Mulbarton Environmental

Issue 4 December 2022

Welcome to

Mulbarton Environmental

a quarterly newsletter about the environment with special emphasis on local issues.

Editorial

We hope you enjoyed Issues 1, 2 and 3 of this newsletter. And thank you for all the feedback, suggestions, articles and pledges. This newsletter really would not exist without you.

Our activities during the Great Big Green Week turned out to be very well supported and of great interest to all those who attended. Please see full details later on in this newsletter.

We wish all our readers (slightly early) a Merry Christmas and Best Wishes for a Happy New Year. And please, when making your New Year resolutions, and gardening plans, think sustainable, good for pollinators, no chemicals, no peat – good for the environment.

If you only do one thing…

…but if you do more than one thing, so much the better…

LEAVE wildlife in peace in autumn and winter! DON'T clear up piles of leaves or turn your compost; there probably is something living in it which will provide food for birds and hedgehogs.

PUT out food for birds. During the short days and long cold nights of winter every calorie counts for survival. A huge amount of energy is used by small birds for staying warm at night.

TOP up bird baths. Birds bathe to clean and regulate the oil on their feathers enabling them to control their temperature more efficiently.

IF you are feeling energetic, plant some bare-root shrubs for a lasting benefit to wildlife. Shrubs provide a mix of flowers for pollinators, berries for birds, leaves for caterpillars to feed to baby birds. Hawthorn, holly, hazel, malus, pyracantha, cotoneaster are all good.

CHECK that the Christmas present wrapping paper you buy can be recycled.

USE scarves, fabric or plain brown paper for gift wrapping. Millions of rolls of wrapping paper will be binned over Christmas and much of it cannot be recycled. Skip the conundrum completely and either use plain brown paper, leftover newspaper, fabric, or even a scarf, to wrap your gifts.

RECYCLE Christmas cards, wrapping paper, Christmas trees…

Articles

Global Warming – A View from 1911 – Popular Mechanics

There is an interesting article from the *Popular Mechanics* magazine dated from around 1911. The full article (some 4 pages long) can be found at the end of this newsletter for those who wish to read it.

It discusses the variation in climatic conditions over geological time, but recognises that the addition of copious quantities of carbon dioxide into the atmosphere may have an effect on the climate.

It concludes that "*…it may well be the enormous present-day combustion of coal is producing carbon dioxide so fast that it will have important climatic effects.*"

The final paragraph copied below is somewhat patronising and complacent:

> It is perhaps somewhat hazardous to make conjectures for centuries yet to come, but in the light of all that is known it is reasonable to conclude that not only has the brain of man contrived machines by means of which he can travel faster than the wind, navigate the ocean depths, fly above the clouds, and do the work of a hundred, but also that indirectly by these very things, which change the constitution of the atmosphere, have his activities reached beyond the near at hand and the immediate present and modified the cosmic processes themselves. It is largely the courageous, enterprising, and ingenious American whose brains are changing the world. Yet even the dull foreigner, who burrows in the earth by the faint gleam of his miner's lamp, not only supports his family and helps to feed the consuming furnaces of modern industry, but by his toil in the dirt and darkness adds to the carbon dioxide in the earth's atmosphere so that men in generations to come shall enjoy milder breezes and live under sunnier skies.

The Science of Seed Germination and Tips Towards Success – by Chris Samson

Many of us each year occasionally struggle to germinate our seeds. There are many reasons why seeds fail to "wake up and grow". Fundamentally, two environmental features are necessary to satisfy germination, namely growing medium quality and temperature.

Growing media must be able to retain water for a reasonable period in order for a seed to germinate. Some media may include vermiculite, perlite, rockwool, clay pellets and peat moss. Emphasis nowadays is to use an eco-friendly medium (peat-free) compost. Growing media density, porosity and texture are properties that promote a good germinating environment. Disposing of your egg shells, fruit & vegetable peelings and other organic household and garden waste in a composting bin enables you to accumulate (takes about a year to form) much home-produced, organic peat-free compost that is excellent for germinating seedlings or for spreading over beds to improve garden soil quality. By the way, always place your composting bin over soil so that red worms will populate your composting bin. If you purchase peat-free compost, be aware that the medium may be coarse, so water retention may be poor and rapid drying out is a potential problem.

Plant life is amazing, as all seeds come with a naturally-tailored food package to set the seed off and produce a healthy seedling. Once the primary root or radicle has emerged, the seedling is anchored by this downward growing tap root. Two seedling leaves then unfold upwards.

continued…

Watering and feeding your seedlings is an art that is best learnt through experience. Just as it is important not to over water, equally, the growing medium should never be allowed to dry out. In other words, try to maintain a constant degree of moisture. Ideally, do not use house mains tap water as, particularly in our region, the water is very chalky ("hard") and produces lime scale. Rain water is best, being "soft", so avoiding minerals (salts) build up within the growing medium which can burn roots. To help seedlings on their way, a few drops of plant feed in rain water is beneficial. The worst scenario is to over water and over feed.

