

THE GOLF COURSE

A SERVICE BULLETIN DEVOTED TO THE DISCUSSION OF MODERN METHODS AS APPLIED TO GOLF COURSE CONSTRUCTION AND UPKEEP

Grass Diseases and Parasites

IN 1916 we published in our monthly Service Bulletin an article on the above subject in which we gave a long account of our experiences in Europe and America with different grass diseases including "Brown Patch" and "Mildew." This seems an opportune time to reprint the article and add a few remarks in reference to the recent epidemic which has attacked so many golf courses in different sections of the country.

Many of our readers are already familiar with the most unfortunate experience of the Columbia Country Club, Washington, D. C., just prior to staging the Open Championship Tournament.

The Green Committee of this Club exerted every effort to condition the course and about three weeks before the tournament the turf was in satisfactory shape when suddenly, almost overnight, the greens were attacked with a fungoid "brown patch" disease or "mildew" which ruined the turf for the event. It was necessary to sand the greens in order that they would play fairly true and of course this made the thin turf look even worse. They had a moth-eaten appearance. It was a terrible catastrophe, but with severe climatic conditions to contend with and

considering the composition of the soil we doubt if anything could have been done to check the disease and save the turf. It will take some time to get the turf back into good condition again.

It is a curious coincidence that the majority of outbreaks of this disease brought to our notice the past five or ten years have occurred immediately after a thunderstorm and it is quite probable that sudden atmospherical changes may account for the rapid development of the disease.

Last year at the Inverness Country Club, Toledo, just before the Championship we experienced some trouble from a plant parasite and since we had contracted to prepare this course for the Championship it caused us considerable worry. Fortunately, however, we were able to check the disease in time and with an improvement in the weather conditions and a strong deep rooted turf to help matters the greens were soon brought back into first class condition for the play.

There are so many diseases which attack grasses from time to time that we think it would be well to describe some of the different cases we have had brought to our attention. Do not be frightened, readers, for the welfare of

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Grass Diseases and Parasites

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your greens when we say that there are nearly a hundred odd diseases which affect grasses; for fortunately the majority of these diseases only attack the grass when it is in the flowering stage, so that only a few diseases will be found on turf such as exists on a well-managed golf course.

As you are, of course, aware, turf is composed of a collection of different species of grasses, such as the *Poas*, *Festucas*, *Airas*, *Agrostides*, etc., and each of these species is liable to different diseases. We thus find that certain parasitic fungi are generally found on a particular sort of turf, and it depends whether the turf contains a larger or smaller proportion of, say, Bent or *Agrostis* grasses as to whether it is badly attacked or not. For instance, the *Isaria* parasite, to which we will refer later on, is mostly found on what we may term a *fescue* turf.

There is, accordingly, a considerable variation in the effects of any particular disease when it breaks out in the turf. Some districts or counties appear to escape the attacks, whilst elsewhere the grass may be affected by various diseases or epidemics not noticed in other parts of the country. Many of you have possibly noticed how grass that has been growing strongly for some time will suddenly turn yellow and apparently die off, forming thin or bare patches. Whilst this may appear to be caused by some fault of soil or treatment, it is more often due to the rapid spread of a fungoid parasite, attacking the tissue of the grass in the same manner as mildew will break out on chrysanthemum leaves. In most cases, however, when turf is growing strongly under good treatment and favorable weather, it will resist the attacks of disease, and comes up again healthy and smiling, so there is seldom any need to break one's heart or one's back in preventing it from becoming permanently destroyed or injured.

Newly sown grass more often suffers from attacks of disease than established turf, and the unfortunate seedsman often receives letters from

purchasers of grass seeds containing some sarcastic remark about the seeds not coming up, when in fact the only fault is that the young grass plant has not formed sufficient root or strength to enable it to withstand an attack of autumn mildew caused by a spell of damp or muggy weather when heavy thunderstorms are experienced followed by extremely hot sun which makes the soil sweat if it has not perfect ventilation and drainage. Nearly all our grass diseases and parasites may be roughly drafted into three main classes. These are—

(1) The mildews and microscopical fungoid diseases which attack and destroy the actual tissue, or live as parasites on the grass plants.

(2) Disease or weakening of the grass leaves or roots that originate through a poisonous or toxic condition of the soil, caused by fungoid growth in the soil itself.

