheppard (*Phot. Jour.*, 1925, 65, 380) directs attention to the well-known fact that some gelatins are photographically active, whilst others are relatively inert. Making use of the unrivalled facilities of such an organisation as that of the Eastman Kodak Company, which has its own gelatin manufactory, several thousand gallons of deliming liquor, which is formed in the manufacture of gelatin, and was found to be photographically active, were concentrated by appropriate treatment, active fractions being separated from time to time. Ultimately, after some years of investigation, the active substance was tracked down and identified as allyl isothiocyanate, or allyl mustard oil. In the course of manufacture of a photographic emulsion, this substance reacts with the silver halide grains to give the silver sulphide specks to which reference has been made above. It is estimated that photographically active gelatin contains only about 1 part per 1,000,000 to 1 part per 300,000 of the sensitising substance. Other sulphur compounds have been found to act in a similar manner, a necessary condition seeming to be that the sulphur must be doubly linked

to another atom, and not singly linked to two other atoms. The analogous compounds of selenium and tellurium act in a similar way.

The presence of a speck of silver sulphide in the silver halide crystal would result in a disorientation of the silver and halogen atoms at the common boundary, and consequently give rise to a region of instability in its neighbourhood, a view which is supported by the work of von Hevesey (*Z. physikal. Chemie*, 1922, 101, 337).

In all the work which has contributed to the achievement of the present position in regard to photographic sensitivity, it is remarkable how interwoven the ideas of various investigators have become. A mass of evidence from very different sources has now been accumulated in support of the theory that the high sensitivity of the modern photographic plate is due to the presence, before exposure, of minute traces or specks of some "impurity" on the surface of the silver halide grains in the emulsion. The work of Sheppard is a great step forward and opens up new avenues of research, but much work remains to be done before the problem of photographic sensitivity is finally solved.

Sino-Himalaya.¹

By F. KINGDON WARD.

THAT "Any Man's Land" where China, Tibet, and India meet has come into prominence amongst botanists in recent years by reason of the remarkable wealth of flora discovered there; and connected with the problems of plant distribution which arise is the no less interesting problem of geological structure and history. A brief description of the physiography of this region may serve to illustrate the nature of these problems.

We have as a starting-point the great Himalayan range and the mountainous area of western China. East of the 93rd meridian the Himalayan axis trends towards the north-east. It seems probable that this axis is prolonged across China, and that structurally it could be traced in that direction to the plains.

However, what the traveller, who is unable to follow the strike of the rocks composing a great mountain chain like the Himalaya, sees, is something rather different. He sees the Himalayan range ending abruptly at the gorge of the Tsangpo in the great peak of Namcha Barwa; and even if he recognises the peak of Gyala Peri, which forms with Namcha Barwa the gateway to the gorge, as being on the main Himalayan axis beyond the Tsangpo, he can follow it no farther, for the country is unexplored. From the Tsangpo gorge eastwards he perceives rather a wide breach in the Asiatic divide, beyond which in the complex skein of mountains which form a network over western China he is unable to pick up the dropped thread of the Himalayan axis, though the facts of both animal and plant distribution in eastern Asia point to its former, if not to its continued existence.

That this supposed breach in the Himalayan axis

does really exist seems clear enough; though whether at the eastern extremity or in the middle of the range is not so clear.

Rising on the plateau of Tibet are several great rivers whose sources are far apart and whose mouths ultimately open on different seas; but all of them, rolling down from the highlands, converge on one another, squeeze through a narrow gap flanked by lofty snow peaks, and separate again as they emerge from the mountains. In the west is the Brahmaputra (Tibetan Tsangpo), which, after rounding the great gable end of the Assam Himalaya, swings away to the west. In the extreme east is the Yangtze (Chinese Kin-sha), which, after squeezing through the breach, swings away to the east to cross China. Between them, but closer to the Yangtze than to the Brahmaputra, flow three other big rivers, the Mekong, Salween, and Taron (or eastern branch of the Irrawaddy).