What temperature range do most seeds prefer for germinating? Well, this will vary according to the plant species. Some like it hot, such as cacti, whilst most of our temperate climate seeds thrive from 15°C to 22°C or, in old money, 60°F to 72°F. During the Spring weeks, if the greenhouse reaches 70°F in the day, but drops to just above freezing at night, then the seeds are unlikely to germinate. An electric seed propagator with a transparent (and breather vent) lid is perfect as the medium is kept constantly warm. After all, who likes cold feet! If you haven't a heated seed tray, a house window sill is a possible alternative (as long as a radiator does not dry out the medium).

How long do seeds take to germinate? Again, this will depend on the species. However, if the germination environment is optimal, then this will minimise the germination period. As the saying goes, "Patience is a virtue", so wait and watch!

Although seeds are quite robust, try not to squeeze them when handling as this can readily destroy them. During germination, if environmental conditions deteriorate, seeds die. Established plants have a greater tolerance for changing growing conditions and can recover. Seed packets do have a shelf life so ensure you aren't buying old stock! As a general rule, after each year of storing, 10% of the remaining seeds won't germinate. So after 7 years only half of the seeds in the packet are likely to germinate.

It's not surprising that in nature some seeds are extremely robust and tolerant of harsh conditions; we are all familiar with our battle against weeds!

Gardening for Wildlife in Winter – Tips – by Lynne Middlemiss

After such a dry summer we may be wondering about how to care for the wildlife in our gardens over the winter:

1. **Don't** tidy everything up – insects, birds and small mammals all need food and shelter over the winter. Provide log and brash piles, leaf piles, leave seed heads on plants and plenty of vegetation. Log piles and other 'dead' wood will lock up carbon for many years whilst they rot down if left undisturbed. They also provide winter shelter and spring nesting material. Leave compost heaps undisturbed over winter – they will provide food and shelter for many insects – and in turn the increased richness of your compost material will improve your garden soil next year. Studies of gardens have shown that the more vegetation you have of all types the greater the diversity of insect species you will have in your garden. Birds such as goldfinches will feed off seed-heads of perennial plants left over the winter. Small mammals such as hedgehogs, mice, voles and shrews (depending on your situation) will use garden habitats such as leaf piles, hedges and long grass for shelter to hibernate, to hunt and for food.

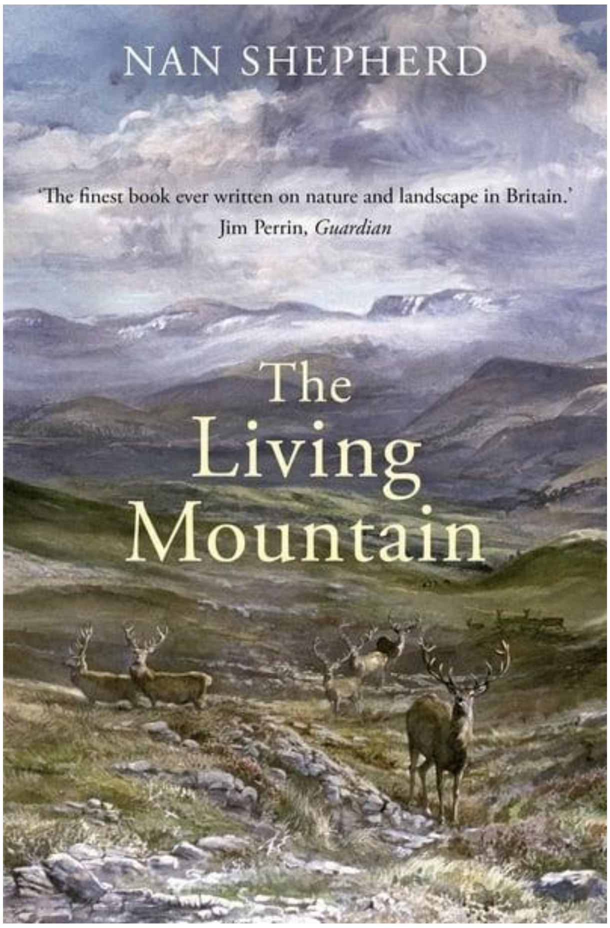
2. **Feeding birds** – many of us will spend quite a lot of money on food for birds over the winter, but will over-tidy or ignore the potential of all the natural food sources which both resident and migrating birds rely on finding in our gardens, especially as hedgerows and other good habitat areas in our 'farmed' landscape have declined. Blackbirds, and other small birds rely on the berries in our gardens for food, 'stocking up' in autumn, which helps them survive over the winter as food sources reduce. Migrant birds such as redwings arrive from colder areas to overwinter here on berry-laden bushes and trees. Blackthorn, hawthorn, elderberries and rose-hips are all popular. The dark berries of ivy are a fantastic food source for birds.