(3) Parasitic plants which attach themselves to grass stems and roots by means of haustoria, and rob the plant of food material or strangle it.

The first division contains the various rusts, mildews, etc., and possibly does the most harm to the whole order of graminæ. The rusts and *Takeall* of wheat, the *Black Mould* of sugar cane, *Ergots* of rye grass are all fungoid disease. The second division is composed of those cases in which the grass is killed by the fast-growing slime fungus, *Fairy Rings*, etc., whilst the third division of plant parasites causes the partial or total destruction of grass by such plants as *Yellow Rattle*, *Dodder*, *Bastard*, *Toad Flax*, and other parasites.

Of the parasitic fungi belonging to the first division, the *Smut* group is the most injurious, not only to corn but to grasses as well. Those *Smuts* known as *Tillitias* will often do a lot of harm to a crop of meadow hay, especially in a dry windy summer. For golfers *Smut* may be said to have some advantage, as one variety (*Tillitias decipiens*) makes *Agrostis* much dwarfer in habit, and it is said that *Agrostis pumila* is

nothing more than *Agrostis vulgaris* dwarfed by this particular *Smut* disease.

Still another disease of the *Smut* group is that known as *Takeall* in wheat, which is a bad fungoid disease in Australia and France in the case of wheat crops. It is also found to a lesser degree to attack *Couch* grass and *Bromes*. *Fusiporium Lolii* is a fairly common fungoid growth found on *Holcus*, *Lolium*, *Paspalum*, etc., in the vicinity of rivers and marshes, the grass blades being covered with reddish plush-like spots. The *Hemibasidii* are another group of *Smut* fungi which attack grasses and cereals, especially on clay soils.

RUST GROUP

We now come to another group called the *Puccinia*, which causes the well-known *rust* on grass. This is a more troublesome group of fungi, as it attacks the leaves and stems of grasses in all stages of their growth, even when growing strongly under good conditions. Nearly all greens and lawns will show a more or less badly rusted patch of grass in a dry Spring or at the end of a dry Summer; in fact, it is the most widely-distributed of all fungoid pests, attacking corn, tea, coffee plants, and chrysanthemum, etc., and attacks nearly a hundred species of grass.

The commonest form of rust found on grass is *Puccinia avenæ*, found on *fortail*, *tall oat grass*, and *cocksfoot*. *Puc. airæ* is found on *Aira cæspitosa* on open heath lands; whilst *Puc. agrostides* is nearly always found on *Agrostis alba* and *A. canina*. We have seen large patches of both these grasses attacked by rust on Wimbledon Common; and on Horsell Heath, near Woking, several varieties of grasses will be seen infested with various rusts. *Puc. poæ* confines itself to the various *Poas*, and will be seen on *Poa pratensis* and *Poa compressa*, even when these are shaded by trees. Another rust, *Puc. coronifera*, produces the spores in the form of a small crown on the leaves of *fortail*, *rye grass*, *tall fescue*, *York-*

shire fog, etc. In America *Timothy* is commonly attacked by *Puc. Phleii pratensis*, but it is comparatively rare in England. Several of these *Rusts* also grow on buttercups, nettles and docks. It is, therefore, desirable to keep these weeds down as much as possible whenever the grass appears liable to attacks of rust. A usual sign of turf being infested by rust is in the turf turning a dingy brown or gray color, which afterwards becomes white as the stems and leaves die and get bleached. Directly these patches are noticed a mixture of 1½ lbs. of copper sulphate and 1½ lbs. hydrated lime in 50 gallons of water should be applied, if it is late in the season using 10 to 15 lbs. of mixture in solution per green, making several applications if necessary; or permanganate of potash (using a quarter-ounce to five gallons of water) if the rust occurs in the spring. Bordeaux mixture is also good applied with a sprayer, 2 lbs. in 50 gallons of water.

There is another disease allied to the rusts that causes long brown stripes on barley as well as grass leaves: this may be called the "grass leaf stripe," *Pyrenophora trichostoma*. It was found to have broken out very badly in parts of England in 1908, and we came across specimens of *Poas cocksfoot*, *Sheep's fescue*, *tall oat grass*, etc., all badly diseased. It is presumed that the disease was spread in that year by the large quantity of cut hay left lying on the fields during the two previous bad haymaking years: and it certainly seems that where cut grass is left on the ground the spread of disease is hastened, more especially amongst the *Poas* and softer meadow grasses.