The extreme breadth of this river gap is about 200 miles; but a much smaller distance—namely, 70 miles—will span the gap between the Yangtze and the Taron, including the gorges of the Mekong and Salween. That is to say, these four rivers, where they flow parallel to one another for a depth of about 100 miles, are confined to a strip only 70 miles wide. A further peculiarity about this strip is a pronounced tilt from east to west, whereby these rivers flow at successively lower and lower levels as we proceed westwards from the Yangtze to the Irrawaddy.

The reasons for this may be at least partly explicable on the theory of isostasy, the vast area of deposition towards the head of the Bay of Bengal being counterbalanced by a rise in the country to the east, which is essentially an area of denudation. Even the progressive lowering of the river beds might be due to a detailed isostatic equilibrium, being proportional to their

¹ Substance of two lectures delivered at the Royal Institution on April 3 and 30.

powers of erosion and capacity for deposition, according to the views of Colonel Tandy.²

That the grading of the river beds should follow mechanically from the proportionate rainfall in the gorges seems to us quite untenable. If we accept the view that a river is primarily erosive in action, then the Yangtze, with its much greater and more powerful stream and its larger volume of glacier water, should have cut out the deepest channel; but it has not. On the other hand, if we accept Colonel Tandy's view that a mountain river bed is primarily an area of deposition, then the Yangtze, which certainly receives a much greater dead-weight load from its arid cliffs than does the forested Taron, should still have sunk its bed lower. Moreover, the several source streams of the Irrawaddy show the same progressive decrease in altitude from east to west, though their respective volumes steadily decrease also; and here the rainfall is obviously constant for all.

We must not, however, lose sight of the fact that the breaching of the Himalayan axis was probably due in the first instance to tectonic causes, not to river action; and that therefore the parallel gorges owe their origin at least in part to tension, and follow lines of weakness in the crust. Here again the weight of material which the crust, immediately to the west, has to support, dragging on the folded rocks of the Burma-Yunnan arc to the east, may have cracked the synclines; for the Burma-Yunnan arc is probably of the same age as the main Himalayan uplift.

Prof. J. W. Gregory indeed refers to the Mekong, Yangtze, and other rivers of Chinese Tibet being formed as "tension clefts by the rupture of hard rocks which were pulled apart on the stretched upper side of an arch."³ However, I can deal here only with results, whatever the causes.

The south-west monsoon, blowing up from the Bay of Bengal, strikes against the south face of the Himalaya and drops the bulk of its moisture. Thus it crosses the line of high peaks a comparatively dry wind, and the plateau country behind the Himalaya is in consequence semi-desert.

The Burma-Assam re-entrant, however, forms a funnel-like approach to the Himalayan gap, and the monsoon rushes like a bore through the neck of the funnel and up the river corridors of the Tsangpo, Irrawaddy, and Salween; with the result that the region lying at the head of the gap, and partly behind the Himalaya, is also drenched with rain. Thus the breach, or gap, as we have called it, is the meeting ground of several floras. To the north is the Central Asian flora—more particularly the Tibetan element, pressing southwards through the gap; while to the south is the Indo-Malayan flora, squeezing northwards up the river corridors until it makes contact with the former. In the east is the Chinese or Oriental flora, while confined to the ranges which form a network over the whole area is the Alpine or Himalayan flora.

On the parallel ranges of the Burma-Yunnan arc is found a flora related on one hand to the Chinese flora generally, on the other to the Himalayan flora; and it would appear that these mountains, having received contributions from both the broken ends of the Sino-

Himalayan ranges, have carried this flora far to the south.

Nothing was previously known of the flora round the knee-bend of the Brahmaputra, however, and it was not until 1924 that, through the kind offices of the Indian and Tibetan governments, permission was granted for a botanical expedition, financed by the Royal Society and the Percy Sladen Memorial Fund.