3. **Other supplementary food sources plus water** for drinking and bathing are also very important in helping birds survive the winter, especially small birds such as goldcrests and long-tailed tits. Buy bird-food from recognised sources and remember to clean bird-feeders to reduce the possibilities of disease. You can also make winter feeders from fir cones, coconut shells or yoghurt pots reducing the cost of winter feeding, and a winter birdbath from recycled materials using a shallow dish and some bricks or other support.

Book Review

This is a new section that we hope will become a regular feature. If you would like to review a book for us, we shall be very pleased to hear from you.

The Living Mountain by Nan Shepherd



This review is by Pauline Campion:

This slim volume by Nan Shepherd was written in the final years of World War 2, but after being rejected by publishers in the 1940s the manuscript was put away in a drawer and didn't surface again until thirty years later. The book was finally published in 1977 by Aberdeen University Press and has subsequently been reprinted a number of times. My copy is a 2011 edition with the addition of an extensive introduction by Robert Macfarlane.

Nan Shepherd lived all her life in the North East of Scotland and must have taken walks in the Cairngorm Mountains hundreds of times in 60 years. "*The Living Mountain*" is a chronical of her observations made during these excursions, a paean to the pristine countryside she knew so well. Written at a time when books about wild places were not as prolific as they are now – the book is held up as the gold standard of writing about the natural world even now.

I love this book. It has been on my bookcase for nigh on ten years and I enjoy dipping in to a chapter at random and reading, or rereading, vivid descriptions of the terrain, the weather and seasonal changes to the water, plants and animals. Miss Shepherd did not look upwards to the summits of this ancient plateau but down into the nooks and crannies, the gullies and the corries, into the streams and lochs to describe the micro worlds therein. She teaches us not to look for the destination of a walk or climb as the achievement but to look at each small aspect that nature has to offer all along the way. Reading her words calms me and lets my mind wander to this idyllic world.

Sadly, that Shangri-la which Nan Shepherd knew nearly a century ago is being destroyed by commerce and the tourist trade. Even in her forward to the 1977 edition she wrote about the fragmentation of the plateau, *"Roads, too many roads."*, bulldozers digging into hillsides and *"boots, too many boots"* climbing the Cairn Gorm making *"the very heather tatty"* and the noise and bustle of the Aviemore ski resort.

It is fruitless to go to Scotland in search of *"The Living Mountain"* which Nan loved, but it can be seen still in our mind's eye as we read her beautiful descriptive prose-poem.

MALGA's Great Big Green Week Activities in September

Families Event – this was really exciting with lots of activities for the children and plenty of information for the adults: we had the Big Nature Game and plant pot making from the Norfolk Wildlife Trust; a puzzle game from the Norfolk Master Composters; a super Children's Nature Quiz; lots of material for Making Bug Hotels; and our Pledging Tree. In addition, there were displays on Connecting the Dots for pollinators and the winners of our Wildlife Photography Competition. There was even an attempted escape from the wormery on display! (See selection of photographs below.)

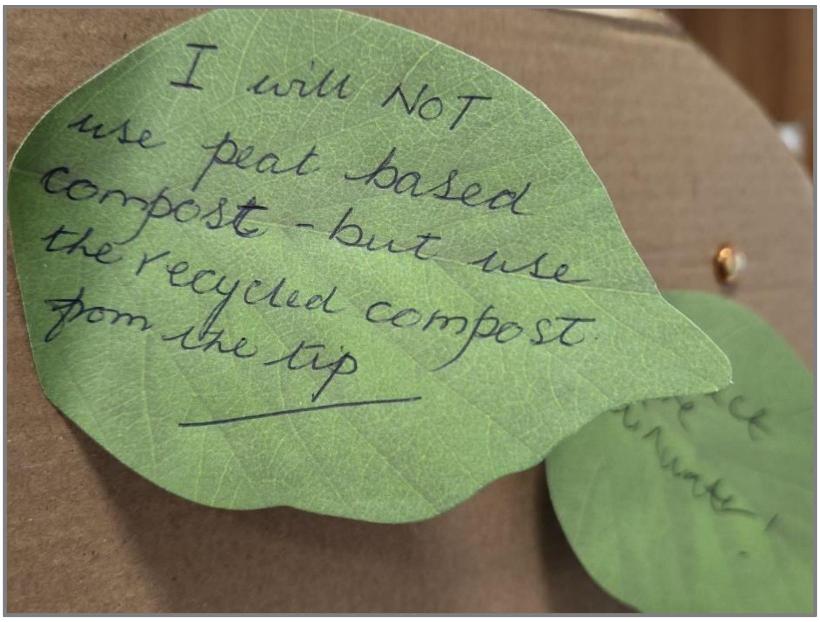
Connecting our Landscapes for Nature was an evening event with two excellent speakers: Helen Baczkowska, from the Norfolk Wildlife Trust, taking a macro view of the importance of creating connecting pathways and habitats for pollinators, small mammals and other insect wildlife. In Mulbarton we are a part of the NWT Claylands Project in South Norfolk which is working with local landowners to create and restore habitat areas for the benefit of wildlife and agriculture – planting trees, restoring hedgerows, ponds and soils. Our second speaker Jonathan Darby, took the micro view explaining the many ways in which we can all garden more sustainably: better for soil health, for wildlife and for the climate; reducing plastic waste, the use of peat composts and the toxic chemicals that are a principal cause of our declining insect numbers. Reduce, reuse, and recycle our natural materials in the garden and on the allotment.