The next group of fungoid diseases are the *Mildews*. Although there are several of these that attack grasses, the commonest species is a white powder-like *Mildew*, *erysiphe graminis*, which grows on several grasses, and can be found in almost any hedgerow during September, and also where grass grows rankly on damp, badly-drained soils. It forms irregular brownish white spots on the sheaves and blades of the grass and the tips of the grass shoots are

covered with a very minute mould. Another *Mildew*, *Phytium de baryanum*, is that which causes the damping-off of seedlings, and those interested in gardening know the effect of this disease when it gets a start in a box of seedlings. It also attacks seedling grasses at the neck when these are growing on a very alkaline soil, or if a spell of wet weather comes just after the seed has sprouted, but, unlike the gardener's seedlings, the grass does not appear to be destroyed by the mildew, and grows away from it directly the weather becomes dry again. In cases where this damping-off occurs a good dressing of sand or a dusting of fine dry lime or ground charcoal in preference will often check it. As a rule, this *Phytium mildew* is more often found where grass seed has been sown on a sour soil.

The different mildews only attack the *Poas* and softer grasses, as a rule, and it is seldom that *Fescues*, etc., get attacked. The disease breaks out at any time of the year whenever the weather is muggy, damp and foggy, though it is seldom noticed in wind-swept places, and is therefore more common on inland courses than those by the sea coast.

In addition to these mildews, there is a small red mould which sometimes attacks grasses named *Fusarium heterosporum*. This will be found on *Yorkshire fog*, *rye grass*, and grasses with downy leaves or stems. Although not so common in England and America, it breaks out periodically in most European countries. We came across several cases of this disease in July, 1916, near Witham, England, the grass flower-heads and shoots being covered with a red or orange-colored gelatinous substance, which became very slimy after a shower of rain. One species of mould, *Fusarium loliacum*, only attacks Italian rye grass, and is seen on sewage farms where the soil is excessively manured. It indicates itself by producing well-defined brown spots on the leaves, these spots developing into a dense mass of mould, which ultimately causes the leaves to rot off.

CLADOCHYTRIUM GRAMINIS

We now come to one of the most troublesome of the mildews, which can best be described as the *blood mildew*. This is a comparatively new grass disease which broke out in various parts of England ten years ago. We have just had a case of this disease brought to our attention at Valparaiso, Chile, where we are constructing a new golf course. It seems only to attack grasses in the seedling stage when they have grown about one to two inches high. Whilst previous to being attacked the grass may have grown strongly and evenly, it will suddenly be seen to turn a brownish or blood-red color in small patches which rapidly extend outwards, and at the same time the ground is seen covered with a very minute reddish-gray mould. If the affected grasses are examined it will be seen that all the tissue is infected with the disease, but that the *seminal node* or *callus* is alive, and this soon puts forth two little tillering shoots, and in a month or so later the lawn is perfectly green again. This will also be hastened by a little stimulant in the way of a weak solution of Kainit.

Last year the disease was particularly bad in some districts and we saw many varieties of grasses attacked, including *Poas*, for as a rule only the *Fescues* and down grasses are attacked. We are glad to say that all the lawns that were attacked last year are now in good condition, and, in fact, it is interesting to say that one of the most badly infested lawns was one in Putney, England, which was so bad that an inspector was sent from the Board of Agriculture to discuss the matter with us as to what could be done to arrest the spread of the disease. In some places the turf looked quite destroyed and dead at the end of March, but in July the lawn was being used for croquet without another ounce of seed being sown, and in September an almost perfect "sole" of turf had been formed.

Where this *Cladochytrium* or *blood mildew* breaks out it is inadvisable to roll the lawn until the turf has recov-

ered. The treatment consists of applying a weak solution of sulphate of iron followed by a solution of Kainit. Paraffin has been tried with sometimes successful results, but we do not recommend this. We have also tried solutions of sulphide of potassium, and this may be used as a very weak solution applied in the evening in very bad cases, but should not be done unless the circumstances render it imperative, as we are inclined to think that the liquid injures the young tillering shoots springing from the *callus* or *basal node* of the plant. Bordeaux mixture can also be used in some instances.