One would naturally suppose that the alpine flora of the Assam Himalaya would more closely resemble that of the Sikkim-Bhutan Himalaya than it does that of the Burma-Yunnan arc; for while the Assam Himalaya stand about midway between Sikkim and Yunnan, the Himalaya form a continuous uplift from Sikkim to Namcha Barwa, whereas the Yunnan ranges are a separate uplift sundered from the Himalaya by several deep river gorges. Yet the reverse was found to be the case.

If we examine the more prolific genera, such as *Rhododendron*, *Primula*, and *Meconopsis*, we find groups common to the Assam Himalaya and to Yunnan which have no representatives in Sikkim. To take a few examples. There exist a group of creeping *Rhododendrons* of the 'Sanguineum' series, previously known only from Yunnan and Burma, now recorded from the Himalaya; they do not extend so far west as Sikkim. Similarly with the undershrub *Rhododendrons* belonging to the 'Saluenense' and 'Campylogynum' series.

Coming next to *Primula*, the section known as 'Sikkimensis' has representatives both in Sikkim and in western China, but hitherto no purple-flowered species was known to occur west of the Mekong; yet such purple-flowered species are abundant in the Assam Himalaya and to the north. Again, the queer *Primulas* which fall into the section 'Maximowiczii' have hitherto been regarded as confined to western China; but two species, possibly identical with the Chinese types, have now turned up in the Assam Himalaya.

Two species of the section 'Dryadifolia,' one of them *P. dryadifolia* itself, hitherto known only from Yunnan, are now definitely recorded as Himalayan, while the 'Nivalis' section, so richly represented in China and so poorly in Sikkim, obtains additional support as a Himalayan group in half-a-dozen species from Namcha Barwa.

In the genus *Meconopsis* we find exactly the same thing—a closer association with Yunnan than with Sikkim. Amongst the 'Grandes,' for example, we find in the Assam Himalaya two yellow-flowered poppies almost exactly like the Chinese *M. integrifolia* and its so-called variety *M. integrifolia* var. *Souliei*; while a species closely allied to *M. impedita* is abundant. The only Sikkim species met with were such as are common to Tibet or to the Himalaya generally, e.g. *M. simplicifolia* and *M. horridula*.

One could multiply examples, but enough has been said to bring out the Sino-Himalayan relationship. I have selected these genera as being those with which, from a horticultural point of view, I am best acquainted; but I believe that when the whole collection has been worked out, this unexpected relationship will be more strongly emphasised. There is also, of course, a considerable endemic flora.

From this it would seem that not only is the present breach between the Himalaya and the Burma-Yunnan

² *Geographical Journal*, May 1921.

³ *Geographical Journal*, March 1923.

arc recent, but that the linking up of the Assam and Sikkim Himalaya is also recent; otherwise their floras should more closely resemble one another, since they are under almost identical conditions.

The most striking feature of the country immediately to the north of the Tsangpo bend is the number of ice-worn valleys and the extent to which deglaciation has gone on and, judging by the retreating glaciers, is still going on. The Tsangpo valley above the gorge seems to have been in part at least formed by ice action. At all events it is certain that the glaciers of Namcha Barwa once crossed the present valley, since one sees huge amounts of moraine material, continuous with "living" moraines on the right bank, piled up on the north bank, and afterwards cut through and stranded, terrace on terrace, by the river. The gorge itself, however, is clearly due to water erosion, though at one point a glacier does actually reach the river bed from the north bank. This retreat of the ice must be due to gradual desiccation rather than to a general increase of temperature, since lakes are also drying up, and these would scarcely be affected by a small rise of temperature. This ice action is far more conspicuous in the Assam Himalaya and on the ranges to the north of the Tsangpo bend than in other regions we visited;

and it might be that the elevation of the Assam Himalaya is of more recent origin than that of the Himalaya as a whole. If, as Sir Sidney Burrard⁴ has suggested, the Tsangpo originally flowed from east to west, then there must have been much less accumulation of silt in the Assam valley formerly than there is now, with the result that there would be less "compensation" needed. The cutting through of the Himalayan axis by the Dihang and the "capture" of the Tsangpo would soon alter this, and the Assam Himalaya might have been considerably raised as a result. But with the rise of this great rain screen, the doom of the glaciers to the north was also sealed. The removal of this enormous weight of ice, and the consequent transport of a huge amount of abraded material by water to the Bay of Bengal, would still further have loaded the crust in that direction and released it in the Himalayan area.