At both events we gave out ideas for *"Things you can do to help connect areas for nature in Mulbarton."* (See copy later in this newsletter.)

We want to thank again the Parish News Magazine which supported both events with a grant.

Below is a selection of photographs from the Families Event:

The Children's Competition

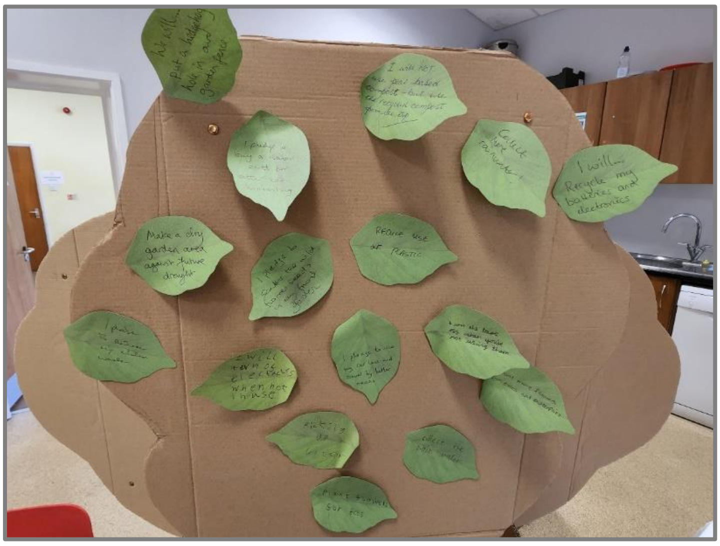


One Of The Pledges On Our Pledging Tree

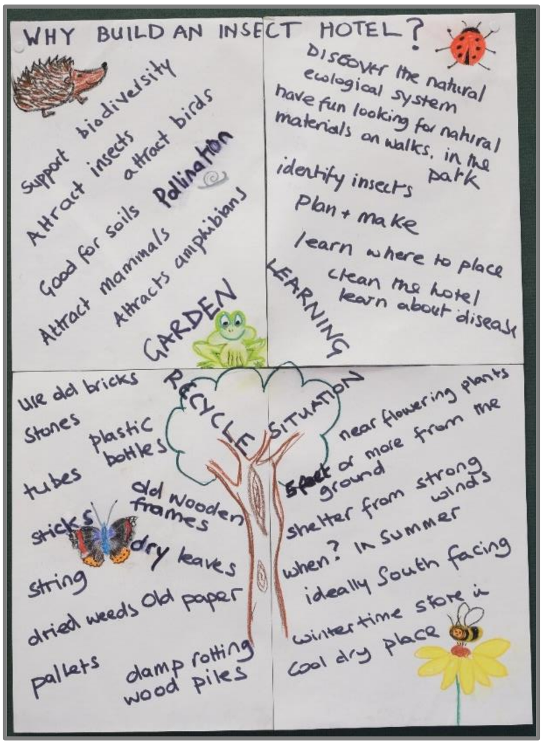
Composting Quiz

One of our Children's Quiz winners

The Norfolk Wildlife Trust Roadshow



The Pledging Tree



Why Build An Insect Hotel?

The Importance Of Connecting Landscapes For Nature – Across Our Gardens, Allotments, Woods And Fields

Looking Forward

We will be working with the Parish Council Open Spaces Group to see what we can do to protect and improve community areas in the village, helping to plant a Wildflower Meadow in the Primary School grounds and thinking ahead to other projects for 2023. If you have ideas for projects or would just like to get involved, please check our Facebook link on the Village website for dates of meetings or email us: malgaenvironmentgroup@gmail.com.