Another cause of alarm is when the grass is seen to turn yellow in the autumn, but this is a very minor ailment and no harm occurs through it. It is due to a kind of "influenza" attack that the grass suffers from, caused by changes of temperature, and is more often seen when the nights are cold after a hot day. The grasses most liable to attack are the different species of *Poas*, *Aira*, *Lolium*, etc. If the leaves are examined they are found crowded with small whitish yellow spores which grow into irregular shaped masses. These spread and connect with each other, destroying the chlorophyll, which causes the leaves to turn yellow and appear to be dying. It is commoner on soils containing an excess of potassic salts or on a strong alkaloid soil. No special treatment is necessary, but a little quick-acting manure soon puts matters right, and if, as is sometimes the case, it is due to an excess of carbonate of lime in the soil, a one-percent solution of iron will often counteract it.

Besides the above microscopical moulds there are other fungi that live as actual parasites on the grass, taking their food from the host plant, *Isaria fuciformis*.

This is a common fungoid parasite that attacks the leaves of *Fescues* and temporarily causes the "flag" to rot off, though the plant itself does not appear to be injured. Where noticed it is a good plan to try a dusting of dry quicklime, or charcoal, followed by a

solution of nitrate of soda or Kainit, and this will check the pest and enable the grass to withstand its attacks. It is generally found on light or calcareous soils. It does not do much damage in this country, however, though in Australia, it is sometimes rather troublesome, where it attacks all sorts of grasses. It is said by some authorities that this *Isaria* fungus is an early stage of the *Cordyceps* fungus which lives as a parasite on caterpillars and other insects. The *Isaria* has the peculiar property of being bright and luminous under certain conditions.

ERGOT IN RYE

We should make a passing reference to the Ergots, *Claviceps purpurea*, which are very troublesome to the farmer, as they attack rye and sometimes barley. The *Ergot* will also be found to attack grass in fairly large patches on pastures adjoining roadsides or where a footpath runs through a field. It is chiefly troublesome in July, when the flowers or spikes of rye grass, barley grass, etc., will be found to contain small black spore masses called *Sclerotium*. Its only harm as far as the greenkeeper is concerned is that grass attacked by *Ergot* has a tendency to throw up a large number of embryonic flower stems instead of tillering, so that the grass becomes coarse. Cattle are said to be poisoned by the *Ergots*, though some authorities dispute this, and there appears to be no absolute proof of this happening. Where grass is badly *Ergoted* the grass should be mown with a scythe and then raked and burned on the spot, if possible.

Epichloe Typhina, known as *reed mace*, *red muff*, etc., is a parasitic fungus found in summer growing on the base or stalks of many grasses growing in damp places. We have found specimens of *cocksfoot*, *Timothy*, and especially *tall oat grass* with this characteristic parasite in various eastern countries, but have not seen it growing on *agrostis*, which is said by authorities to be its commonest host plant. It grows in the form of a muff surrounding the

stem usually above the node or joint, and is white at first, then turns orange or purple, when it is in the *conidia* or spore-bearing stage. Although it is practically harmless, it is as well to cut the grass before the fungus turns orange-colored.

FUNGUS GROWTHS

The second division consists of those diseases set up by poisonous conditions of the soil, the commonest example being the fairy ring. These are caused by various fungi, the commonest being *Marasmius oreades*, but *Lycoperdon perlatum* and *Stropharia squamosa* are two other species often observed. The *mycelium* of these fungi feed to a certain extent on the roots of the grass, and the *mycelium* sets up a kind of fermentation in the soil, rotting the roots so that the grass dies off in patches or is at least considerably weakened. As it is difficult to dig out the rings, it is best to apply a solution of sulphate of iron (one pound to one and a half gallons of water) starting from the outside of the green ring. A second solution at half strength may be applied fourteen days later, three applications being generally sufficient. The ground should first of all be pricked over with a fork before watering, and it is best to do it in the evening if the weather is hot or dry. The other fungi, *Tricholoma* and *Lycoperdon*, are more troublesome on light soils where the *mycelium* spreads out in an irregular net work, causing the turf to look very unsightly. It is generally due to decaying roots of trees or hedges that have been cut down on the site of the lawn or green.