The numerous considerable falls in the Tsangpo gorge and the steep grade of the bed suggest that this river is much newer than the Salween or the Mekong. Thus the Assam Himalaya might be regarded rather as an outlier of the Burma-Yunnan arc, severed from it by the cutting back of the Brahmaputra (or Dihang), and still bearing a very close resemblance to it in its flora.

⁴ "A Sketch of the Geography and Geology of the Himalaya and Tibet."

Science and Intellectual Freedom.

By WATSON DAVIS and Dr. FRANK THONE, Science Service, Washington, D.C.

AMERICAN men of science naturally felt considerable interest in the trial of John T. Scopes, high school teacher, at Dayton, Tennessee, for the alleged violation of the now famous anti-evolution act on the statute books of that State. Relatively few scientists in this country are directly threatened by the epidemic of anti-evolution legislation; for this is at present confined largely to the southern States, and the majority of the more important colleges and universities, both independent and State-supported, are in the north and west. However, interest in the continued academic independence of their colleagues in the south brought a number of scientists to Dayton as scientific coadjutors for the defence counsel, while many more had signified their willingness to attend if called upon. They would have appeared as expert witnesses also, had the judge not ruled against the admissibility of scientific testimony.

Certain aspects about the outcome of the case may possibly need a word of explanation to those unfamiliar with American law procedure and with the somewhat peculiar circumstances of this particular trial. The defence did not attempt to prove that their client, Mr. Scopes, had not violated the statute as interpreted by the court. They stated that they intended to prove that the law was contrary to the constitution of the State of Tennessee and to the constitution of the United States, and that it was so vague and unscientific in its structure as to be meaningless. For this reason they wished to introduce scientific testimony; and when the court ruled that such testimony was irrelevant, the ground was cut from under their feet. It was conjectured, however, with a good deal of probability, that two or three men on the jury, irritated over the conduct of the case, were prepared to "hang the jury" and prevent the unanimous

verdict necessary to convict. The counsel for the defence wished to prevent such an outcome, for then the case would have had to be tried all over again before another jury, with the outcome just as unpredictable as it was the first time. Therefore we were treated to the unprecedented spectacle of the chief counsel for the defence virtually appealing to the jury to convict his client, so that the case might be carried to a higher court on appeal.

Mr. Scopes was accordingly adjudged "guilty"; and the case will come before the supreme court of the State of Tennessee in September. This tribunal may do one of two things: either decide that the lower court was in error in certain of its rulings and remand the case for re-trial, or declare the statute to be contrary to the constitution of the State. Appeal may also be taken to the United States supreme court, on the ground that the statute is in violation of certain clauses in the Bill of Rights appended to the United States constitution. Of course it is impossible to predict the outcome of either of these appeals.

Certain after-effects of this case have already been making themselves felt. An anti-evolution bill, similar to the Tennessee statute, offered in the Georgia State legislature, was decisively defeated by a viva voce vote. The "fundamentalists" wish to introduce a similar measure at the next session of the national congress, but so far have been unable to find a member willing to sponsor such a bill. An effort to enforce a dead-letter clause in the regulations of the Washington, D.C., schools appears to have gone off as a flash in the pan.

The effort to force an Old Testament theocracy upon the American people will continue, but now that the only champion of the movement who enjoyed national prominence has passed away, his cause will probably dwindle accordingly.