Things you can do to help connect areas for nature in Mulbarton!

Tell us on our Facebook page so we can include them on our **Map for Nature** ….

Join the **MALGA Environment Group** – check date of our next Open Meeting.

Start a **Youth Group** for Nature and Wildlife with your friends in Mulbarton.

Join a wildlife/nature organisation such as the **Norfolk Wildlife Trust**, the **RSPB** or the **Woodland Trust** – these organisations all have special groups for young members.

Work on a nature project for wildlife at **school.**

Ideas for local communities/housing areas:

Plant a **wildflower** area in your garden, at school, in the village …

Work with friends and neighbours to create a **nature recovery network.**

Make a **hedgehog highway.**

Taking a step for nature:

Make a **bug hotel,** put up a nest box, make a hedgehog house.

Build a **pond** in your garden.

Put out **food and water** for birds and small mammals – see RSPB or NWT websites for advice.

Plant a **butterfly** patch.

Easier options for small gardens:

Plant a **window-box** with flowers for pollinators.

Make your own compost with a **mini-wormery.**

Put in a small **vegetable** area – salad crops, a courgette plant, and a tomato plant?

Re-thinking the larger garden:

Sow or plant a **wildflower area in the lawn** to attract pollinators.

Plant a **'dry' gravel garden** to save water next year.

Put in more **water-butts.**

Reduce use of **plastic** in house and garden – reuse and recycle.

Stop using **pesticides or fungicides** as they are harming us and the insects.

Leave **plants and seed-heads** over winter for insects and birds.

Start growing **fruit and vegetables –** join **MALGA** for advice, fun and friendship.

Check out **wildaboutgardens.org.uk** for further advice.

Remember every one of us can make a difference for nature …!!!

Pledges

Take care of the Earth - there's no planet B.

The idea of "pledges" is that a person makes a public declaration of an intention to take an action to try to improve some aspect of the environment. It doesn't matter what. It can be something very small. But it is a start and we hope that in time others will follow your lead and make their own pledges. Possibilities include:

- Composting kitchen waste;
- Leaving areas of lawn uncut;
- Not killing wasps;
- Not using ****cides in your garden;
- Growing plants loved by pollinators.

Please send your pledges to us to be published in the next issue of Mulbarton Environmental.

We were delighted with the response to our pledging tree at our Great Big Green Week event on Saturday 24 September when the following pledges were made:

1. To reduce my kitchen waste.
2. We will put a hedgehog hole in our garden fence.
3. To reduce the use of plastic.
4. To use my car less and travel by better means.
5. To collect rain water.
6. To plant more flowers for bees and butterflies.
7. I will not use peat-based compost but use the recycled compost from the tip.
8. I will scatter the wild flower seeds in my front garden.
9. I will collect more rain water.
10. Make a dry garden against future drought.
11. To stop using as much plastic (as I do).
12. To buy a water butt for better rain harvesting.
13. I will recycle my batteries and electronics.
14. Pick up litter.
15. I will build a home for animals.
16. I will plant flowers for bees.
17. I will turn off taps when I'm not using them.

Quiz

1. PV is the conversion of light into electricity using semiconducting materials. What does PV stand for?
2. Greenpeace was founded in which country in 1969?
3. How many pieces of plastic particles are there estimated to be currently floating around in world’s oceans: (a) 500 million, (b) 5 billion, or (c) 5 trillion?
4. In which year in the UK did renewables plus nuclear power generate more power than gas and coal combined for the first time ever?
5. What is the name of the device fitted to car exhausts to reduce pollution?

Answers:

1. *Photovoltaics*
2. *Canada (in Vancouver)*
3. *(c) 5 trillion*
4. *2017 (June)*
5. *Catalytic convertor*

Links

Norfolk Wildlife Trust:

https://www.norfolkwildlifetrust.org.uk/support-us/local-groups

Norfolk Biodiversity Partnership:

https://www.norfolkbiodiversity.org/community-2/community-directory/

Greening Wymondham:

https://www.greeningwymondham.org/other-local-groups

RSPB – Build a bug hotel:

https://www.rspb.org.uk/get-involved/activities/nature-on-your-doorstep/garden-activities/build-a-bug-hotel/

How to create a safe bee watering station:

https://www.buddhabeeapiary.com/blog/bee-watering-station

Wild About Gardens:

www.wildaboutgardens.org.uk

The Earthworm Society of Britain:

www.earthwormsoc.org.uk

The Wildlife Trusts and RHS booklet "Go Wild For Worms":

https://www.wildaboutgardens.org.uk/sites/default/files/2018-08/Wild%20About%20Gardens_%20go%20wild%20for%20worms.pdf

Plantlife:

www.plantlife.org.uk

Next Issue

The next issue of Mulbarton Environmental will be March 2023.