We must class in this division the Clover Mildew, *Peronosporum trifoliorum*. This is not a grass disease, as it only attacks clovers and other leguminous plants; but when it does, it sets up a decay which spreads to the grasses, and for this reason it should be checked where noticed. It can be distinguished by the under surface of the clover leaves becoming covered with a dense dingy and lilac-colored mildew. The leaves turn yellow and then rot off.

The disease spreads rapidly outwards in rings if the weather is warm and moist, but a spell of frost or dry bright weather will generally check it. A particularly bad case came under our notice in England, where one of the most beautiful lawns we have seen was made unsightly a few years ago by the clover being attacked by this mildew. It was checked, however, by mowing the turf very closely and applying a weak solution of liver of sulphur followed by muriate of potash. Besides clover mildew, there are other mildews which attack plants in turf, such as *Peronosporum calotheca*, which is common on *Spurrey*, *Sheradia*, *Serastium*, etc. None of these diseases actually attack grass, but they make the turf unsightly and weaken it, hence our making reference to them here.

Spumaria Alba.—Although not actually a parasitic grass fungus as it lives in the soil, yet it may be considered as an enemy of the greenkeeper, as the *plasmidium* creeps up the blades of grasses, especially on a calcareous soil, and forms a dense mass of hard sponge-like crust which effectually chokes the grass. It is also said to kill horses if they eat this crusted grass, so it is advisable to mow it as closely as possible when noticed and the grass forced by sulphate of ammonia or a quick-acting manure. We might also refer to the poisonous drips of trees which kill grass, that from sycamores, beech, and horse chestnut being particularly poisonous. Where it is necessary to make grass grow strongly under trees it must be helped along with good dressings of manure or sweetened compost.

Slimy Morrell (Leotica lubrica).—This is troublesome in wet lawns under trees, as it causes large black masses of fungus which rot the grass. It often originates from the use of sawdust, mushroom soil or peat moss manure; and if troublesome a dressing of basic slag or ground charcoal may be given.

Peltidia Canina Refulgens.—This is a small black lichenous growth often found in mossy turf. It may be destroyed or checked by a five-percent solution of sulphate of iron, the turf

afterwards being dressed with potassic manures.

The Elf or Fairy Cup (*Peziza aurantia*) is a troublesome fungus on loamy soils overlying chalk, but as it is so readily removed by being cut bodily out with a knife no further reference need be made to it.

Slime Fungus (*Myxomycetes*).—Under this name may be classed the various slimes, green or black, that cover a soil in shady or confined situations where it is not covered by grass. They usually prove most troublesome on a damp soil or after a spell of continuous warm wet weather. A two-per-cent solution of sulphate of iron may be used if the grass is very thin, but half this quantity if the turf is of fine quality.

Where the blacker olive-colored *algae Nostoc commune* makes its appearance, it is as well to apply a dusting of dry lime. This pest spreads rapidly over the ground towards the end of summer in damp situations, especially when situated near slow-running streams or pools. As the *Nostoc* has the power of movement and travels over the ground, in all probability it originates from adjoining pools, and it is therefore advisable to apply a dusting of dry lime around the banks of the pool if it proves troublesome at all.

THIRD DIVISION

The third division consists of those plant parasites that live more or less on grasses, and we will briefly refer to a few of the commonest plants that are parasitic on grass.

The Yellow Rattle (*Rhinanthus cristagalli*) is a pretty yellow-flowered plant found in meadows that are badly drained. Spring grazing with sheep and an application of six cwt. of salt or basic slag is a good preventive and will tend to check or destroy the plants.

Red Rattle (*Pedicularis palustris*) is another parasitic plant found on grasses, especially cocksfoot and tall oat grass when growing in peaty or damp soils.

Bartsia Odontites is a red flowered

parasitic plant found on poor soils by the roadsides or in gravel pits, and, whilst not invariably parasitic on grass, several of its roots will be found attached to grass roots by means of little suckers.

Melanpyrum Pratense, the *Cow Wheat*, is also semi-parasitic on grass, but as a rule only when growing strongly on the edge of a plantation will it become parasitic.