Please send us any feedback, articles, photos, suggestions, requests, pledges to:

n.martin2811@gmail.com

Please write "Mulbarton Environmental" in the Subject box.

Mulbarton Allotment and Leisure Gardeners' Association (MALGA)

MALGA aims to promote an interest in all things horticultural (including the associated health benefits). Membership is open to all allotment holders, and all leisure gardeners however large or small their garden or window box may be.

Activities

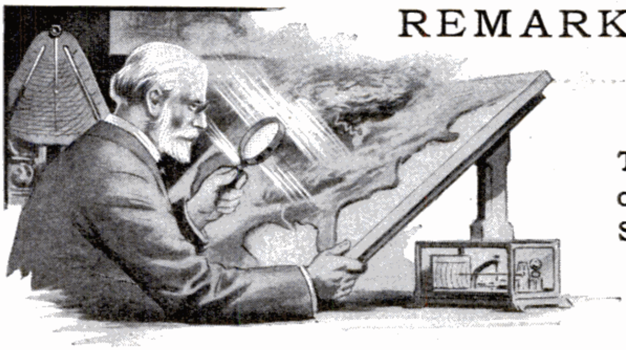
Our activities include social events (such as pub nights, quiz nights, dinners and barbeques); talks by outside specialists; a Mulbarton Gardeners' Question Time; group visits to public gardens in the area; and a Mulbarton Open Gardens in friendly rivalry with East Carleton.

Membership

If you would like to join, membership is presently a meagre £4 annually. Your membership card gets you discounts at some local garden centres.

To join us, email our Secretary geoffandvirginia@tiscali.co.uk or contact our Chair Chris Samson on 07837 969 715 or cjmsamson@yahoo.co.uk Or simply download the application form from "Files" on our Facebook page – see QR codes.

MALGA Facebook page: **Membership Application Form:**



REMARKABLE WEATHER OF 1911

The Effect of the Combustion of Coal on the Climate — What Scientists Predict for the Future

By FRANCIS MOLENA

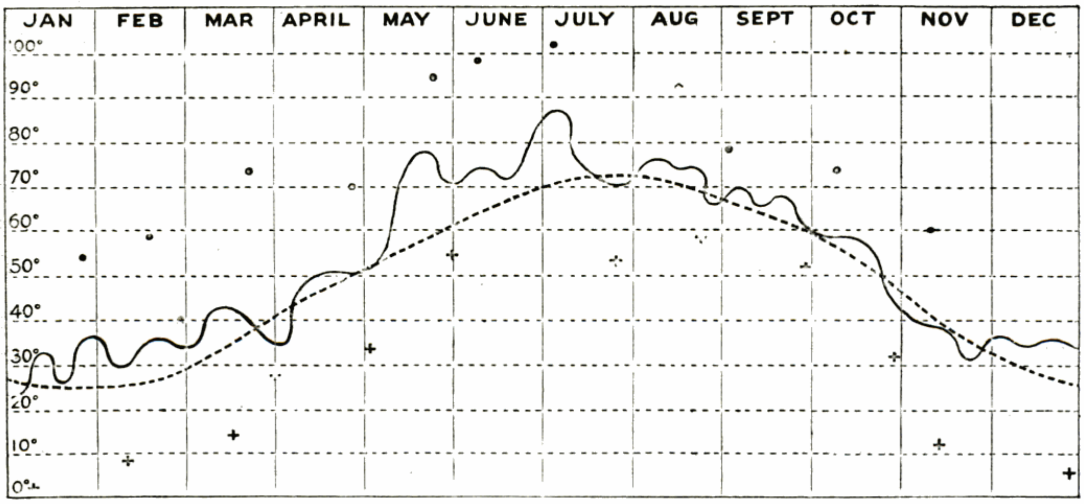
THE year 1911 will long be remembered for the violence of its weather. The spring opened mild and delightful, but in June a torrid wave of unparalleled severity swept over the country. The cities baked and gasped for breath, while the burning sun and hot winds withered the corn and cost the farmers a million dollars a day. A little later England was scorched and France and Germany sweltered. The mercury went above 100 deg. in western Canada, and whalers brought back reports from the Arctic regions of open water where always before there had been solid ice. The reports from Mexico and Central America would well describe the lower regions, but it is said that the summer in Iceland was enjoyable.

In August the elements took a different turn and the flood-gates of the heavens were opened. Kentucky and the South Atlantic states were deluged, and the Philippines were more thoroughly drowned than they had been before since the time of Noah. Alberta was visited by a killing frost which ruined hundreds of pioneer farmers. A cyclone devastated Costa Rica and a violent gale swept the South Atlantic coast, destroying a great number of vessels. During the later fall, the North Atlantic was tormented by a series of more violent storms than were known to the oldest sea captains. In November the southern states were visited by a killing frost, while December was remarkable for its high temperatures.

Aside from the extreme heat, the frosts of the far North and the sunny South, and the violent storms at sea, the year 1911 was still exceptional. The mean temperature of every month except November was above the average of that of the 40 years covered by the records of the United States Weather Bureau. The average daily excess was from four to six degrees.

With only one month out of twelve below normal, one may well ask if the climate is not changing and getting warmer. There is a general impression among older men that the good old-fashioned winters in which "the snow was fifteen feet deep and lasted six months" do not come any more. In spite of the fact that the year just past was above the average in temperature, there is no clear indication that there is any progressive change in the direction of a warmer climate. The average temperature of the year 1878 was as high as that of 1911. There seem to be moderate changes in a cycle of about 35 years, and it is suggested that this is related to the period of sun-spot activities, which is about one-third as long.

It has recently been found by archeologists from their studies in Asia Minor that, during the thousands of years these semiarid countries have been inhabited by civilized men, their populations have increased and decreased with a period of two or three hundred years. It is supposed that the epochs of greatest population were when there was more than the normal amount of rainfall, so that more people than ordinarily could be supported. When the oscillation in climate changed toward a dry period, so that food became scarce, the population necessarily decreased, though the changes might be ascribed in some instances to other causes. The cli-



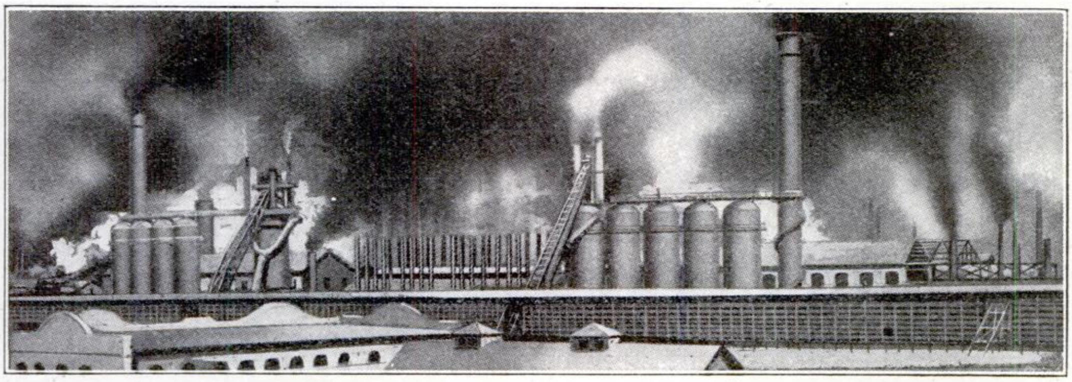
Temperature variations for 1911 as observed at Chicago by the U. S. Weather Station. The full curve shows the variations of mean temperatures based on weekly averages. The dotted curve is the mean for the 40 years covered by the observations of the Weather Bureau. The round dots give the highest temperatures for each month, and the crosses the lowest. In 1911 the average for each month except November was above normal.

matic explanation of these variations in population seems most reasonable.

But it is not necessary to refer to the history of mankind in order to prove that the earth has undergone much greater changes in climate than those we are now experiencing. The deposits of salt and gypsum which are found in New York and Michigan are the beds of ancient seas which dried up when these regions were deserts; on the other hand, arid Arizona was once watered with abundant rains, as is shown by the petrified remains of enormous trees which hundreds of thousands of years ago grew in that region. In frozen Greenland, the fossil remains of magnolias and other semitropical plants are found; while at the other end of the earth, near the south pole, there are beds of coal formed from vegetation which flourished when that region had a temperate climate.

On the other hand, time after time, great sheets of ice have pushed down from the table-lands of Canada through the valleys of the Great Lakes, over the prairies and across the hills, and have reached as far south as the Ohio and the Missouri Rivers. The records written on the hillsides by these slowly moving glaciers, and the heaps of soil and rounded boulders where they have stopped and melted, prove that at least seven times this country has been buried beneath the snow and ice. At other times, still earlier in the history of the world, there have been glaciers at moderate altitudes on both sides of the equator, well within the tropical zone. It is difficult to determine with any high degree of accuracy how long it has been since the last glacial epoch, but fifty or a hundred thousand years have passed since the ice sheets covered this region.