Euphrasia Officinalis, the common *Eyebright*, is more often than not parasitic on grass. The *Bastard Toad Flax* (*Thesium linophyllum*) is another semi-parasitic plant, found more especially on chalk pastures in the southern counties of England.

Bastard Toad Flax.—All the above parasites attach themselves to the grass roots by means of *haustoria* or suckers, and rob it of the food material that it manufactures for itself.

Dodder on Gorse.—The well-known *Dodder* of clover is not parasitic on grass, but there is a species, *Cuscuta epithimum*, that is said to be parasitic on grass; but whilst we have found it growing on many other plants, we have only once come across it, and even then it was doubtful whether the *Dodder* was living on a piece of heather or the grass that surrounded it.

REMEDIES

Having described the more common grass diseases, we must say something about the remedies. First and foremost the best treatment in all cases where grass is attacked by disease is to mow the turf as closely as possible and then to encourage a strong growth of grass by quick-acting manures, so as to enable the grass to grow away from the disease. In soft shady turf, and on those golf courses that lie on river flats where fungoid diseases spread very quickly, drastic treatment may be rendered necessary. In this case, spraying with sulphide of potassium (one ounce to ten gallons of water) may be done. Permanganate of potash diluted to a clear rose color also makes a useful preventive, and applications of flow-

ers of sulphur applied when the grass is wet may also be recommended for bad outbreaks of the red mould, etc. Excepting in cases where soil is sour, solutions of Kainit (one ounce per gallon) are useful in helping the grass to resist mild attacks of rust, etc. Ground charcoal is particularly useful in most cases. Note—Several weak applications of Bordeaux mixture applied with a hand pump and spray will check most all of the common grass diseases.

All dressings are best applied in the evening, as it is during the night that mildew spreads most rapidly. On soils liable to repeated attacks of various grass mildews, the excessive use of nitrogenous and crude acid manures should be avoided, and where it is necessary to hasten the growth without unduly forcing the grass, phosphatic dressings should be used. Bone meal must be blamed for causing a large amount of fungoid growth as well as encouraging clover; whilst leaf mould, especially that from ash and sycamore leaves, also sets up mildews, though the advantages of the leaf mould may possibly outweigh the disadvantages. It is quite possible that the use of mushroom soil for top dressing greens causes a fungus growth under certain conditions.

Most of the diseases referred to are noticeable when they are in the form of white, gray or orange-colored moulds, this generally being the spore-bearing stage. It is then that precautions to prevent the disease from spreading should be taken. Rough grasses in hedgerows, reeds, and rushes are nearly always infected with rust and other diseases, so these should be kept cut down as much as possible. Cigarette ends and bits of rag lying in the turf are frequently the starting place of the white grass mildew. Leaving cut rye grass on the turf is also particularly bad, as a poisonous ferment is set up by the rye grass leaves that rots the finer grasses.

There is, however, a brighter side to this gloomy article, for parasitic fungi are not always injurious to the plants on which they live, and in some cases

plants when infested with a particular parasite often grow more robust and vigorous than the non-infested plants. This condition, known as *symbiosis*, is noticeable in the case of rye grass. Even if grasses have their parasitic enemies, all plants are affected in the same manner, and, like "the fleas that have lesser fleas upon their backs to bite 'em," so these different mildews and fungi have other moulds that live upon them, which keeps the balance of Nature and prevents every blade of grass in the country from being destroyed. The *Yellow Rattle* is also punished for its greedy disposition of living on the grass roots by suffering in its turn from a parasitic fungus that causes gouty swellings on its roots.

EDITORIAL

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enough seed to supply one-hundredth part of the clubs which would naturally use it if they followed the advice of the bent agitators. Obviously since there is not enough to go round, their advice is not practical.

There is, however, no denying that bent grass is the most desirable species in the finest putting green turf with the possible exception of New Zealand Fescue. Unfortunately it is not at present commercially available. The time may come when the importation of true German bent seed, of sufficiently good quality to satisfy the demands of our Government and of reasonable price, will be possible. When and if it does, let us use it, not alone but in combination with reliable fescue and when occasion demands one or two other varieties to suit local conditions.

THE BENT SITUATION

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all-around turf for putting greens in many sections of the country. In some districts the Bent varieties are natural grasses in the soil and should by all means be encouraged.