If the earth has undergone such remarkable changes in temperature and has experienced such extremes of drought and moisture, it may be asked what the prospects are for the future. It may be answered immediately that these climatic variations are so slow and that these cycles are so vast, that there is no prospect of any material change in the lifetime of a single individual, or even of a nation. It is highly improbable that the mean temperature will change sensibly in a thousand years, and very probable that it will not be much different from what it is at present ten thousand years from now. But if we may judge the future from the past, we may conclude that extremes of cold and warmth will succeed each other in long cycles measured by tens of thousands or hun-



The furnaces of the world are now burning about 2,000,000,000 tons of coal a year. When this is burned, uniting with oxygen, it adds about 7,000,000,000 tons of carbon dioxide to the atmosphere yearly. This tends to make the air a more effective blanket for the earth and to raise its temperature. The effect may be considerable in a few centuries.

dreds of thousands of years; for there is no more reason now to suppose that conditions will henceforth be fixed or even steadily progressive in one direction than there would have been to have made the supposition at the corresponding stage in any previous cycle. There are indications that the maximum of the warm era in which we now live has not yet been reached and that, therefore, the climate will probably become slowly warmer for some thousands of years, this progression being broken by many small oscillations. After the maximum is past the climate will, on the whole, probably steadily become colder until another ice age follows.

The causes of the changes are about as interesting as the changes themselves, and if they are known it may be questioned whether we can not control the climate in the future. While the heat which warms the earth comes from the sun, the climate is fundamentally dependent upon the earth's atmosphere and upon its circulation. It screens off the heat somewhat in the daytime and holds it in at night. The winds carry vast quantities from the torrid equator to the higher latitudes, and freshen the equatorial zone with the cooler atmosphere from the polar regions. The absorption and screening properties of the atmosphere depend upon its constitution. It has been found that if the air contained more carbon dioxide, which is the product of the combustion of coal or vegetable material, the temperature would be somewhat higher. In fact, a theory has been elaborated, primarily by the great Swedish scientist Arrhenius, that the earth has had a warm climate when the amount of carbon dioxide in the air was abundant, and a cold climate when it was scarce. It is believed that if the atmosphere contained two or three times its present amount, the climate would be considerably warmer, and that if it should lose half of that which it now has, the glaciers would again form in Canada. There are good reasons for believing that the quantity of this gas in the atmosphere may slowly undergo variations.

Since burning coal produces carbon dioxide it may be inquired whether the enormous use of that fuel in modern times may not be an important factor in filling the atmosphere with this substance, and consequently in indirectly raising the temperature of the earth. In the United States about 500,000,000 tons of coal were mined in 1911. Suppose four times this amount were mined and burned in the whole world. When this amount of coal is burned, 7,000,000,000 tons of carbon dioxide are put into the atmosphere. The question is, simply, whether this is an appreciable fraction of that which the atmosphere already holds, and whether there are any important ways in which it is being removed from the atmosphere.

The atmosphere contains altogether 1,500,000,000,000 tons of carbon dioxide. Consequently the combustion of coal at the present rate will double it in about 200 years, unless it is removed by some means in enormous quantities. Carbon dioxide is removed from the atmosphere by growing plants, and in fact the carbon in the coal came from the air through the vegetable matter from which it has

Outline map of North America at the time of most extensive ice cap. The glaciers radiated from three points, covered 4,000,000 square miles, and were probably two or three miles deep in some places. They disappeared probably 50,000 years ago. There have been several glacial epochs and there may be others in the future.

been formed. But when vegetable matter is burned, or decays, or is consumed by animals, the carbon dioxide is returned to the atmosphere. It does not seem that there will be in this way any great gain or loss in the next few centuries. A more important factor is the oceans which now hold enormous quantities of carbon dioxide and which, under suitable conditions, can absorb much more. In fact, they are the great regulators and have been involved essentially in all the variations of the past. But the action of the sea is very slow, and it may well be that the enormous present-day combustion of coal is producing carbon dioxide so fast that it will have important climatic effects.

It is perhaps somewhat hazardous to make conjectures for centuries yet to come, but in the light of all that is known it is reasonable to conclude that not only has the brain of man contrived machines by means of which he can travel faster than the wind, navigate the ocean depths, fly above the clouds, and do the work of a hundred, but also that indirectly by these very things, which change the constitution of the atmosphere, have his activities reached beyond the near at hand and the immediate present and modified the cosmic processes themselves. It is largely the courageous, enterprising, and ingenious American whose brains are changing the world. Yet even the dull foreigner, who burrows in the earth by the faint gleam of his miner's lamp, not only supports his family and helps to feed the consuming furnaces of modern industry, but by his toil in the dirt and darkness adds to the carbon dioxide in the earth's atmosphere so that men in generations to come shall enjoy milder breezes and live under sunnier skies.